BU 0250 – en

NORDAC *LINK* (SK 250E-FDS series)

Users Manual for Frequency Inverters as Field Distributors

Read document and keep for future reference

Read this document carefully prior to performing any work on or putting the device into operation. It is essential to read and observe the instructions in this document. They serve as the prerequisite for smooth and safe operation and the fulfilment of any warranty claims.

Contact Getriebebau NORD GmbH & Co. KG if your questions regarding the handling of the device are not answered in this document or if you require further information.

The German version of this document is the original. The German document is always decisive. If this document is available in other languages, this will be a translation of the original document.

Keep this document in the vicinity of the device so that it is available if required.

Use the version of this documentation that is valid for your device at the time of delivery. You can find the currently valid version of the documentation under www.nord.com.

Please also note the following documents:

- Catalogue “NORDAC electronic drive technology” (E3000),
- Documentation for optional accessories
- Documentation for equipment which is attached or provided.

Please contact Getriebebau NORD GmbH & Co. KG if you require further information.

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 firmware 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 assignments • 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 warning and danger information • 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 firmware 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” feature supplemented as AS-Interface option 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 of “Standards and Approvals” • Update of EU Declaration of Conformity • Supplementation of data according to the Ecodesign Directive
BU 0250, June 2022	6072502 / 2322	V 1.3 R0	Including • General corrections • Adaptation of UL plug connectors • Extension of the overview on the connection of an external braking resistor • Update of EU Declaration of Conformity • Supplementation of disposal notes
BU 0250, April 2024	6072502 / 1724	**V 2.0 R2**	Including • General corrections • Adaptation of UL plug connectors • Extension of the notes for use in IT networks • Supplementation/adjustment of parameters: P337, P400, P420 • Update of EU Declaration of Conformity • Supplementation

Table 1: Version list BU0250

Copyright notice

Publisher

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Member of the NORD DRIVESYSTEMS Group

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1 General

The devices 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, this means very high starting and overload torques at a constant speed.

The power range is from 0.37 kW to 7.5 kW.

The device series 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 retrofitting 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 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 or via DIP switches and potentiometers. The access to these elements or for the connection of a parameterisation tool is via blind plugs. These blind plugs may only be removed for works 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 the total number of possible functions and configurations. Depending on the device type, the configuration and functions are limited.

Basic characteristics

- High starting torque and precise motor speed control by means of sensorless current vector control
- Close-to-motor mounting as wall mounting
- Permissible ambient temperature: -25 °C to 40 °C (please refer to technical data)
- Integrated EMC mains filter for Class A / Category C2 limit values
- Automatic measurement of the stator resistance and determination of the exact motor data possible
- Programmable direct current braking
- Installed 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 possible a)
- NORD system bus for connecting additional modular assemblies a)
- Four separate online switchable parameter sets
- LEDs for diagnosis (including signal states of the digital inputs and outputs)
- RS232/RS485 interface via RJ12 port, alternatively USB
- 24 V DC control voltage
  - Must be provided via a plug connector, or
  - Can be provided by the device (only with –HVS option).

    It is possible to connect an external 24 V DC voltage supply via optional plug connectors in order to supply a powerful peripheral (e.g. actuators).
- Integrated “POSICON“ positioning control (📖 BU 0210)
- CANopen absolute encoder evaluation via the NORD system bus a)
- Operation of *three-phase **as**ynchronous **m**otors* (ASM) and ***p**ermanent **m**agnet **s**ynchronous **m**otors* (PMSM)
- Integrated PLC (📖 BU 0550)

a) Connection is only possible via optional plug connectors.

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

Additional characteristics

Characteristic	250E	260E	270E	280E
Number of digital inputs (DIN) 1) 2)	5+2	5+2	5+2	5+2
Number of digital outputs (DOUT)	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 may be defined at the factory by using 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 characteristics

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 device 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

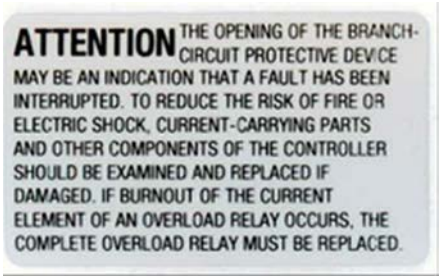
Defect in the device

Use of impermissible accessories and options (e.g. also options for other inverter series) may result in defects of interconnected components.

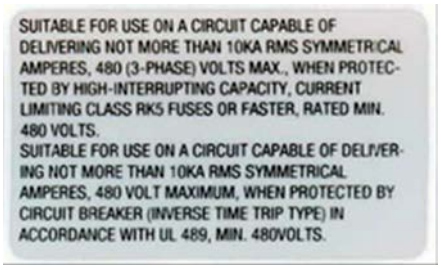
- Only use accessories and options which are explicitly intended for use with this device and stated in this manual.

Standard version:

- Device with IP65 version (with attached fan: IP55)
- Operating instructions as PDF file on CD ROM including NORDCON software
- Warning signs as addition for assembly near to the device according to UL/cUL, 1x each in the languages English and French:



- Warning sign as addition for assembly near to the device according to UL, 1x in English language:



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 injury or death from electric shock or rupture of electrical components, e.g. high power capacitors.

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

Depending on its protection class, the devices may have live, bare, moving or rotating parts or hot surfaces during operation.

The device is operated with hazardous 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 master mains switch and is thus always live when connected to mains voltage. Voltages may therefore be connected to a connected motor at standstill.

A connected motor may also rotate if the drive is disconnected from the mains and possibly generate hazardous voltage.

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

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

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

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

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

All work on the device, e.g. transportation, installation, commissioning and maintenance work must be carried out by qualified 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 low-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).

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.

Further information can be found in this documentation.

Triggering of a circuit breaker

If the device is secured by a circuit breaker and if this was triggered, this may indicate that a residual current was interrupted. A component (e.g. device, cable or plug connector) in this circuit may have caused an overload (e.g. short circuit or earth fault).

A direct reset of the circuit breaker may lead to the circuit breaker not being triggered afterwards although the fault cause is still present. As a result, any current flowing into the fault location may cause overheating and ignite the surrounding material.

After each triggering of a circuit breaker, all live components within this circuit must thus be visually checked for defects and flashover tracks. Also check the connections at the device’s connection terminals.

In case of no faults found or after the replacement of the defect components, switch on the power supply by resetting the circuit breaker. Carefully observe the components keeping a safe physical distance. As soon as you observe a malfunction (e.g. smoke, heat or unusual odours), the occurrence of a new fault or if the status LED on the device does not light up, switch off the circuit breaker immediately and disconnect the defect component from the mains. Replace the defect component.

2. Qualified specialist personnel

Within the meaning of this basic safety information, qualified specialist personnel are persons who are familiar with the installation, assembly, commissioning and operation of the product and who have the qualifications appropriate to their work.

In addition, the device and the accessories associated with it must only be installed and commissioned by a qualified electrician. A qualified electrician is a person who, because of his/her technical training and experience, has sufficient knowledge with regard to

- switching on, switching off, disconnection, earthing and labelling of electric circuits and devices,
- correct maintenance and use of protective devices according to specified safety standards.

3. Intended use – general

The frequency inverters are devices for industrial and commercial systems that are used to operate 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 name 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 meet the requirements of the Low Voltage Directive 2014/35/EU. The harmonised standards stated in the Declaration of Conformity are used for the devices.

a. Supplementation: Intended use within the European Union

When installed in machines, commissioning of the devices (i.e. commencement of intended operation) is prohibited until it has been established 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. commencement of intended operation) is only permitted if the EMC directive (2014/30/EU) is complied with.

b. Supplementation: Intended 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: Intended use within the European Union”).

4. Do not make any modifications.

Unauthorised changes and the use of spare parts and additional equipment tnot purchased from or recommended by NORD may cause fire, electric shock and injury.

Do not change the original coating / paint or apply additional coatings / paints.

Do not make any structural modifications to the product.

5. 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, hazardous voltages may be present on the device for up to 5 minutes after being switched off from the mains). Before starting work it is essential to check by measurement that all contacts of the power plug connections or the connection terminals 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 installations 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 devices 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 device into operation. Contact with electrically live components may result in electric shock, possibly with fatal consequences.

All poles of cable connections (e.g. power supply) must always be disconnected.

Setup, troubleshooting and commissioning

When working on live devices, the applicable national accident prevention regulations must be complied with.

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

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

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.

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, hazardous voltages may be present on the device for up to 5 minutes after being switched off from the mains). Before starting the work, it is essential to check by measurement that all contacts of the power plug connectors or the connection terminals are voltage-free.

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 electrolytic 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 electrolytic capacitors, there is also a risk of explosion, with the associated risk of injury.

6. 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 Explanation of markings

DANGER

Indicates an immediate danger, which may result in death or very serious injury if it is not avoided.

WARNING

Indicates a dangerous situation, which may result in death or serious injury if it is not avoided.

CAUTION

Indicates a dangerous situation, which may result in minor injuries if it is not avoided.

NOTICE

Indicates a situation, which may result in damage to the product or its environment if it is not avoided.

Information

Indicates hints for use and especially important information to ensure reliability of operation.

1.6 Standards and approvals

All devices across the entire series comply with the standards and directives listed below.

Approval	Directive		Applied standards	Certificates	Label
CE *(European Union)*	Low Voltage	2014/35/EU	EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 61800-9-1 EN 61800-9-2	C310701	CE
	EMC	2014/30/EU			
	RoHS	2011/65/EU			
	Delegated Directive (EU)	2015/863			
	Ecodesign	2009/125/EC			
	EU Ecodesign Directive	2019/1781			
UL *(USA)*			UL 61800-5-1	E171342	c UL us LISTED IND.CONT.EQ. E171342
CSA *(Canada)*			C22.2 No.274-13	E171342	
RCM *(Australia)*	F2018L00028		EN 61800-3	133520966	
EAC *(Eurasia)*	TR CU 004/2011, TR CU 020/2011		IEC 61800-5-1 IEC 61800-3	ЕАЭС N RU Д-DE.HB27.B.02725/20	EAC
UkrSEPRO *(Ukraine)*			EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 60947-1 EN 60947-4 EN 61558-1 EN 50581	C311900	
UKCA *(United Kingdom)*			EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 61800-9-1 EN 61800-9-2	C350900	UK CA

Table 4: Standards and approvals

1.6.1 UL and CSA approval

File No. E171342

The categorisation of protective equipment approved by the UL according to United States standards for the devices described in this manual is listed below, basically with the original wording. The categorisation of the individually relevant fuses or circuit breakers can be found in the “Electrical Data” section of this manual.

All devices include motor protection.

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.

Additional adhesive labels with supplementary warning information

Attach the signs enclosed with the device and listed according to Section 1.2 "Delivery"in a clearly visible position in the immediate vicinity of the device.

Conditions UL/CSA according to 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) 🕮 (see chapter "Electrical data ")

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 Name plate

All of the information which is relevant for the device, including information for the identification of the device, can be obtained from the name plate. The name plate is located on the front side of the upper device shell.

(2) Two further plates containing the supplementary technical data for UL/CSA are affixed to the right-hand side of the device.

First plate

This warning information is attached in general.

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
Phoenix Contact	**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)

- (-xxx): Configuration features (multiple statements possible)
- A: Radio interference filter: O = Without, **A** = Class **A**1(C2)
- 340: Mains voltage: x**40** = **400** V
- 301: Number of mains phases: **3**xx = **3**-phase
- 301: Digits before decimal point for power: **0** = **0**.xx, 1 = 0x.x0
- 301: Rated power of the FI: 370 = 0.37 kW, … **30**1 = **3.0 kW**, ... 751 = 7.50 kW
- SK 250E-FDS: Frequency inverter series: **SK 250E-FDS**, SK 260E-FDS, SK 270E-FDS, SK 280E-FDS

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 [1)]	Integrated brake rectifier for controlling a 205 V DC brake (EU)
-EEP	Plug-in EEPROM for additional data backup
-FANO [2)]	Heat sink with attached fan (only for devices < 2.2 kW)
-HWR [1)]	Integrated brake rectifier for controlling a 180 V DC brake (EU) or 205 V DC (US)
-HVS	Integrated 24 V power supply unit
-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	Using the -TIDIO option, the digital IOs of the frequency inverter are connected to the corresponding IOs of an SK CU4- installed in the device.
-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:** Parameterisation units cannot be connected to the USB port. In this case, parameterisation and diagnosis is only possible via a PC with NORDCON software.

1) Notes on dimensioning can be found in Section 2.3.2.5 "Electromechanical brake".

2) As standard, devices 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-size assignment

Size	Mains/power assignment
	3~ 380 – 500 V
Size 0	0.37 kW
Size 1	0.55 ... 3.0 kW
Size 2	4.0 ... 7.5 kW

1.9 Version with protection class IP55, IP65

The frequency inverter of the field distributor series SK 250E-FDS meets the following IP protection class:

- IP55: all devices with attached fan
- IP65: all devices without attached fan

There are no functional restrictions or differences in the protection classes stated.

Information

Cable laying

Ensure that the cables and cable glands in all versions comply at least with the device's protection class and the mounting regulations, and are carefully matched to each other.

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 units, 🕮 BU0040
- 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.

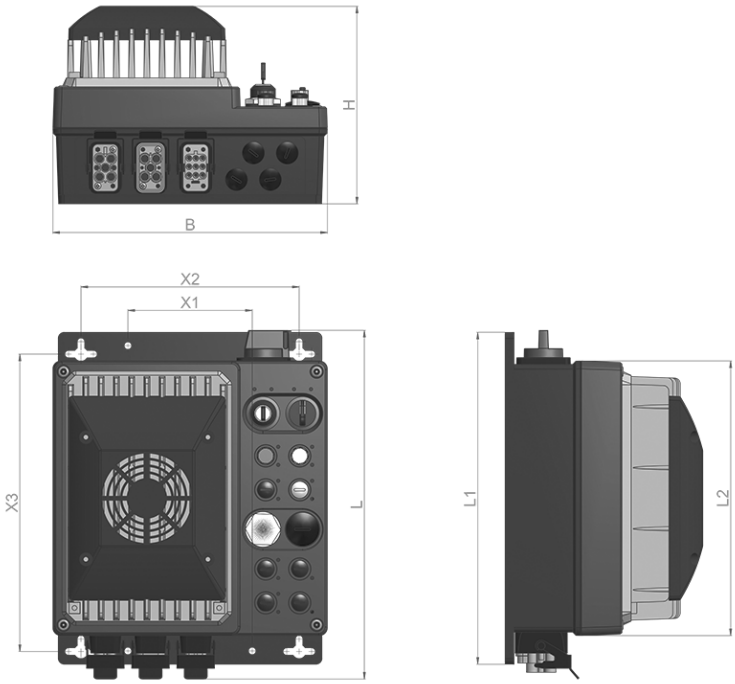
Dimensions:

The devices 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.

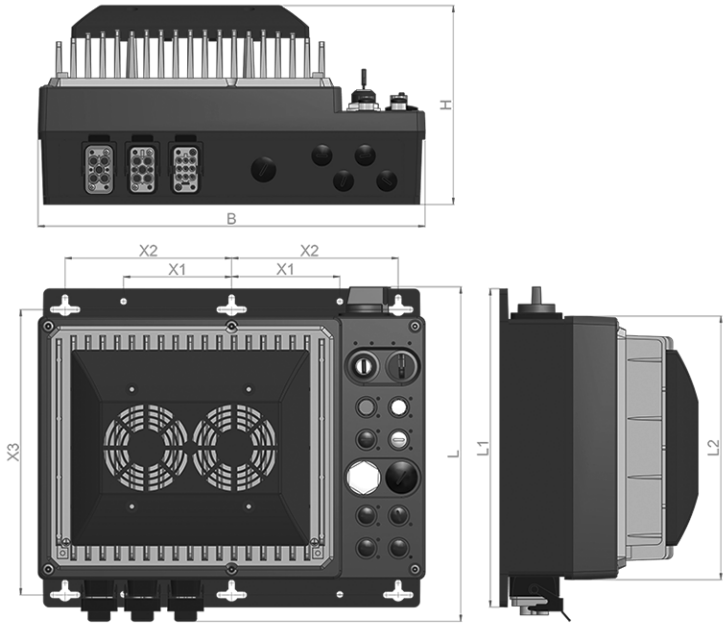
Power [kW]		Device type SK 2xxE-FDS-…		Size	Housing dimensions					Wall mounting				Weight [3] (approx.)
From	to	From	to		B	H	L [2]	L1	L2	X1	X2	X3	∅	
0.37	0.37	370-340-…	370-340-…	0	243	130	312	294	243	110	193	263	5.5	3.8
0.55	1.5	550-340-…	151-340-…	1	243	155 [1]	312	294	243	110	193	263	5.5	4.6
2.2	3.0	221-340-…	301-340-…	1	287 [4]	175								4.8
4.0	7.5	401-340-…	751-340-…	2	358 402 [4]	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
4) With external resistor

Sizes 0 and 1

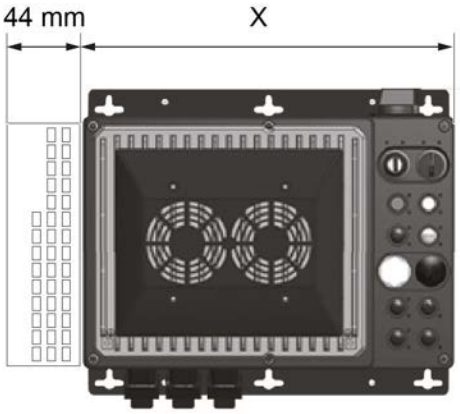


Size 2



External braking resistor

The attachment increases the frequency inverter's width (measurement "X") by 44 mm. This applies to sizes 1 and 2.



2.2 Option slots and equipment versions

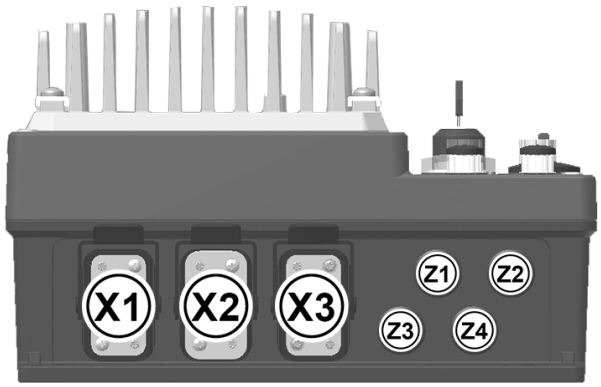
The device is configured according to the customer specification. No options can be retrofitted. All options must be recorded by NORD when ordering and before the production process.

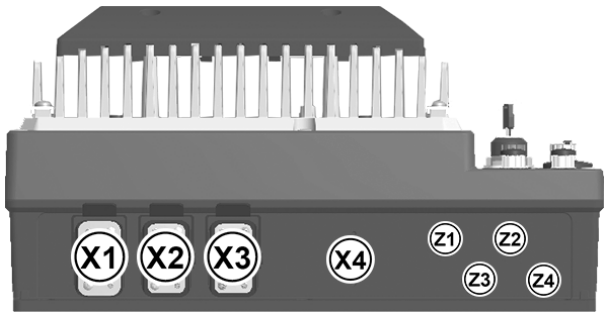
Defined positions on the device apply for the selected options and features. Dependencies between the selected options and on relevant signalling devices (LEDs) or parameter settings are explained in this instruction.

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





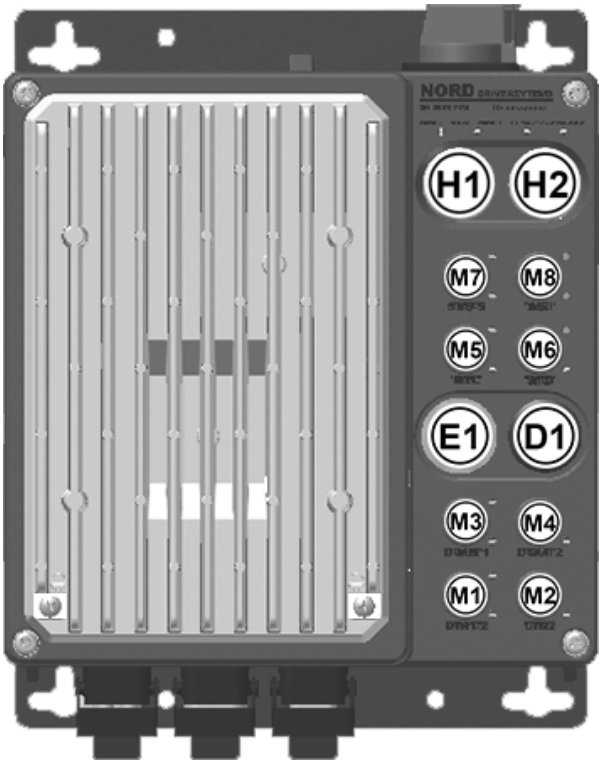
Position: bottom

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



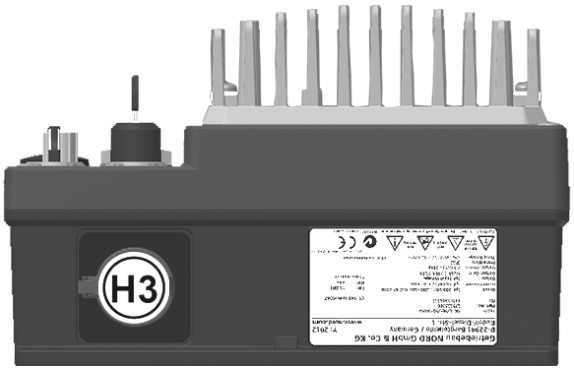
Position: front

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 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]	
			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]	
		HTL encoder with zero track	Track 0	P337	
	d	System bus Master	SYSM		
	e	RS485 encoder		P300, P600	Activate depending on requirement
M6	a	No option			
	b	Initiator 3	DIN3	P420[-03]	Only SK 250E-FDS, SK 270E-FDS
	c	Safe stop	STO [4]		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”) [3]	ASI		
	f	AS-Interface (“AXS“)	AXS		
	g	AS-Interface (“ASS“) [3]	ASS		

1) Encoder cable available on request If the encoder has a zero track, evaluation of the zero track is only via **M5 PIN5**.

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.

3) The 24 V DC control voltage can also be generated from the ASI voltage via **M8 e** and **M8 g**.

4) The use of **STO** when supplied from an **IT network** is **not permitted**.

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 - H	-	/	{0}	{15}	{0}
5	II	A - H	II	Off - On	{0}	{37}	{33}
6	II	A - H	I	L - Off - R	{34}	{37}	{33}
7	II	A - H	II	Sp1 - Sp2	{0}	{33}	{35}
8	III	H - A - Q	-	/	{15}	{12}	{0}
9	III	H - A - Q	II	Off - On	{37}	{12}	{33}
10	III	H - A - Q	II	Sp1 - Sp2	{33}	{12}	{35}
11	V	0% ... 100%	I	L - Off - R	{02}	{0}	{01}
12	V	0% ... 100%	II	Off - On	{0}	{0}	{01}

Functions

A	Automatic mode active	**H**	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), latching or momentary, switch or key switch version
II	Switch (centre – right), latching or momentary, switch or key switch version
III	Switch (left – centre – right), centre and right latching, switch or key switch version
IV	Pushbutton
V	Potentiometer 0 – 100%

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

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

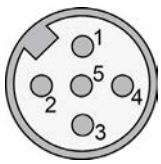
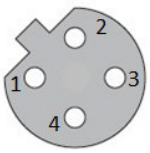
3) Variants for which the parameter functions are configured to the value {0} do not have a functional effect on the corresponding digital input. In these cases, corresponding analogue functions can be assigned via the respective alternative analogue input (also see previous table).

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		M8	WH
SYSM [1]			24 V	GND	CAN_H or SYS+	CAN_L or SYS-	M5	BU
RS485 encoder [1]		12 V	Data +	GND	Data -		M5	BK
HTL with zero track [1]		24 V	Track B	GND	Track A	Track 0	M5	BK
STO [1]	 Plug, A-coded			GND SH	24 V SH		M6	YE
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
AXB		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

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

2) RS485 encoder connection with firmware version 2.0 and higher

Information

Connection material such as T-connectors for connection of double initiators for looping an external 24 V DC supply or an STO signal can be obtained commercially or from NORD on request (see chapter 8.13 "Connection accessories").

2.2.2.2 Configuration of option slots on the connection level

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

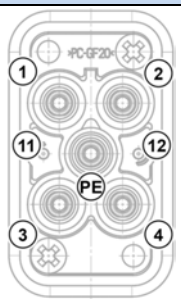
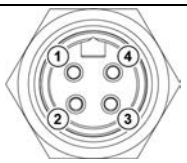
DANGER **Electric shock at X2**

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**).

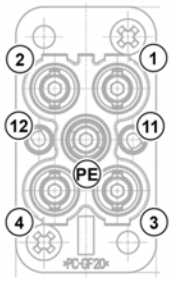
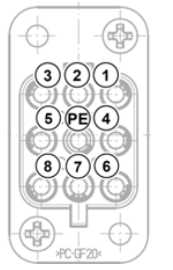
Area 1, option slots X1 to X4

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.**

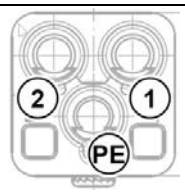
Option slot	Plug connector type		Function		Contact assignment
X1	a	HARTING Q4/2+ (plug)	Mains connection (supply) 4 mm² / 25 A [1] (24 V DC: 1.5 mm²) 6 mm² / 30 A (without 24 V DC!)	LE	 **1** L1 **2** L2 **3** L3 **4** N **PE** PE **11** 24 V DC **12** GND
	b	PHOENIX QPD-25 (plug)	Mains connection (supply) 2.5 mm² / 16 A	LE	 **1** L1 **2** L2 **3** L3 ⏚ PE
	c	Amphenol P29036-M1 (plug)	Mains connection (supply)	LE	

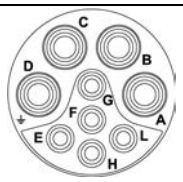
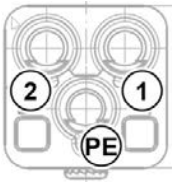
1) For size 0: 20 A, with and without 24 V DC

Option slot	Plug connector type		Function		Contact assignment
			2.5 mm² / 16 A		**1** L1 **2** L2 **3** L3 **4** PE

X2	a	-	No function		**Option slot not used**
	b	HARTING Q4/2+ (socket)	Mains connection (outlet) 4 mm² / 25 A [1] (24 V DC: 1.5 mm²) 6 mm² / 30 A [1] (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 **2** nc. **3** W **4** BR- **5** TF+ **6** BR+ **7** V **8** TF- **PE** PE

1) For size 0: 20 A, with and without 24 V DC

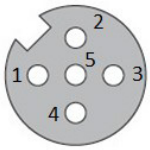
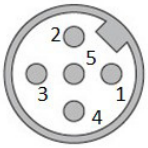
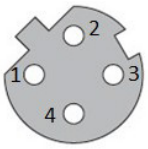
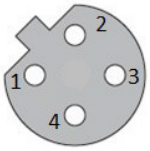
	e	HARTING Q2/0+ (socket)	Braking resistor 4 mm² / 25 A	OI	 **1** B+ **2** B- **PE** PE

X3	a	HARTING Q8/0+ (socket)	Motor connection 1 (outlet) 4 mm² / 16 A	MA	 **1** U **3** W **4** BR- **5** TF+ **6** BR+ **7** V **8** TF- **PE** PE
	b	AMPHENOL P30539 (socket)	Motor connection 1 (outlet)	MA	 **A** U **B** V **C** W **D** PE **E** MB1 **F** TH 2 **W** TH1 **H** nc. **L** MB2
X4 (size 2 only)	a	HARTING Q2/0+ (socket)	Brake resistor 4 mm² / 25 A	BA	 **1** B+ **2** B- **PE** PE

Area 2, option slots Z1 to Z4

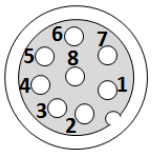
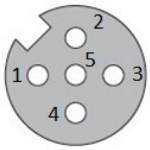
The option slots M1 to M8 are designed for M12 plug connectors. No fixed functions are allocated to the option slots. Primarily, these option slots are used to connect initiators, an integrated option of type SK CU4-… . However, if required they can also accept plug connectors for connecting other signal 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 assignment**						
		1	**2**	**3**	**4**	**5**	**No.**	**Colour**
DIN1 / DIN2	 Socket, A-coded	24 V	DIN2	GND	DIN1	PE	Z3	BK
DIN1		24 V		GND	DIN1	PE	Z3	BK
DIN2		24 V		GND	DIN2	PE	Z4	BK
AIN1 / AIN2		24 V	AIN2	GND	AIN1	+10 V Ref	Z1	WH
AIN2		24 V		GND	AIN2	+10 V Ref	Z2	WH
AOUT		24 V	AIN2	GND			Z1 - Z4	WH
24VO		24 V		GND			Z1 - Z4	BK
CAO (Bus-IN)		Shield	24 V	GND	CAN_H	CAN_L	Z1	GY
DEV (Bus-IN)		Shield	24 V	GND	CAN_H	CAN_L	Z1	GY
CAO-OUT (Bus-OUT)	 Plug, A-coded		24 V	GND	CAN_H	CAN_L	Z2	GY
24VI		24 V		GND			Z1 - Z4	BK
ETH (Bus-IN)	 Socket, D-coded	TX+	RX+	TX-	RX-		Z1	GN
ETH (Bus-OUT)		TX+	RX+	TX-	RX-		Z2	GN
PBR (Bus-IN)	 Plug, B-coded		PBR A		PBR B		Z1 / Z2	VT
PBR (Bus-OUT)	 Socket, B-coded	5 V	PBR A	GND	PBR B		Z2 / Z1	VT

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

2) If 2 IO modules of type SK CU4-IOE 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]								Option 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	YE
SI / Clock (Safe input/clock)	 Socket, A-coded	SI1	SI2	-	T1	T2				Z4	YE

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

2.2.2.3 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**).

WARNING

Hazardous voltage at the TF+, TF-, BR+, BR-, U, V and W contacts

Touching the contacts may lead to an electric shock.

- If the TF+ and TF- BR+ or BR- contacts are not used, the open wire ends must be insulated
- BR+, BR- must not be bridged

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).
- Earth devices.

Information

Temperature sensor and PTC resistor (TF)

As with other signal cables, PTC resistor 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.

Observe the notes on long-term storage in Chapter 9 "Maintenance and servicing information".

Electrical connections are made exclusively with plug connectors.

2.3.1 Wiring guidelines

The devices 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 clamps) 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 shielding of analogue setpoint cables should only be earthed on one side on the device.
4. 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 suppressors 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.

Furthermore, attention must be paid to the EMC-compliant wiring.

During the installation of the devices, the safety requirements must not be violated under any circumstances!

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 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 (earth fault), a frequency inverter which is switched off may switch on by itself. 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 (earth fault) 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 power supply 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 power supply 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.

Note: Despite connection of the braking resistor, the error message "*Overvoltage DC link voltage*" may occur. The use of the braking resistor to dissipate the charging prevents the destruction/damage of the device. However, the switching threshold for activation of the brake chopper is above the fault threshold so that an error is indicated and the earth fault can be detected.

The device must be configured for operation in an IT network by adjusting the integrated mains filter. The mains filter is adjusted at the factory and must be taken into account in the order. Configuration for IT networks reduces the EMC.

NOTICE

The "Safe Stop" function (STO, SS1) cannot be used in IT networks

If you operate the frequency inverter in an IT network, the capacitors can be overcharged and the frequency inverter destroyed if an earth fault occurs and the STO function is triggered.

- **Do not use the STO function in an IT network**, see also 🕮 BU0235.

When operating the device on an insulation monitor, observe the device's insulation resistance (see chapter "Technical data").

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

The device can also be operated in supply networks with a high-resistance earthed star point (**H**igh **R**esistance **G**rounding). These networks are common in the USA, for example. The same conditions and adjustments must be taken into account as for operation in an IT network (see above).

2.3.2.2 Daisy chain connection

Power connections provide the possibility of setting up a daisy chain. This way, the wiring effort for devices close to each other can be reduced. The current that is allowed to flow through the daisy chain cables in such an installation is limited. For information on the maximum permitted currents, refer to Chapter 7 "Technical data".

⚠ WARNING

Hazardous voltage at the contacts of the mains output socket

Danger of electric shock, short circuit or earth fault if water or cleaning agents enter.

- If the “daisy chain” mains output socket is not used, make sure to seal it with a sealing cap. This is the only way to achieve the required protection class.

2.3.2.3 Motor cable

The U, V, W and PE terminals are intended for connection of the motor cable. The motor cable may have a **total length of 20 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 can be obtained from NORD.

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

Multiple motor operation

Multiple motor operation is the parallel operation of several motors by a frequency inverter.

For multiple motor operation the frequency inverter must be changed to a linear voltage/frequency characteristic curve (→ **P211 = 0** and **P212 = 0**).

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

2.3.2.4 Braking 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 prevent the device from being shut down due to overvoltage. With this, the integrated brake chopper (electronic switch) pulses the link circuit voltage (switching threshold approx. 720 V DC) into the braking resistor. The braking resistor converts excess energy into heat.

Information

Combination of braking resistors

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

Internal braking resistor

Depending on the device power, braking resistors with the following nominal ratings are installed.

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

SK 2xxE-FDS-…	Resistance	Max. continuous power / limitation [2] (P_n)	Energy 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) To prevent impermissibly high heating of the device, the continuous power is limited to 1/4 of the braking resistor's rated power.
This also has a limiting effect on the energy consumption.

External braking resistor

If larger braking power is to be expected, it can only be dissipated through an **external** braking resistor. An add-on variant and a variant for installation close to the drive are available.

Add-on variant

Like internal braking resistors, external braking resistors are intended for applications with low braking energy. Unlike internal braking resistors, their nominal continuous power is fully available.

Attachment of a braking resistor is optional. This is carried out at the factory and must therefore be taken into account in the order. Retrofitting is not possible.

A braking resistor as an add-on variant is only available for sizes 1 and 2 and has the following nominal ratings.

SK 2xxE-FDS-…	Resistance	Max. continuous power	Energy consumption[1]
…111-340- to …751-340-	200 Ω	200 W	2.0 kWs

1) Maximum once within 10 s

Parameters **P556** and **P557** must be parameterised accordingly by the operator in order to prevent damage to the device or braking resistor due to overloads.

Braking resistor close to the inverter

A corresponding plug connection is provided at 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. Retrofitting is not possible.

The electrical specifications (see chapter 7 "Technical data") must be complied with when dimensioning an external braking resistor. Parameters **P556** and **P557** must be parameterised accordingly by the operator in order to prevent damage to the device or braking resistor due to overloads.

A short, shielded 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 an optionally available connection cable.

Information

External braking resistor or daisy chain wiring

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

2.3.2.5 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 total currents drawn 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, also 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, also 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 to 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 2.2.2.2 "Configuration of option slots on the connection level")
DIN6 / AIN1	Digital input 6	P420 [-06]	
DIN7 / AIN2	Digital input 7	P420 [-07]	
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 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 device e.g. for supply of accessories	
	24 V DC ± 25%, short-circuit protected	Maximum load
VO / 24V	Voltage output	The 24 Vout at M1-M8 are limited to 100 mA each in groups of two. The groups are M1 and M2, M3 and M4, M5 and M6 as well as M7and M8. For the maximum total currents, refer to Section 2.3.3 "Electrical connection of the control unit".
GND / 0V	Reference potential GND	

Control voltage connection	Supply voltage for the device		
	24 V DC ± 25% 380 mA … 800 mA, depending on the load on inputs and outputs and use of options [1]	With option (-HVS): Automatic switching between external supply via plug-in connector and internal power supply unit if connected control voltage is insufficient.	
24 V	Input voltage	-	-
GND / 0V	Reference potential GND	-	-

1) If the frequency inverter's control unit is loaded with full power an external 24 Vpower supply unit has to be able to provide at least 800 mA See also the information regarding control voltage overload (📖 section 2.3.3 "Electrical connection of the control unit")

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}

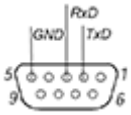
Brake actuation	Connection and actuation of an electromechanical brake. The FI generates an output voltage for this, which depends on the mains voltage. The assignment of the correct brake coil voltage must be taken into account in the selection.		
	Connected loads: (📖 Section 2.3.2.5 "Electromechanical brake") 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		

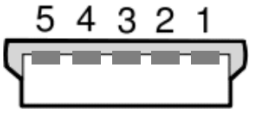
AS Interface	Control of FI via the simple field bus level: Actuator/sensor interface		
	Electrical data: See 📖 4.5.2 "Features and technical data"		
ASI+	ASI+	P480 …	-
ASI-	ASI-	P483	-

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		Connection of the FI to various communication tools		
		24 VDC ± 20%	*RS485 (*for connecting a parametrisation box) 9600 … 38400 Baud *Terminating resistor* (1 kΩ) fixed *RS232 (*for connection to a PC(NORDCON)) 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	Bus signal reference potential		
4	RS232 TXD	Data cable RS232		
5	RS232 RXD	Data cable RS232		
6	+24 V	Voltage output		

Make sure that the diagnostic connection is sealed with the transparent screw cap (diagnostic glass) when not in use. This is the only way to ensure that the device achieves the specified protection class.

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 assignment for incremental encoder (HTL)

Function	Wire colours, for incremental encoders	SK 2xxE-FDS assignment
24 V supply	Brown / green	24V (VO)
0 V 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	Z-track
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 control voltage source.

To use the encoder, parameter (**P300**) or (**P600**) must be activated according to the requirements (speed feedback / servo mode or positioning).

Information

Direction of rotation and counting direction

The incremental encoder’s “counting direction” must correspond to the motor’s direction of rotation. 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 can be set with a negative prefix in parameter **P301**.

Information

Encoder signal faults

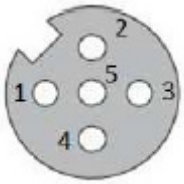
It is necessary to insulate wires that are not required (e.g. track A inverse / B inverse) to prevent short circuits.

The contact between such wires or with the cable shield can cause encoder signal faults or damage the encoder.

For encoders with a zero track signal, the signal is read via option slot **M5**. The function in **P337** must be switched on.

2.5 RS485 encoder

From firmware version 2.0 and higher, the frequency inverter has an RS485 encoder interface. High-resolution encoders can transmit their information to the frequency inverter in real time via this interface.

Function	M12 socket, A-coded	Contact assignment					Colour
		1	2	3	4	5	
Encoder connection		12 V	Data +	GND	Data -	–	Black

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

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

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 at the device 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 generally 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)
  If option type c SYSS is assigned to option slot M7, the LEDs for M7 do not light up. A status is not displayed.
  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 (📖 2.2.2.1 "Configuration of option slots of the control level"). Retrofitting is not possible.

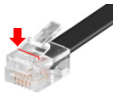
Parameterisation units furthermore allow for an access to and the adjustment of the device's parametrisation.

Designation		Material number	Comment
Control and parameterisation units (handheld)			
SK CSX-3H	SimpleBox	275281013	📖 BU 0040
SK PAR-3H	ParameterBox [1)]	275281014	📖 BU 0040
SK PAR-5H	ParameterBox	275281614	📖 BU 0040
SK TIE5-BT-STICK	NORDAC *ACCESS BT* Bluetooth stick	275900120	📖 BU 0960

1) The product has been discontinued and is no longer available. The successor model SK PAR-5H is fully compatible.

Connection of a control and parameterisation unit

1. Remove the diagnostics glass of the RJ12 socket.
2. Establish RJ12-RJ12 cable connection between control unit and Frequency Inverter.



Ensure that the latching tab on the connection side to the Frequency Inverter has been removed without burrs (see figure on the left). Otherwise, the plug may get jammed in the RJ12 socket.

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.

3.2.1 Connection of multiple devices to one parametrisation tool

In principle it is possible to access several frequency inverters via the **ParameterBox** or the **NORDCON 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 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 1: SK CU4 … optional modules as internal control terminals (example)

Designation*		Material number	Document
Bus interfaces			
SK CU4-ETH(-C)	Industrial Ethernet	275271027 / (275271527)	TI 275271027 / (TI 275271527)
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 marked with **–C** have varnished 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.

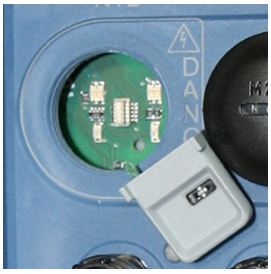
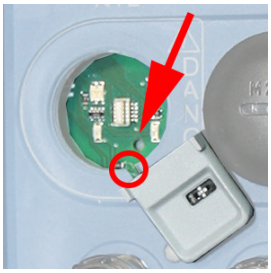
Disassembly / assembly

DANGER

Electric shock

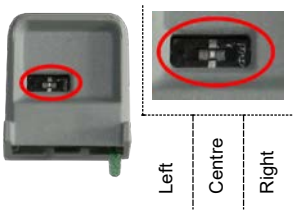
The PCB below the transparent screw cap (EEPROM cover) is at the potential of the DC link circuit (approx. ½ UZW = 500 V DC). Touching the PCB or its components will result in an electric shock.

- 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.

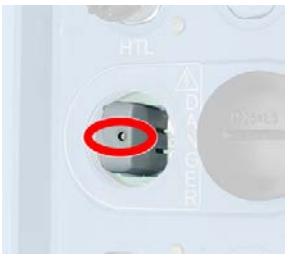
1.	**Disconnecting the frequency inverter from the low voltage and checking the absence of voltage in the device**	
Removing the EEPROM		
2.	Remove the transparent screw cap.	
3.	Pull off the EEPROM Continue with step 5 if the frequency inverter is to be operated without a plug-in EEPROM.	
EEPROM installation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



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



DIP switch: Left position (coding pin pointing downwards)

	Function sequence	LED
	After commissioning the frequency inverter, the data is copied once from the EEPROM to the frequency inverter.	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 again, the plug-in EEPROM must have been temporarily operated with a different DIP switch position. **Note the section "Disassembly/assembly" (see above)!**	

DIP switch: Centre 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 have been 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 device 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 system (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: Mains fault (earth fault)

• To avoid any resulting hazard, the drive / 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 device’s parameters. The control and parameterisation units (SK CSX-3H, SK PAR-3H (discontinued) or SK PAR-5H) or the PC-based NORDCON software or NORCON *APP* with NORDAC *ACCESS BT* are available. The parameter settings are stored in the device’s internal EEPROM.

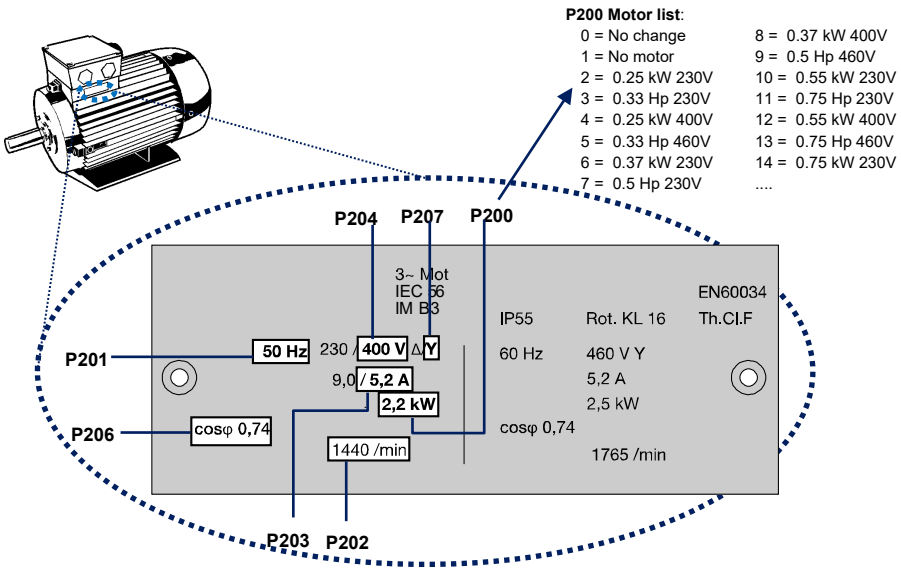
The device parameters are pre-set with typical values (factory settings). Therefore, basic operation capability can be typically established by parameterising the correct motor data (P200 et. seq.) and, if necessary, the operating mode (P300 et seq.).

Individual adaptations to the drive application, communication settings for other devices or a control unit as well as optimisation of the operating characteristics must afterwards also be carried out through parameterisation (see chapter 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 three-phase standard motors (same power and voltage). For use with motors with other powers or number of poles, the data from the name plate of the motor must be entered into the parameters **P201**...**P207** under the menu item >Motor data<.

All motor data (IE3, IE5+) can be pre-set with parameter **P200**. After the function has been used, this parameter is reset to 0 = no change! The data is automatically loaded once into parameter **P201**...**P209** and can be compared with the data on the motor type plate.



For correct operation of the drive unit, it is necessary to set the motor data as accurately as possible in accordance with the name plate. In particular, automatic stator resistance measurement using parameter **P220** is recommended.

4.3 Selecting the operating mode for motor control

The frequency inverter is able to control motors with efficiency classes IE1 to IE5+. Our motors are designed as asynchronous motors in efficiency classes IE1 to IE3, and IE4 and IE5+ motors are designed as synchronous motors.

In terms of control technology, the operation of synchronous motors shows many special features. In order to achieve ideal results, the frequency inverter was therefore designed for the control of synchronous motors from NORD, which match the type of an IPMSM (Interior Permanent Magnet Synchronous Motor) in terms of structure. In these motors, the permanent magnets are embedded in the rotor. The operation of other manufacturer's motors must be checked by NORD, if required. See also technical information TI 60-0001, “Planning and commissioning guide for NORD synchronous motors (PMSM) 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.

- VFC open-loop mode (**P300 = 0**)
  This operating mode is based on a voltage-controlled, field-oriented control method (Voltage Flux Control Mode “VFC”). It is used with ASM and PMSM. In the context of the operation of asynchronous motors, the term “ISD control” is also used.
  Control takes place without encoder and only based on fixed parameters and measurement results of actual electrical values. No specific setting of the speed control is required to use this operating mode. However, the parameterisation of motor data as precisely as possible is an essential condition for high-quality operation.
  For the ASM mode, there is also the possibility of control according to a simple V/f characteristic curve. This mode is suitable for the operation of several, mechanical, non-coupled motors in parallel on one frequency inverter, or if the motor data cannot be precisely determined.
  Operation according to a V/f characteristic curve is only suitable for drive applications with low requirements on speed quality and dynamics (ramp times ≥ 1 s). Even for machinery that, due to its design, tends towards mechanical vibrations, control according to a V/f characteristic curve may be advantageous. V/f characteristic curves are usually used to control fans, certain pump drives, or for agitators. Operation according to V/f characteristic curve is activated via the parameters **P211 = 0** and **P212 = 0**.

- CFC closed-loop mode (**P300 = 1**)

  In comparison with **P300 = 0**, this is generally a control with current-controlled field orientation (Current Flux Control). For this operating mode, which with ASM is functionally identical to the designation previously listed under “servo control”, the use of an encoder is mandatory. This way, the motor’s exact speed characteristics are recorded and included in the calculation for the motor control. The encoder also enables the determination of the rotor position, where for the operation of a PMSM the initial value of the rotor position must be additionally determined. This allows for a more precise and faster control of the drive.
  For ASM and PMSM, this operating mode provides optimal results in control behaviour, and is especially suitable for lifting gear applications or applications with requirements on optimal dynamic behaviour (ramp times ≥ 0.05 s). This operating mode has the greatest benefit in connection with a motor of energy efficiency class IE5+ (energy efficiency, dynamics, precision).

- CFC open-loop mode (**P300 = 2**)
  The CFC mode is also possible in the open-loop method, i.e. in operation without encoder. Speed and position detection are determined using “observers” from measuring and actuating values. The prerequisite for this operating mode is a precise setting of the current and speed controller. This operating mode is suitable for applications with higher requirements on dynamics (ramp times ≥ 0.25 s) compared to the VFC control, and for pumping applications with high breakaway 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 .

"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. The correct assignment of the frequency inverter/motor and the mains voltage selection are assumed. Detailed information, especially for optimisation of the current, speed and position controllers of asynchronous motors is described in the guide “Controller Optimisation” (AG 0100). Detailed information on commissioning and optimisation for PMSMs in CFC closed-loop mode can be found in the “Drive Optimisation” guide (AG 0101). Please contact our Technical Support.

1. Carry out the frequency inverter and 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 name plate/motor data sheet.
6. Measure the stator resistance (P220) → P208, P241[-01] are measured, P241[-02] is calculated. (Note: If an SPMSM is used, P241[-02] must be overwritten with the value from P241[-01]). Leave the existing values for parameters P241[-03] to P241[-06].)
7. Encoders: Check the settings (P301, P735)
8. With PMSM only:
   a. EMF voltage (P240) → Motor name plate/motor data sheet
   b. Determine/set reluctance angle (P243) (not required with NORD motors)
   c. Peak current (P244) → Motor data sheet (not required with NORD motors)
   d. Only for PMSMs in VFC mode:
      Determine (P245), (P247)
   e. Determine (P246)
9. Select the operating mode (P300).
10. Determine/set the current controller (P312 … P316).
11. Determine/set the speed controller (P310, P311).
12. PMSM only:
    a. Select the procedure for the recognition of the rotor position (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 and P328 ≠ 0)

Information

Commissioning of NORD synchronous motors

Further information on the commissioning of NORD synchronous motors with NORD frequency inverters can be found in the AG 0101 application guide.

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)

Frequency inverters from Getriebebau NORD GmbH & Co. KG that feature an AS-Interface support the ASi-3 version of the AS protocol.

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 slaves is implemented 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"	... "-AXB"
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	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	S-7.A
I/O code	7	7	7	7	7	7	7
ID code	A	A	0	A	A	0	A
Ext. ID code 1 / 2	7	7 / 5	F	7	7 / 5	F	7
Address	1A – 31A, 1B – 31B		1 – 31	1A – 31A, 1B – 31B		1 – 31	1A-31A, 1B-31B
As delivered	0 A		0	0 A		0	0 A
Cycle time							
Slave → Master	≤ 10 ms	≤ 10 ms	≤ 5 ms	≤ 10 ms	≤ 10 ms	≤ 5 ms	≤ 10 ms
Master → Slave	≤ 21 ms	≤ 10 ms	≤ 5 ms	≤ 21 ms	≤ 10 ms	≤ 5 ms	≤ 21 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	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	4I/4O

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

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

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

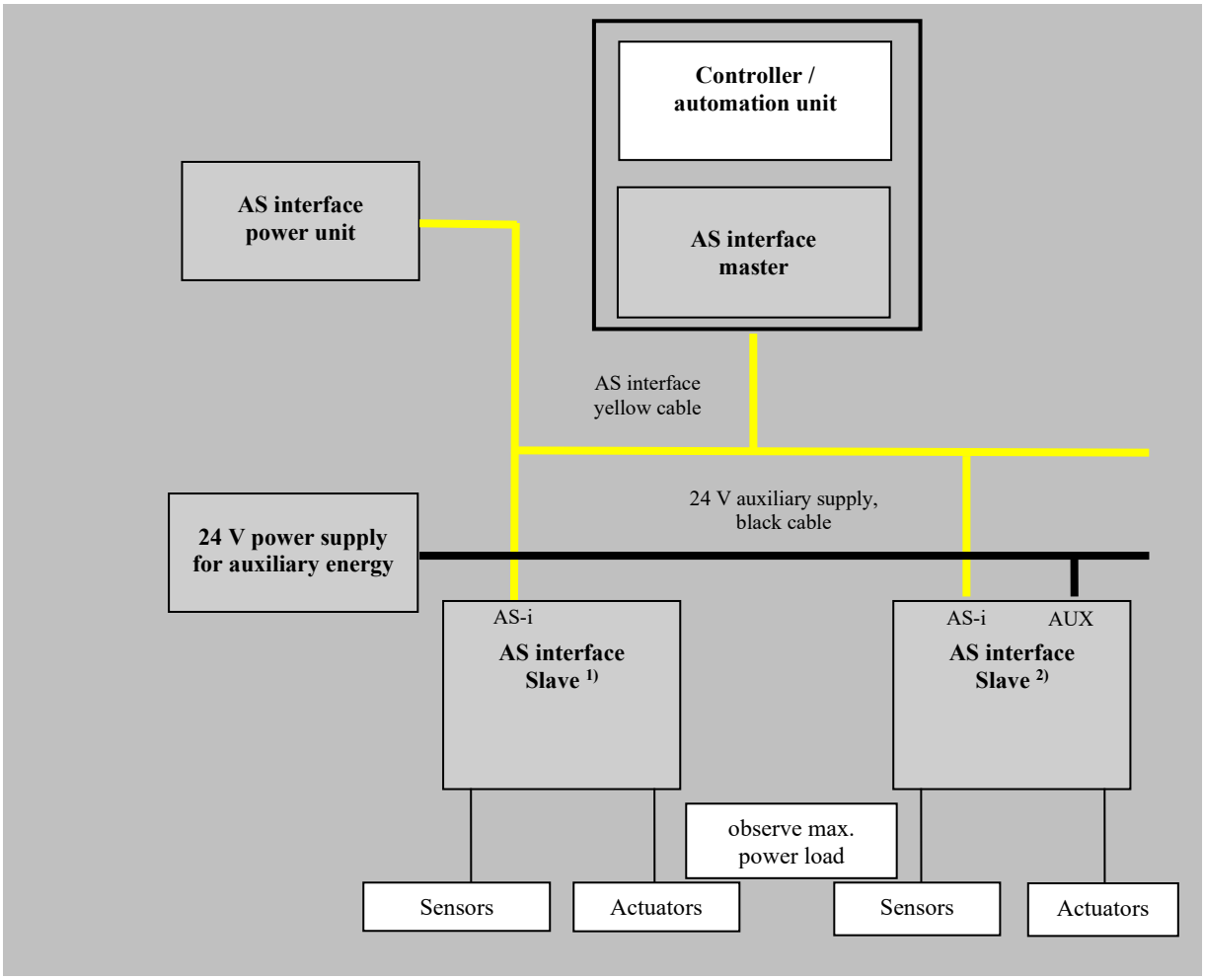
4.5.3 Bus structure and topology

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**“, “**-ASS**“ or **-AXB** 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**“, “**-AXS**“ or **-AXB** plug connector on option slot **M8** (only if available). The supply should preferably be affected via PELV.

More details (see chapter 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 device’s digital inputs. Connection of actuators is possible via the device’s available digital outputs. The following assignments are provided for the 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	Fault acknowledgement [2]
Bit 4 [3]	Release brake manually

State		Status
Bit 1	Bit 0	
0	0	Motor is switched off
0	1	Rotating field “right” applied to motor
1	0	Rotating field “left” applied to motor
1	1	Motor is switched off

1) Enabled via jog frequency 1 or 2 (according to Bit 2 selection)

2) Acknowledgement via edge 0 → 1.
When controlled via the bus, acknowledgement is not carried out automatically by an edge at one of the enable inputs.

3) Only for connector option “-ASI“ or “-AUX“

BUS OUT	Function (P481 [-01 … -06])
Bit 0	Inverter ready
Bit 1	Warning
Bit 2	Status dig in 1
Bit 3	Status dig in 4
Bit 4 [1]	**H1** switch: Remote control
Bit 5 [1]	STO inactive

State		Status
Bit 1	Bit 0	
0	0	Fault active
0	1	Warning
1	0	Switch-on inhibit
1	1	Ready for operation / run

1) Only for connector option “-ASI“ or “-AUX“

Control via the BUS and via the digital inputs is possible in parallel. The corresponding inputs are treated like 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 for “-AXS“, “-ASS“ or -AXB connector option

In order to use the device in an AS-i network, it must receive a unique address. Address 0 is set at the factory. This allows the device to be recognised 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

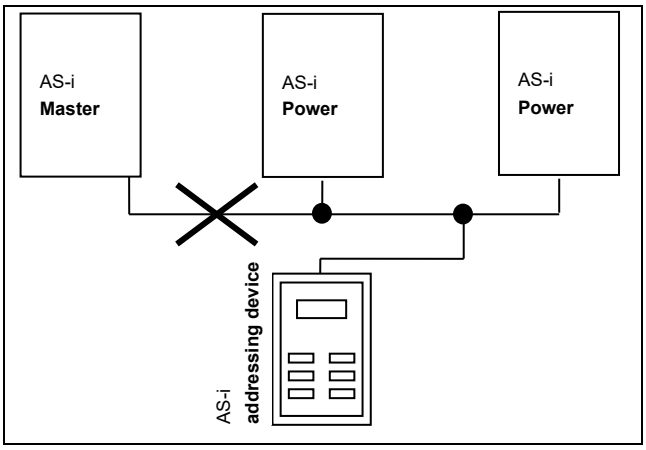
Special conditions for the supply exclusively via the yellow cable

- 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.

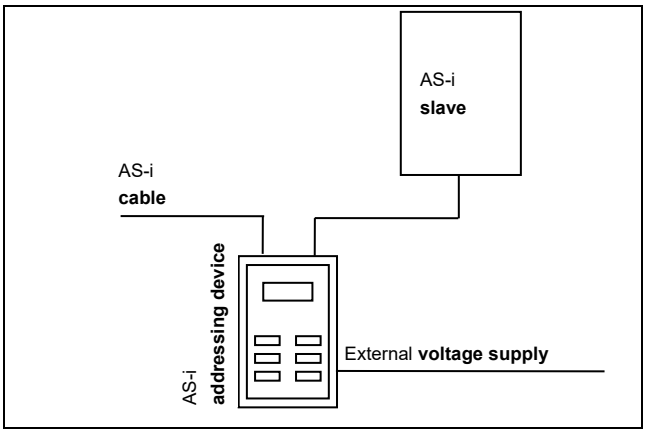
Version 1

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 device 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 system (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: Mains fault (earth fault)

- To avoid any resulting hazard, the drive / 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, a “breakdown” of the motor may cause unexpected movement (e.g. dropping of loads by lifting equipment).

To prevent 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 protection against falling (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 device configuration, the control voltage can be supplied via an optional plug connector. As an alternative, the device may be equipped with a power supply unit (option: “-HVS”) that generates the required 24 V DC control voltage by applying the mains voltage (see chapter 2.3.2 "Electrical connection of power unit").

Each device is pre-set at the factory for a NORD motor of the same power. All parameters can be adjusted “online”. Four switchable parameter sets are available during operation. The scope of the parameters to be displayed can be influenced using the supervisor parameter **P003**.

The factory settings of parameter **P420** depend on the device configuration (see chapter 2.2.2.2 "Configuration of option slots on the connection level").

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

Information

ParameterBox SK PAR-3H

The ParameterBox SK PAR-3H 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	**P310** Speed Ctrl P
P311 Speed Ctrl I	**P312** Torque curr. ctrl. P	**P313** Torque curr. ctrl. I
P314 Torq curr ctrl limit	**P315** Field curr. ctrl. P	**P316** Field curr. ctrl. I
P317 Field curr ctrl lim	**P318** P-Weak	**P319** I-Weak
P320 Weak Border	**P321** Speedctr.I brake off	**P325** Function encoder
P326 Ratio encoder	**P327** Speed slip error	**P328** Speed slip delay
P330 Ident startrotor pos	**P331** Switch over freq.	**P332** Hyst.Switchover Freq
P333 Flux feedb.fact.PMSM	**P334** Encoder offset PMSM	**P336** Mode Rotorpos ident
P337 Rot pos Z-track sync	**P350** PLC Functionality	**P351** PLC set val. select.
P353 Bus status via PLC	**P355** PLC Integer setvalue	**P356** PLC long setvalue
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 I²t
P534	Torque shutoff lim.	**P535**	I²t 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		

P000 (parameter number)	**Operating para. disp.** (parameter name)		**S**	**P**
Setting range or display range	Display of the typical display format, possible setting range and number of decimal places			
Arrays	[-01]	If parameters have a substructure in several arrays, this is shown here.		
Factory setting	{ 0 }	Typical default setting of parameters in the as-delivered condition of the device, or to which it is set after carrying out “Restore factory settings” (see parameter **P523**).		
Scope of application	List of device variants for which this parameter applies. If the parameter is generally valid, i.e. for the entire model series, this line is omitted.			
Description	Description, function, meaning and similar for this parameter.			
Note	Additional notes about this parameter			
Setting values or display values	List of possible settings with description of their respective functions			

Figure 2: Explanation of parameter description

Information

Parameter description

Unused lines of information are not listed.

Notes / Explanations

Label	Designation	Meaning
S	Supervisor parameter	The parameter can only be displayed and changed if the relevant supervisor code has been set (see parameter **P003**).
P	Depending on the parameter set	The parameter provides various setting options which depend on the selected parameter set.

5.1.1 Operating displays

P000	**Operating para. disp**
Display range	0.01 … 9999
Description	The operating value selected in parameter **P001** is displayed. Important information about the operating status of the drive can be read out as required.

P001	**Selection of display value**	
Setting range	0 … 65	
Factory setting	{ 0 }	
Description	Selection of the operating display for display via 7-segment display.	
Display values	**Value**	**Meaning**

P002	**Display factor**	**S**
Setting range	0.01 … 999.99	
Factory setting	{ 1.00 }	
Description	The selected operating value in parameter **P001** *“Select of disp.value”* is multiplied by the scaling factor in **P000** and displayed in the *“Operating para. display”*. It is therefore possible to display system-specific operating values such as the throughput quantity.	

P003	Supervisor-Code
Setting range	0 … 9999
Factory setting	{ 1 }
Description	The scope of the visible parameters can be influenced by setting the supervisor code.
Note	**Display via NORDCON** If parameterisation is carried out with the NORDCON software, the settings 4 ... 9999 the settings are as for the 0 setting. The settings 1 and 2 are similar to the 3 setting.
Setting values	

Value	Meaning
0	The supervisor parameter and the P3xx / P6xx groups are not visible, all others are.
1	All parameters are visible except for the P3xx and P6xx groups.
2	All parameters are visible except for the P6xx group.
3	All parameters are visible.
4	…9999, only **P001** and **P003** are visible

5.1.2 Basic parameters

P100	Parameter set	S
Setting range	0 … 3	
Factory setting	{ 0 }	
Description	Selection of the parameters sets to be parameterised. Four parameter sets are available. The parameters to which different values can also be assigned in the four parameter sets are known as “parameter set-dependent” and are indicated with a “**P**” in the header in the following descriptions. The operating parameter set is selected via correspondingly parametrised digital inputs or BUS actuation. If enabling is via the keyboard of a ParameterBox, the operating parameter set corresponds to the settings in **P100**.	

P101	Copy parameter set	S
Setting range	0 … 4	
Factory setting	{ 0 }	
Description	“*Copy parameter set*”. By confirmation with the OK key, the active parameter set (set in **P100**) is copied into the selected parameter set.	

Setting values

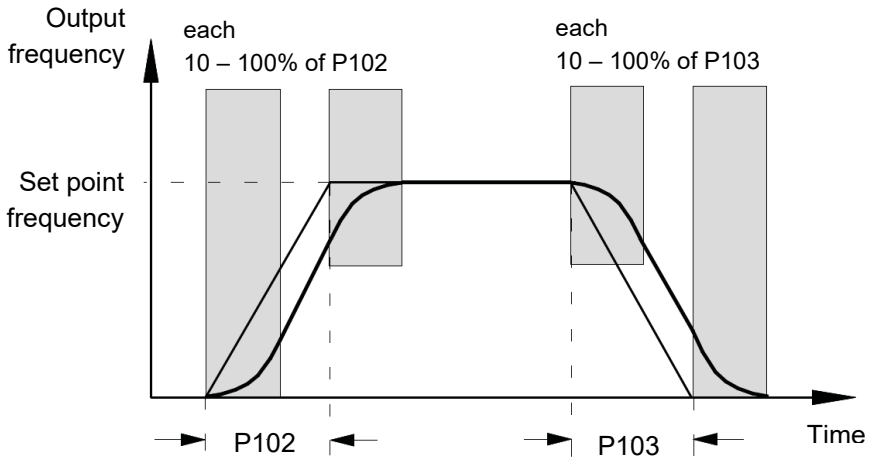
Value		Meaning
0	Do not copy	No copy process triggered.
1	Copy actual to P1	Copies the active parameter set to parameter set 1
2	Copy actual to P2	Copies the active parameter set to parameter set 2
3	Copy actual to P3	Copies the active parameter set to parameter set 3
4	Copy actual to P4	Copies the active parameter set to parameter set 4

P102	Acceleration time	P
Setting range	0.00 … 320.00 s	
Factory setting	{ 2.00 }	
Description	The acceleration time is the time which corresponds to the linear frequency increase from 0 Hz to the set maximum frequency **P105**. If an actual setpoint of < 100% is being used, the acceleration time is linearly reduced according to the setpoint which has been set. The acceleration time can be extended by certain circumstances, for example, FI overload, setpoint delay, ramp smoothing, or if the current limit is reached.	
Note	Ensure that the parameter values are realistic. A setting of **P102 = 0** is not permissible! **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 “breakdown” of the motor. Extremely steep ramps (e.g.: 0 - 50 Hz in < 0.1 s) should be avoided, as these may cause damage to the frequency inverter.	

P103	Deceleration time	P
Setting range	0.00 … 320.00 s	
Factory setting	{ 2.00 }	
Description	The deceleration time is the time corresponding to the linear frequency reduction from the set maximum frequency **P105** to 0 Hz. If a current setpoint < 100% is being used, the deceleration time reduces accordingly. The deceleration time can be extended by certain circumstances, for example, by the selected *“Disconnection mode”* **P108** or *“Ramp smoothing”* **P106**.	
Note	Ensure that the parameter values are realistic. The setting of **P103 = 0** is not permissible! **Notes on ramp gradient**: see **P102**	

P104	Minimum frequency	P
Setting range	0.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	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. analogue setpoint or fixed frequencies) these are added to the set minimum frequency. This frequency is undershot when • The drive is accelerated from standstill. • The FI is blocked. The frequency then reduces to the absolute minimum frequency **P505** before it is blocked. • The FI reverses. Reversal of the rotation field takes place at the absolute minimum frequency **P505**. This frequency can be continuously undershot if the function *"Maintain the freq.”* (digital input function = 9) was executed during acceleration or deceleration.	

P105	Maximum frequency	P
Setting range	0.1 … 400.0 Hz	
Factory setting	{ 50.0 }	
Description	The maximum frequency is the frequency supplied by the FI after being enabled and once the maximum setpoint is present (e. g. analogue setpoint according to **P403**, a correspondingly fixed frequency or maximum via a ParameterBox). This frequency can only be exceeded by the slip compensation **P212**, the function *“Maintain the freq.”* (Digit inputs function = 9) or the switch 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: Restriction of the maximum frequency to a value which is slightly above the nominal frequency. This value is calculated from the motor data and the input voltage.	

P106	Ramp smoothing	S	P
Setting range	0 … 100%		
Factory setting	{ 0 }		
Description	This parameter enables 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 ramp smoothing: $t_{ges\ \ ACCELERATION\ TIME} = t_{P102} + t_{P102} \cdot \frac{P106\ [\%]}{100\%}$ $t_{ges\ \ BRAKING\ TIME} = t_{P103} + t_{P103} \cdot \frac{P106\ [\%]}{100\%}$ 		
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^{-1} • Acceleration values (±) greater than 1 Hz ms^{-1} • Rounding values < 10%		

P107	Brake reaction time		P
Setting range	0 … 2.50 s		
Factory setting	{ 0.00 }		
Description	Electromagnetic brakes have a physically-dependent delayed brake reaction time when actuated. This can result in the dropping of the load in lifting gear applications. The brake takes up the load after a delay. The reaction time must be taken into consideration by setting parameter **P107**. Within the adjustable reaction time, the FI supplies the set absolute minimum frequency **P505** and so prevents movement against the brake and load drop when stopping. 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 excitation current is present, the FI remains in excitation mode and the motor brake is not released.		
Note	In order to achieve a switch-off and a fault message **E016** in case of a too low excitation current, set parameter **P539 = 2** or **P539 = 3**.		

Information

Brake control

To control the electromechanical brake (especially for lifting gears), the relevant connection on the frequency inverter must be used, if available. The absolute minimum 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 on the inverter or breakdown of the motor, if

- for application of the brake, the *brake reaction time* (**P107**) is set too long, or
- for release of the brake, the *absolute minimum frequency* (**P505**) is set too high.

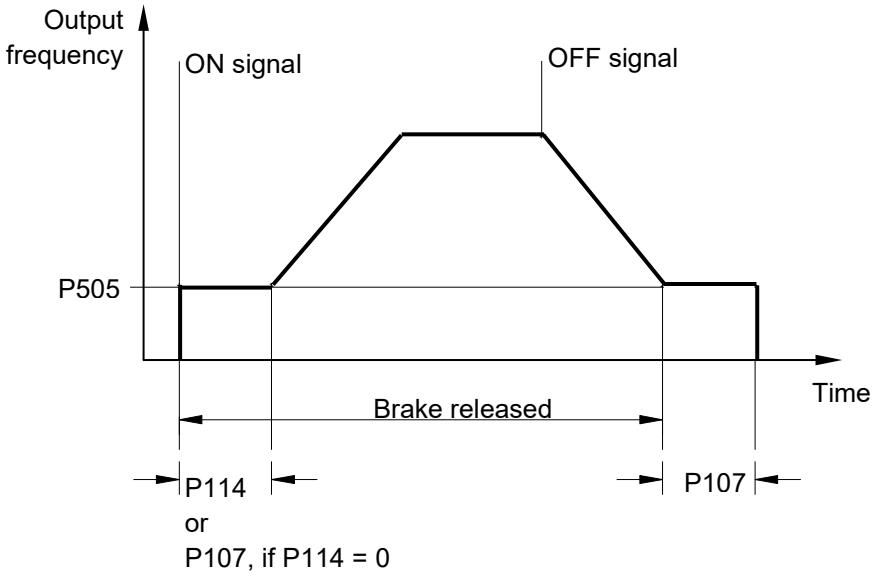
Recommended parameterisation for the application:
Lifting gear with brake without speed feedback

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 starting
P112 = “Off”
P536 = “Off”
P537 = Factory setting
P539 = Check of exciting current

Against load drops
P214 = 50 ... 100% (precontrol)

* Setting values (**P107**/**P114**) depend on braking type and motor size. For low powers (< 1.5 kW), smaller values apply; for higher powers (> 4.0 kW), larger values apply.



P108	Switch-off mode	S	P
Setting range	0 ... 13		
Factory setting	{ 1 }		
Description	This parameter determines the way in which the output frequency is reduced after "Blocking" (controller enable → Low).		

Setting values

Value		Meaning
0	Voltage disable	The output signal is switched off immediately. The FI no longer supplies an output frequency. The motor is only braked by mechanical friction. Switching the FI on again immediately can cause an error message.
1	Ramp down	The current output frequency is reduced in proportion to the remaining deceleration time from **P103/P105**. The DC run-on **P559** follows the end of the ramp.
2	Delayed ramping	Same as **P108 = 1**. For generational operation, however, the brake ramp is extended, and for static operation, the output frequency is increased. Under certain conditions, this function can prevent overvoltage switch-off or reduce braking resistor power dissipation. **Note**: This function must not be programmed if defined deceleration is required, for example for lifting gears.
3	Instant d.c. braking	The FI switches immediately to the preselected DC current **P109**. This DC current is supplied for the remaining proportion of the "*Time DC-brake on*" **P110** Depending on the relationship of the current output frequency to the 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 inertia of the load, friction and the DC current set in **P109**. With this type of braking, no energy is fed back into the FI. Heat losses primarily occur in the rotor of the motor. **Note**: ***This function is not suitable for PMSM motors***
4	Const. brakedistance	"*Constant brake distance*": Start of the brake ramp is delayed if operation is not at the maximum output frequency (**P105**). This results in an approximately similar braking distance for different current frequencies. **Note:** This function cannot be used as a positioning function. This function should not be combined with ramp smoothing (**P106**).
5	Combi. braking	*"Combined braking"*: Depending on the current DC link voltage, a high frequency voltage is switched to the basic frequency (only for linear characteristic curves, **P211 = 0** and **P212 = 0**). The deceleration time **P103** is complied with if possible. → Additional heating in the motor! **Note**: ***This function is not suitable 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 **P108 = 2** and **P108 = 6**.
8	Quad.Ramp w. braking	"*Quadratic combined braking*": Combination of **P108 = 5** and **P108 = 6**. **Note**: ***This function is not suitable for PMSM motors***
9	Constant accn.	*"Constant acceleration power"*: Only applies in field weakening range. The drive is accelerated or braked with constant electrical power. The shape of the ramps depends on the load.
10	Distance Calculator	Constant distance between current frequency / speed and the set minimum output frequency **P104**. Same as **P108 = 10**, but it only becomes active if the frequency setpoint undershoots the set minimum frequency. In this case, enabling must be retained.
11	Constant accn.delay	*"Constant acceleration power with delay"*: Combination of **P108 = 2** and **P108 = 9**.
12	Constant accn. Mode3	*"Constant acceleration power mode 3"*: Same as **P108 = 11**, but with additional relief of the brake chopper.
13	Switch off delay	*"Ramp with switch-off delay"*: Same as **P108 = 1**, but the drive remains at the absolute minimum frequency set in parameter **P110** for the time specified in parameter **P505** before the brake is applied. Application example: Re-positioning for crane control

P109	DC brake current	S	P
Setting range	0 … 250 %		
Factory setting	{ 100 }		
Description	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 corresponds to a current value as stored in the "Nominal motor current" parameter **P203**.		
Note	The 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 110 %. ***DC Braking: Not for PMSM motors!***		

P110	Time DC-brake on	S	P
Setting range	0.00 … 60.00 s		
Factory setting	{ 2.00 }		
Description	The time for which the DC current selected in **P109** is applied to the motor. **P108 = 3** must be selected. Depending on the relationship of the current output frequency to the max. frequency **P105** , the “Time DC-brake on” is shortened. The time starts running with the removal of the enable and can be interrupted by renewed enabling.		
Note	***DC Braking: Not for PMSM motors!***		

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

P112	Torque current limit	S	P
Setting range	25 … 400% / 401		
Factory setting	{ 401 }		
Description ASM	With this parameter, a limit value for the torque-generating current can be set. This can prevent mechanical overloading of the drive. However, it cannot provide protection against mechanical blockages (moving on block). A slipping clutch, which acts as a safety device, is not replaceable. The torque current limit can also be set over a continuous range of settings using an analogue input. The maximum setpoint (cf. adjustment 100%, **P403 [-01] … [-06]**) then corresponds to the setting value in **P112**. The limit value 20% of torque current cannot be undershot by a smaller analogue setpoint (**P400 [-01] … [-09**], setting 11 or 12). In servo mode **P300**, setting 1, a limit value of 0% is possible with firmware version V 1.3 and higher (older firmware version: at least 10%).		
Description PMSM	In VFC and CFC open-loop modes of a PMSM, a torque limit is set by force, if none has been programmed in parameter **P112**, or if the set value should be greater than the following limit values: VFC open-loop: Setting value from **P210** + max. 30% CFC open-loop: Setting value from **P210** + max. 50%		
Note	A torque limit is not permissible for lifting gear applications!		
Setting values	**Value** / **Meaning** 401 OFF — The torque current is not limited.		

P113	Jog frequency	S	P
Setting range	-400.0 … 400.0 Hz		
Arrays	[-01] = Jog frequency 1 [-02] = Jog frequency 2		
Factory setting	{ 0.0 }		
Description	When using a parameterisation unit to control the frequency inverter, the jog frequency represents the initial value after enabling. Alternatively, if control is via the control terminals, the jog frequency can be activated via one of the digital inputs. The jog frequency 1 can either be set directly via this parameter of by pressing the OK key. The latter requires the frequency inverter to be enabled via the keyboard. In this case, the current output frequency is applied to array [-01] of parameter **P113** and is available when it is enabled again. The jog frequency 2 can only be set directly via this parameter and not by pressing the OK key.		
Note	Setpoint specifications via the control terminals, such as the jog frequency, fixed frequencies or the analogue setpoint, are generally added with the correct sign. The set maximum frequency **P105** cannot be exceeded and the minimum frequency **P104** cannot be undershot.		

P114	Brake delay off	S	P
Setting range	0.00 … 2.50 s		
Factory setting	{ 0.00 }		
Description	Electromagnetic brakes have a delayed response time for their release, which depends on physical factors. This can lead to the motor running while the brake is still applied, which will cause the FI to switch off with an overcurrent message. This release time can be taken into consideration by parameter **P114** (braking control). During the adjustable release time **P114**, the FI supplies the set absolute minimum frequency **P505** and thus prevents movement against the brake. See also parameter **P107** “Brake reaction time” (setting example).		
Note	If **P114 = 0**, then **P107** is the brake release and reaction time.		

P120	Ext Control Units		S	P
Setting range	0 … 2			
Arrays	[-01] = Bus option (ext1)	[-03] = 1.IOE (ext3)		
	[-02] = 2.IOE (ext2)	[-04] = Extension unit 4		
Factory setting	{ 1 }			
Description	Monitoring of communication at system bus level (in case of fault: error message **E10.9**).			
Note	If fault messages detected by the optional module (e.g. faults at field bus level) are not to result in a switch-off of the drive electronics, then parameter **P513 = -0.1** must be set additionally.			

Setting values

Value		Meaning
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 if an extension starts communication with the FI.
2	Monitoring active immediately	"*Monitoring active immediately*"; the FI starts to monitor the corresponding module immediately after it is switched on. If the module is not detected on switch-on, the FI remains in the status "not ready for switch-on" for 5 seconds and then triggers an error message.

5.1.3 Motor data / characteristic curve parameters

P200	Motor list	P
Setting range	0 … 148	
Factory setting	{ 0 }	
Description	The factory settings for the motor data can be edited with this parameter. A 4-pole IE1 asynchronous standard motor is set at the factory in parameters **P201 … P209** to match the nominal power of the FI. By selecting one of the possible setting values and pressing the OK key, all of the motor parameters **P201** ... **P209** are set to the selected motor power. The motor data for NORD synchronous motors can be found in the final section of the list.	
Note	After confirmation of the selection, **P200** becomes **= 0** again. The selection which has been made can be checked via **P205**.	
	IE2/IE3motors If IE2/IE3 motors are used after selecting a IE1 motor, the motor data in **P201** … **P209** must be matched to the data on the motor type plate.	

Setting values

Value	Meaning
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 operating a motor. The following motor data is set here: 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	0.25 kW 230V 71SP	10	0.55 kW 230V 80SP	18	1.1 kW 230V 90SP
3	0.33 Hp 230V 71SP	11	0.75 Hp 230V 80SP	19	1.5 Hp 230V 90SP
4	0.25 kW 400V 71SP	12	0.55 kW 400V 80SP	20	1.1 kW 400V 90SP
5	0.33 Hp 460V 71SP	13	0.75 Hp 460V 80SP	21	1.5 Hp 460V 90SP
6	0.37 kW 230V 71LP	14	0.75 kW 230V 80LP	22	1.5 kW 230V 90LP
7	0.5 Hp 230V 71LP	15	1.0 Hp 230V 80LP	23	2.0 Hp 230V 90LP
8	0.37 kW 400V 71LP	16	0.75 kW 400V 80LP	24	1.5 kW 400V 90LP
9	0.5 Hp 460V 71LP	17	1.0 Hp 460V 80LP	25	2.0 Hp 460V 90LP
26	2.2 kW 230V 100MP	36	5.5 kW 230V 132SP	46	15.0 kW 400V 160LP
27	3.0 Hp 230V 100LP	37	7.5 Hp 230V 132SP	47	20.0 Hp 460V 160LP
28	2.2 kW 400V 100MP	38	5.5 kW 400V 132SP	48	18.5 kW 400V 180MP
29	3.0 Hp 460V 100LP	39	7.5 Hp 460V 132SP	49	25.0 Hp 460V 180MP
30	3.0 kW 230V 100AP	40	7.5 kW 230V 132MP	50	22.0 kW 400V 180LP
31	3.0 kW 400 V 100 AP	41	10.0 Hp 230V 132MP	51	30.0 Hp 460V 180LP
32	4.0 kW 230V 112MP	42	7.5 kW 400V 132MP	52	30.0 kW 400V 225RP
33	5.0 Hp 230V 112MP	43	10.0 Hp 460V 132MP	53	40.0 Hp 460V 225RP
34	4.0 kW 400V 112MP	44	11.0 kW 400V 160MP	54	37.0 kW 400V 225SP
35	5.0 Hp 460V 112MP	45	15.0 Hp 460V 160MP	55	50.0 Hp 460V
56	45.0 kW 400V 225MP	66	132.0 kW 400V 315MP	76	15.0 kW 230V 160LP
57	60.0 Hp 460V 225SP	67	180.0 Hp 460 V 315MP	77	20.0 Hp 230V 160LP
58	55.0 kW 400V 250WP	68	160.0 kW 400V 315RP	78	18.5 kW 230V 180MP
59	75.0 Hp 460V 250WP	69	220.0 Hp 460V 315RP	79	25.0 Hp 230V 180MP
60	75.0 kW 400V 280SP	70	200.0kW 400V	80	22.0 kW 230V 180LP
61	100.0 Hp 460V 280SP	71	270.0 Hp 460V	81	30.0 Hp 230V 180LP
62	90.0 kW 400V 280MP	72	250.0kW 400V	82	30.0 kW 230V 225RP
63	120.0 Hp 460V 280MP	73	340.0 Hp 460V	83	40.00 Hp 230V 225RP
64	110.0 kW 400V 315SP	74	11.0 kW 230V 160MP	84	37.0 kW 230V 225SP
65	150.0 Hp 460V 315SP	75	15.0 Hp 230V 160MP	85	50.0 Hp 230V

86	0.12kW 115V	96	1.10 kW 230 V 90T1/4	106	2.20 kW 400 V 90T1/4
87	0.18kW 115V	97	1.10 kW 230 V 80T1/4	107	3.00 kW 230 V 100T5/4
88	0.25kW 115V	98	1.10 kW 400 V 80T1/4	108	3.00 kW 230 V 100T2/4
89	0.37kW 115V	99	1.50 kW 230 V 90T3/4	109	3.00 kW 400 V 100T2/4
90	0.55kW 115V	100	1.50 kW 230 V 90T1/4	110	3.00 kW 400 V 90T3/4
91	0.75kW 115V	101	1.50 kW 400 V 90T1/4	111	4.00 kW 230 V 100T5/4
92	1.1kW 115V	102	1.50 kW 400 V 80T1/4	112	4.00 kW 400 V 100T5/4
93	4.00 Hp 230V	103	2.20 kW 230 V 100T2/4	113	4.00 kW 400 V 100T2/4
94	4.00 Hp 460V	104	2.20 kW 230 V 90T3/4	114	5.50 kW 400 V 100T5/4
95	0.75 kW 230 V 80T1/4	105	2.20 kW 400 V 90T3/4	117	0.35 kW 400 V 71N1/8
118	0.50 kW 400 V 71F1/8	128	2.20 kW 400 V 90F2/8	142	1.30 kW 230 V 90F1/8
119	0.70 kW 400 V 71N2/8	129	3.00 kW 400 V 90F3/8	143	1.50 kW 230 V 90N2/8
120	1.00 kW 400 V 71F2/8	130	3.70 kW 400 V 90F4/8	144	1.80 kW 230 V 71F4/8
121	1.05 kW 400 V 71N3/8	135	0.35 kW 230 V 71N1/8	145	2.20 kW 230 V 90N3/8
122	1.10 kW 400 V 71N1/8	136	0.42 kW 230 V 71F1/8	146	1.85 kW 230 V 90F2/8
123	1.50 kW 400 V 71F3/8	137	0.70 kW 230 V 71N2/8	147	2.40 kW 230 V 90F3/8
124	1.50 kW 400 V 90N2/8	138	0.83 kW 230 V 71F2/8	148	3.10 kW 230 V 90F4/8
125	1.50 kW 400 V 90F1/8	139	1.05 kW 230 V 71N3/8		
126	2.20 kW 400 V 71F4/8	140	1.10 kW 230 V 90N1/8		
127	2.20 kW 400 V 90N3/8	141	1.30 kW 230 V 71F3/8		

P201	Nominal frequency	S	P
Setting range	10.0 … 399.9 Hz		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The nominal motor frequency determines the V/f break point at which the FI supplies the nominal voltage (**P204**) at the output.		

P202	Nominal speed	S	P
Setting range	150 ... 24000 rpm		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The nominal motor speed is important for correct calculation and control of the motor slip and the speed display (**P001 = 1**).		

P203	Nominal current	S	P
Setting range	0.1 … 1000.0 A		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The nominal motor current is a decisive parameter for current vector control.		

P204	Nominal voltage	S	P
Setting range	100 … 800 V		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	This parameter sets the nominal voltage. In combination with the nominal frequency, the voltage/frequency characteristic curve is produced.		

P205	Nominal power		P
Setting range	0.00 … 250.00 kW		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	Displays the nominal motor power		

P206	Cos phi	S	P
Setting range	0.50 … 0.98		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The motor cos φ is a decisive parameter for current vector control.		

P207	Star Delta con.	S	P
Setting range	0 ... 1		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The Star Delta connection is decisive for stator resistance measurement (**P220**) and therefore for current vector control.		
Setting values	**Value** / **Meaning**		
	0 – Star		
	1 – Delta		

P208	Stator resistance	S	P
Setting range	0.00 … 300.00 Ω		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	Motor stator resistance → Resistance of a phase winding with a three-phase motor. The stator resistance 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. The result of the stator resistance measurement (see **P220**) is shown in **P208**. However, this value can also be overwritten there.		
Note	For optimum functioning of the current vector control, the stator resistance must be measured automatically by the FI.		

P209	No-load current	S	P
Setting range	0.0 … 1000.0 A		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	This value is always calculated automatically from the motor data if there is a change in the parameter **P206** "Cos φ" and **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.		

P210	Static boost		S	P
Setting range	0 ... 400%			
Factory setting	{ 100 }			
Description	ASM	The static boost affects the current which generates the magnetic field. This corresponds to the no-load current of the respective motor and therefore does not depend on the load. The no-load current is calculated using the motor data. The factory setting is sufficient for typical applications.		
	PMSM	For permanent magnet synchronous motors (PMSM), the level of the current which is used for rotor position identification can be modified as a percentage. The duration of the dwell process can be set via **P558**.		

P211	Dynamic boost	S	P
Setting range	0 ... 150 %		
Factory setting	{ 100 }		
Description	Dynamic boost affects the torque-generating current and is therefore a load-dependent parameter. Here too, the factory setting is sufficient for typical applications. A value which is too high can result in overcurrent in the FI. Under load, the output current is increased too much. A value which is too low will result in insufficient torque.		
Note	In particular, applications with large inertial masses (e.g. fan operation) may require control according to a V/f characteristic curve. For this, parameters **P211** and **P212** must each be set to 0%.		

P212	Slip compensation	S	P
Setting range	0 ... 150%		
Factory setting	{ 100 }		
Description	**Asynchronous motor operation:** Slip compensation increases the output frequency depending on the load, in order to keep the three-phase asynchronous motor speed approximately constant. The factory setting of 100% is optimal for three-phase asynchronous motors if the correct motor data has been set. If several motors (different loads or outputs) are operated with a single FI, the slip compensation **P212 = 0%** must be set. **Synchronous motor operation:** When controlling a PMSM, this parameter determines the voltage level of the test signal method (**P330**). The required voltage level depends on various factors (ambient and motor temperature, motor size, motor cable length, size of frequency inverter and others). If the rotor position identification is not successful, this parameter can be used to adjust the voltage level.		
Note	• In particular, applications with high inertial masses (for example fan drives) driven by an asynchronous motor may require control according to a V/f characteristic curve. For this, parameters **P211** and **P212** must each be set to 0%. • When using closed-loop mode (**P300 = 1**), the slip compensation must be left in the factory setting. • **Synchronous motor operation:** – The higher the voltage for the test signal principal, the higher the noise level while the test signal method is running. – Setting values < 50% are internally limited to the value 50%.		

P213	ISD ctrl. loop gain	S	P
Setting range	25 ... 400%		
Factory setting	{ 100 }		
Description	"*ISD ctrl. loop gain"*. This parameter influences the dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower. Dependent on the type of application, this parameter can be adjusted, e.g. to avoid unstable operation.		

P214	Torque precontrol	S	P
Setting range	-200 ... 200 %		
Factory setting	{ 0 }		
Description	This function allows a value for the expected torque requirement to be set in the current controller. This function can be used in lifting applications for better load take-up during starting.		
Note	Motor torques with "right" rotation field are entered with a positive sign, generator torques are entered with a negative sign. The reverse applies for the "left" rotation field.		

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

P216	Time boost prectrl.	S	P
Setting range	0.0 ... 10.0 s		
Factory setting	{ 0.0 }		
Description	This parameter is used for 3 functionalities: 1. Time limit for the boost precontrol: Application time for the increased starting current. Only with linear characteristic curve (**P211 = 0%** and **P212 = 0%**). 2. Time limit for suppression of pulse disconnection **P537**: enables start-up under heavy load. 3. Time limit for suppression of error switch-off in parameter **P401**, function *"0 ... 100 % with error switch-off 2"*.		

P217	Oscillation damping	S
Setting range	0 ... 400%	
Factory setting	{ 10 }	
Description	The parameter is a measure of the damping power. Oscillations caused by resonance under no-load conditions can be suppressed with oscillation damping. 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	

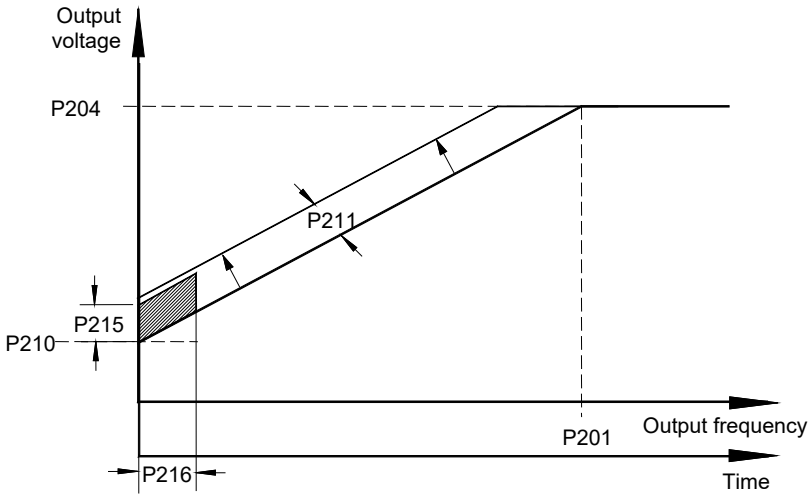
Note	This function is not active in control mode "CFC closed-loop" (Servo Mode) **P300= 1**,

P218	Modulation depth	S
Setting range	50 ... 110 %	
Factory setting	{ 100 }	
Description	This setting influences the maximum possible output voltage of the FI in relation to the mains voltage. Values <100% reduce the voltage to values which are less than the mains voltage. Values >100 % increase the output voltage to the motor. resulting in increased harmonics in the current, which may cause "hunting", i.e. fluctuating speed in some motors. The parameter should normally be set to 100%.	

P219	Auto.magn.adjustment	S
Setting range	25 ... 100% / 101	
Factory setting	{ 100 }	
Description	"*Automatic flux optimisation*". 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 the limit value, to which the field in the motor can be reduced. Reduction of the field is performed with a time constant of 7.5 s. If the load increases, the field is increased with a time constant of approx. 300 ms. The field is reduced so that the magnetisation current and the torque current are approximately equal, i.e. the motor is operated with "optimum efficiency". This function is suitable for applications with relatively constant torque (e.g. pump and fan applications). Its effect therefore replaces a quadratic characteristic curve, as it adapts the voltage to the load.	
Note	For applications with rapid torque fluctuations (e.g. lifting gear), this parameter should be left at the factory setting (100%). Otherwise, rapid load changes could cause switch-off due to overcurrent or "breakdown".	
	This parameter does not function with synchronous motors.	

Setting values	**Value**	**Meaning**
	100 Function disabled	
	101 Automatic	Activation of automatic excitation current control. The ISD controller then operates with a subordinate flux controller, which improves the slippage calculation, especially at higher loads. The control times are considerably faster than with normal ISD control **P219 = 100**.

P2xx Control/characteristic curve parameters



NOTE:

"typical"

Settings for the...

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

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

Information

If the mains voltage is not connected (X1) the following parameter shows the value 0 and not the actual correct operating value.

P220	Par.-identification	P
Setting range	0 ... 2	
Factory setting	{ 0 }	
Description	*"Parameter identification"*. For devices with an output up to 7.5 KW, the motor data is determined automatically by the device via this parameter. Do not switch off the mains voltage during the parameter's identification. Better drive behaviour is often achieved with measured motor data. If there is unfavourable operating behaviour after identification, set the parameters **P201... P208** manually.	
Note	• Before starting parameter identification, check the following motor data according to the name plate: – Nominal frequency **P201** – Nominal speed **P202** – Voltage **P204** – Power **P205** – Star Delta con. **P207** • Parameter identification should only be carried out when the motor is cold (15 … 25 °C). Warming 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 three power levels lower than the nominal power of the FI. • A maximum motor cable length of 20 m must be complied with for reliable identification. • Take care that the connection to the motor is not interrupted during the measuring process. • If the identification cannot be completed successfully, error message **E019** is generated. • After parameter identification, **P220** is **= 0** again. • When using synchronous motors, the parameters P241, P243, P244 and P246 must be set up additionally.	
Setting values	**Value** / **Meaning**	

0	No identification	
1	R_S identification	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

P240	EMF voltage PMSM	S	P
Setting range	0 … 800 V		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The EMF voltage PMSM describes the mutual induction voltage of the motor. The value to be set can be found on the data sheet for the motor or on the name 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, name plate): 89 V Nn (Nominal speed): 2100 rpm Value in P240: P240 = E × Nn / 1000 P240 = 89 V × 2100 rpm / 1000 rpm P240 = 187 V		

Setting values	Value		Meaning
	0	ASM is used	"*Asynchronous motor used*" No compensation

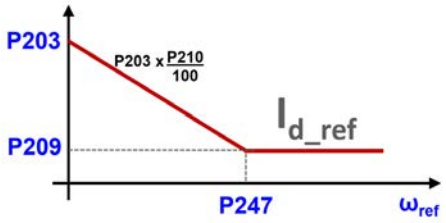
P241	Inductivity PMSM		S	P
Setting range	0.1 … 200.0 mH			
Arrays	[-01] = Ld	[-02] = Lq		
	[-03] = unsaturated Ld	[-04] = unsaturated Lq		
	[-05] = saturated Ld	[-06] = saturated Lq		
Factory setting	The default setting depends on the nominal power of the FI.			
Description	The stator inductivity of the d or q component of a permanently excited synchronous motor (PMSM). The stator inductances can be measured by the frequency inverter (**P220**).			

P243	Reluct. angle IPMSM	S	P
Setting range	0 … 30°		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	*"Reluctance angle IPMSM"*. In addition to the synchronous torque, synchronous machines with embedded magnets (IPMSM) also have a reluctance torque. This is due to the anisotropy (imbalance) between the inductance 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 is taken into account with this parameter. The smaller the angle, the smaller the reluctance proportion. The specific reluctance angle for the motor can be determined as follows: • Allows 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 its minimum		

P244	Peak current PMSM			S	P
Setting range	-20.0 … 1000.0 A				
Arrays	[-01] =	Peak current PMSM	[-02] =	Imax unsaturated Ld	
	[-03] =	Imax unsaturated Lq	[-04] =	Imin saturated Ld	
	[-05] =	Imin saturated Lq			
Factory setting	The default setting depends on the nominal power of the FI.				
Description	For PMSMs with non-linear characteristic induction curves, the linearity limits can be entered with parameter **P244 [-02] … [-05]**. For NORD PMSMs (IE4 and IE5⁺ motors), the necessary data is stored if the motor is selected in **P200**.				

P245	Power system stabilisation PMSM VFC	S	P
Setting range	5 … 250 %		
Factory setting	{ 25 }		
Description	"*Oscillation damping PMSM VFC*". 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	S	P
Setting range	0 ... 1000.0 kg cm²		
Factory setting	The default setting depends on the nominal power of the FI.		
Description	The mass inertia of the drive system can be entered in this parameter. The default setting is sufficient for most applications, but, 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.		
Note	Parameter applies for ASM and PMSM.		

P247	Switch freq VFC PMSM	S	P
Setting range	1 ... 100%		
Factory setting	{ 25 }		
Description	"*Switchover frequency VFC PMSM*". In order to immediately provide a minimum amount of torque in case of spontaneous load changes, and in particular for small frequencies, in VFC mode the setpoint of I_d (excitation current) is controlled depending on the frequency (field increase mode).		
	The value of this additional field current is determined by parameter **P210**. This reduces linearly to the value "zero", which is reached at the frequency that is governed by **P247**. In this case, 100% corresponds to the nominal frequency from **P201**. 		

5.1.4 Speed control

In connection with an HTL incremental encoder, a closed-loop speed control can be set up via the FI's digital inputs 2 and 3.

Alternatively, the incremental encoder signal can also be used for other purposes. The required function must then be selected in parameter **P325** .

The supervisor parameter **P003** = {2} or {3} must be set to make this parameter visible.

P300	**Servo Mode**		**P**
Setting range	0 … 2		
Factory setting	{ 0 }		
Description	Definition of the control method for the motor.		
Note	Commissioning information: (see chapter 4.3.1 "Explanation of the operating modes (P300)")).		
Setting values	**Value**	**Meaning**	
	0 Off (VFC open loop)	Field-oriented control without encoder feedback	
	1 On (CFC closed loop)	Speed control with encoder feedback	
	2 Obs (CFC open loop)	Observer-based speed control without encoder feedback (In the lower speed range: field-oriented control (VFC open-loop))	

Information

Operation of a synchronous motor with P300 { 1 } On (CFC closed loop)

When operating a synchronous motor in the CFC closed-loop mode, the slip error monitoring must be activated (**P327 ≠ 0 and P328 ≠ 0.0**).

P301	Incremental encoder
Setting range	0 … 19
Factory setting	{ 6 }
Description	"*Encoder resolution*". Input of the pulse count per rotation of the connected incremental encoder. If the direction of rotation of the encoder is not the same as the FI (depending on installation and wiring), this can be taken into account by selecting the corresponding negative pulse numbers.
Note	**P301** is also significant for position control via incremental encoders. If an incremental encoder is used for positioning **P604 = 0**, the setting of the pulse number is made here (see supplementary POSICON manual).
Setting values	

Value		Value	
0	500 pulses	8	-500 pulses
1	512 pulses	9	-512 pulses
2	1000 pulses	10	-1000 pulses
3	1024 pulses	11	-1024 pulses
4	2000 pulses	12	-2000 pulses
5	2048 pulses	13	-2048 pulses
6	4096 pulses	14	-4096 pulses
7	5000 pulses	15	-5000 pulses
		16	-8192 pulses
17	8192 pulses		
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.

P310	Speed controller P	P
Setting range	0 … 3200 %	
Factory setting	{ 100 }	
Description	P-component of the 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 Ctrl I	P
Setting range	0 … 800% ms^{-1}	
Factory setting	{ 20 }	
Description	I-component of the encoder (integration component). The integration component of the controller enables complete elimination of any control deviation. The value indicates how large the setpoint change is per millisecond. Values that are too small cause the controller to slow down (reset time is too long).	

P312	Torque curr. ctrl. P	S	P
Setting range	0 … 1000 %		
Factory setting	{ 400 }		
Description	Current controller for the torque current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. At low frequencies, excessively high values of **P312** generally result in high frequency oscillations. On the other hand, excessively high values of **P313** usually cause low frequency oscillations over the entire speed range If the value "Zero" is set in **P312** and **P313**, the torque current control is switched off. In this case, only the lead time for the motor model is used.		

P313	Torque curr. ctrl. I	S	P
Setting range	0 … 800% ms^{-1}		
Factory setting	{ 50 }		
Description	I component of the torque current controller (see **P312** “Torque curr. ctrl. P”).		

P314	Torq curr ctrl limit	S	P
Setting range	0 … 400 V		
Factory setting	{ 400 }		
Description	"*Torque curr. Ctrl. limit*". 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 range (see **P320**). The values for **P314** and **P317** should always be set approximately the same, so that the field and torque current controllers are balanced.		

P315	Field curr. ctrl. P	S	P
Setting range	0 … 1000 %		
Factory setting	{ 400 }		
Description	Current controller for the field current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. At low frequencies, excessively high values of **P315** generally result in high frequency oscillations. On the other hand, excessively high values of **P316** usually cause low frequency oscillations over the entire speed range The field current controller is switched off if the value "Zero" is entered in **P315** and **P316**. In this case, only the lead time for the motor model is used.		

P316	Field curr. ctrl. I	S	P
Setting range	0 … 800% ms^{-1}		
Factory setting	{ 50 }		
Description	I component of the field current controller (see **P315** “Field current controller P”).		

P317	Field curr ctrl lim	S	P
Setting range	0 … 400 V		
Factory setting	{ 400 }		
Description	"*Field curr. ctrl. limit*". Determines the maximum voltage increase of the field current controller. The higher the value, the greater the maximum effect of the field current controller. Excessive values in **P317** can specifically lead to instability during transition to the field weakening range (see **P320**). The values for **P314** and **P317** should always be set approximately the same, so that the field and torque current controllers are balanced.		

P318	P weak	S	P
Setting range	0 … 800 %		
Factory setting	{ 150 }		
Description	The field weakening controller reduces the field setpoint if the synchronous speed is exceeded. In the basic speed range, the field weakening controller has no function; for this reason, the field weakening controller only needs to be set if speeds above the nominal motor speed are set. Excessive values for **P318** / **P319** cause 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	I-Weak	S	P
Setting range	0 … 800% ms^{-1}		
Factory setting	{ 20 }		
Description	Only affects the field weakening range (see **P318** “P-Weak”).		

P320	Weak border	S	P
Setting range	0 … 110 %		
Factory setting	{ 100 }		
Description	The field weakening limit determines the speed /current at which the controller begins to weaken the field. At a set value of 100 % the controller begins 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**, the field weakening limit should be correspondingly reduced, so that the control range is actually available to the current controller.		

P321	Speed ctr. I brake off	S	P
Setting range	0 … 4		
Factory setting	{ 0 }		
Description	"*Speed control I brake off*". During the brake release time **P107** / **P114**, the I-component of the speed controller is increased. This leads to better load take-up, especially with vertical movements.		

Setting values

Value		Value	
0	P311 speed control I x 1		
1	P311 speed control I x 2	3	P311 speed control I x 8
2	P311 speed control I x 4	4	P311 speed control I x 16

P325	Function encoder	S	P
Setting range	0 … 4		
Factory setting	{ 0 }		
Description	The actual speed value supplied by an incremental encoder to the FI can be used for various functions in the FI.		

Setting values

Value		Meaning
0	Speedmeas. servomode	“*Servo mode speed measurement*”: The actual motor speed value is used for speed control with encoder feedback. The ISD control cannot be switched off in this function.
1	PID actual frequency	The actual speed value 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 evaluate an incremental encoder that is not mounted directly onto the motor for speed control. **P413** … **P416** govern the control.
2	Frequency addition	The determined speed is added to the current setpoint.
3	Freq. subtraction	The determined speed is subtracted from the current setpoint.
4	Maximum frequency	The maximum possible output frequency / speed is limited by the speed of the encoder.

P326	Ratio encoder	S
Setting range	0.01 … 100.00	
Factory setting	{ 1.00 }	
Description	"*Ratio encoder*". If the incremental encoder is not mounted directly onto the motor shaft, then the respectively correct ratio of motor speed to encoder speed must be set. $P236 = \frac{\text{Motor speed}}{\text{Encoder speed}}$	
Note	Not for **P325** = 0 "Speedmeas. servomode".	

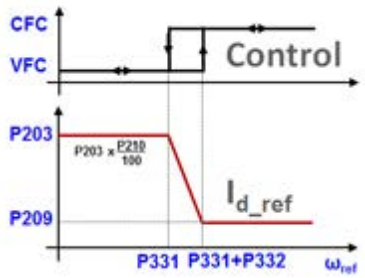
P327	Speed slip error	P
Setting range	0 … 3000 rpm	
Factory setting	{ 0 }	
Description	"*Slip error speed control*". The limit value for a permitted maximum slip error can be set. If this value is reached, the FI switches off and indicates an error message: • Limit value has been exceeded during operation: Error **E013.1**. Slip error monitoring functions with all control methods (**P300**).	
Note	If no limit values are parameterised in **P327** and **P328**, a mandatory limit becomes active (see *Default values mandatory limit*) while a PMSM is in closed-loop mode (**P300** = 1).	
	Default values mandatory limit • Speed slip limit (**P327 [-01]**): 500 rpm • Speed slip delay (**P328 [-01]**) 0.5 s	
Setting values	0 = OFF	

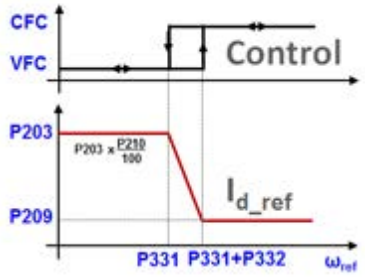
P328	Speed slip delay	P
Setting range	0.0 ... 10.0 s	
Factory setting	{ 0.0 }	
Description	"*Slip error delay*". If the permissible slip error defined in **P327** is exceeded, the error message **E013.1** is suppressed within the time limits which are set here.	
Setting values	0.0 = Off	

P330	Ident startrotor pos	S	P
Setting range	0 … 6		
Factory setting	{ 1 }		
Description	"*Rotor starting position detection* ". 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 = 1**).		

Setting values

Value	Meaning
0	**Voltage controlled**: With the first start of the motor, a voltage indicator is memorised to ensure that the rotor of the motor is set to the rotor position "zero". This type of identifying starting position of the rotor can only be used if there is no counter-torque from the motor (e.g. flywheel drive) at frequency "zero". If this condition is fulfilled, this method of identifying the position of the rotor is very accurate (<1° electrical). This method is unsuitable for lifting equipment applications, as there is always a counter-torque. For operation without encoders: Up to the switch-over frequency **P331** the motor (with the nominal current memorised) is operated under voltage control. Once the switch-over frequency has been reached, the method for identifying the rotor position is switched over to the EMF method. If hysteresis (**P332**) is taken into 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. If this method is also to be used at a standstill with the brake applied, a PMSM with sufficient anisotropy between the inductance of the d and q axes is required. The greater this anisotropy is, the greater the precision of the method. With parameter **P212** the voltage level of the test signal can be changed and the rotor position controller can be adjusted with parameter **P333**. 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). The conditions for activating the test signal method can be selected with **P336**.
3	**Value CANopen enc.,** *"Value from CANopen encoder"*: This method determines the rotor starting position from the absolute position of a CANopen absolute encoder. The CANopen absolute encoder type is set in parameter **P604**. The CANopen absolute encoder should be located on the motor shaft. 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 ratio must be stored in parameter **P334** "*Encoder offset PMSM*". If this offset value is not available on the motor, it can also be determined with parameter **P330 = 0** and **P330 = 1**. After the first start, the determined offset value is available in parameter **P334**. This value is volatile, i.e. it is only stored in the RAM. In order to save it in 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 running under no load. For this, the drive is operated in closed-loop mode (**P300 = 1**) at as high a speed as possible but below the field weakening point. From the starting point, the offset is gradually adjusted so that the value of the voltage component Ud (**P723**) is as close as possible to zero. A balance between the positive and negative direction of rotation should be sought. In general, the value "0" cannot be achieved, as the synchronous motor has a slight load due to the fan wheel at high speeds.
4	**voltage control cycl** *"Voltage control, cyclically.* Same as **P330 = 0**, but taking into account the zero track of the encoder. Evaluation of the zero track is activated via **P420** "Digit inputs". With incremental encoders as encoders with zero track, the position of the zero track is aligned with the magnet position "0" of the motor during the production of NORD motors Therefore, after the first time that the zero pulse is reached, the inverter adopts this value as a reference value and thus achieves a high precision. This achieves optimum use of current per torque or optimum efficiency of the motor. Whether the zero track is only to be evaluated once or after each enable can be set via **P420**.
5	**Testsignal cycl.**: Same as **P330 = 1**, but taking into account the zero track of the encoder. Evaluation of the zero track is activated via **P420** "Digit inputs".
6	**value CANopen.cycl**, *"Value from CANopen encoder cyclically":* Same as **P330 = 4**, but the starting position of the rotor is determined with each enable.

P331	Switch over freq.	S	P
Setting range	5.0 ... 100.0%		
Factory setting	{ 15.0 }		
Description	"*Switchover frequency CFC open-loop*": For **P300 = 2**: Definition of the frequency above which, in operation without encoder, the control method is activated according to **P300**.		
Note	• 100% corresponds to the nominal frequency from **P201**. • The parameter is only relevant for: **P300 = 2**.		

P332	Hyst.Switchover Freq	S	P
Setting range	0.1 ... 25.0%		
Factory setting	{ 5.0 }		
Description	"*Hysteresis switchover frequency CFC open-loop*". Difference between the switch-on and switch-off point in order to prevent oscillation on transition of operation without encoder to the control method specified in **P330** (and vice versa).		

P333	Flux feedb.fact.PMSM	S	P
Setting range	5 ... 400%		
Factory setting	{ 25 }		
Description	"*Flux feedback CFC open-loop*". 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 also 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.		
Note	The default value is selected so that it typically does not need to be adjusted for NORD synchronous motors.		

P334	Encoder offset PMSM	S	P
Setting range	-0.500 ... 0.500 rev		
Factory setting	{ 0.000 }		
Description	Evaluation of the zero track is necessary for closed-loop operation of PMSMs (Permanent Magnet Synchronous Motors) with incremental encoders. The zero pulse is then used for synchronisation of the rotor position. 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. Enter the electrical angle here. The mechanical angle then results in $\frac{P334\ x\ 360°}{Number\ of\ pole\ pairs}$.		
Note	NORD motors are delivered so that the zero pulse of the encoder corresponds to the zero pole position of the motor. In case of deviation, this can be obtained from an adhesive label on the motor.		

P336	Mode Rotorpos ident	S	P
Setting range	0 ... 2		
Factory setting	{ 0 }		
Description	*“Mode of identification of the starting conditions”.* This parameter has a double function. ***Function 1:*** Definition of the mode for the rotor position identification of a synchronous motor (PMSM). The precise position of the rotor must be known in order to operate a PMSM. This can be determined by various methods according to the “setting values”. ***Function 2:*** Definition of the mode for determining the approximate motor start temperature in connection with I²t monitoring according to parameter **P535**.		
Note	Use of the parameter for rotor position identification (function 1) is only advisable if the test signal method is set (**P330**). Use of the parameter for determining the approximate motor start temperature (function 2) is only advisable if I²t monitoring is active (**P535**).		
Setting values	**Value** / **Meaning**		
	0 – First enable: Identification of the PMSM rotor position or determination of the approximate motor start temperature is performed when the drive is enabled for the first time.		
	1 – Supply voltage: Identification of the PMSM rotor position or determination of the approximate motor start temperature is performed when the supply voltage is applied for the first time.		
	2 – DIN/BUS IO IN: Identification of the PMSM rotor position or determination of the approximate motor start temperature is triggered by an external order by means of a binary bit (digital input (**P420**)) or Bus-In-Bit (**P480 = 79**). Identification of the rotor position is only performed if the frequency inverter is in the “Ready to switch-on” status and the rotor position is not known (see **P434**, **P481 = 28**).		

P337	Rot pos Z-track sync	S
Setting range	0 … 1	
Factory setting	{ 0 }	
Description	*“Rotor position Z-track synchronisation”.* Evaluation of the encoder’s zero track for synchronisation of the rotor position.	
Note	If the function { 42 } or { 43 } is parameterised in parameter **P420** for the evaluation of the zero track, it is irrelevant which setting has been selected in parameter **P337**. The evaluation of the zero track is active in any case.	
Setting values	**Value** / **Meaning**	
	0 – Off: No function	
	1 – On: Evaluation of the zero track is activated.	

P350	PLC functionality
Setting range	0 … 1
Factory setting	{ 0 }
Description	Activation of the integrated PLC
Setting values	**Value** / **Meaning**
	0 – Off: The PLC is not active, control of the device is via IOs or switch options (see option slot **H1** / **H2**)
	1 – On: The PLC is active, device is actuated via the PLC, depending on **P351**.

P351	**PLC set val. select.**
Setting range	0 … 3
Factory setting	{ 0 }
Description	Selection of the source for the control word (CTW) and the main setpoint (MSW) with active PLC functionality (**P350 = 1**). With the settings **P351 = 0** and **P351 = 1**, the main setpoints are defined via **P553**, but the definition of the auxiliary setpoints remains unchanged via **P546**. This parameter is only applied if the frequency inverter is in “Ready to switch-on” status.

Setting values

Value		Meaning
0	STW & HSW = PLC	The PLC provides the control word (CTW) and the main setpoint (MSW) Parameters **P509** and **P510 [-01]** have no function.
1	CTW = P509	The PLC provides the main setpoint (MSW) The control word source (CTW) corresponds to the setting in parameter **P509**.
2	MSW = P510[1]	The PLC provides the control word (CTW) The source for the main setpoint (MSV) corresponds to the setting in parameter **P510[-01]**.
3	CTW & MSW = P509/510	The source for the control word (CTW) and the main setpoint (MSW) corresponds to the setting in parameter **P509 / P510 [-01]**.

P353	Bus status via PLC	
Setting range	0 … 3	
Factory setting	{ 0 }	
Description	This parameter decides whether the control word for the master function and the status word of the frequency inverter are further processed by the PLC.	
Setting values	**Value**	**Meaning**
	0 Off	Control word for the master function **P503 ≠ 0** and the status word continue to be processed by the PLC.
	1 CTW for broadcast	The control word 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 STW for bus	The status word 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 CTW broadcast&STWbus	See **P353 = 1** and **P353 = 2**

P355	PLC Integer setvalue
Setting range	-32768 … 32767
Arrays	[-01] … [-10]
Factory setting	All { 0 }
Description	Data can be exchanged with the PLC via this INT array. This data can be used by the corresponding process variables in the PLC.

P356	PLC long setvalue
Setting range	-2 147 483 648 … 2 147 483 647
Arrays	[-01] … [-05]
Factory setting	All { 0 }
Description	Data can be exchanged with the PLC via this DINT array. This data can be used by the corresponding process variables in the PLC.

P360	PLC display value
Display range	-2 147 483.648 … 2 147 483.647
Arrays	[-01] … [-05]
Factory setting	All { 0.000 }
Description	Display of PLC data. The arrays of the parameter can be described by the PLC through corresponding process variables. The values are not saved!

P370	PLC status	
Display range	0000h … FFFFh	0000 0000 0000 0000b … 1111 1111 1111 1111b
Description	Display of the current PLC status.	
Display values	**Value**	**Meaning**
	Bit 0 **P350 = 1**	**P350** has been set to the function “Activate internal PLC”.
	Bit 1 PLC active	The internal PLC is active
	Bit 2 Stop active	The PLC program is set to “Stop”
	Bit 3 Debug active	Debugging of the PLC program is running.
	Bit 4 PLC Fault	The PLC has an error. However, PLC user errors 23.xx are not displayed here.
	Bit 5 PLC stopped	The PLC program has been stopped (single step or breakpoint)
	Bit 6 Using scope memory	A function block is using the memory area for the oscilloscope function of the NORDCON software. The oscilloscope function cannot be used.

5.1.5 Control terminals

P400	**Setpoint I/P Funct**		**P**
Setting range	0 … 36		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter	
	[-03] = Ext. Analogue in 1	*"External analogue input 1".* Analogue input 1 of the first I/O extension (SK xU4-IOE)	
	[-04] = Ext. Analogue in 2	*"External analogue input 2".* Analogue input 2 of the first I/O extension (SK xU4-IOE)	
	[-05] = Setpoint module		
	[-06] = Reserved	---	
	[-07] = Digital input 3	The input can be set to pulse signal evaluation via **P420 [-03] = 26** or **P420 [-03] = 27**. The pulses can then be evaluated as an analogue signal in the FI according to the function set here.	
	[-08] = Ext.AI 1 2.IOE	*"External analogue input 1, 2nd IOE"*, analogue input 1 of the second I/O extension (SK xU4-IOE) (= analogue input 3)	
	[-09] = Ext.AI 2 2.IOE	*"External analogue input 2, 2nd IOE"*, analogue input 2 of the second I/O extension (SK xU4-IOE) (= analogue input 4)	
Factory setting	[-05] and [-07] = { 1 }	All others { 0 }	
Description	"*Setpoint input function*". Assignment of analogue functions to internal analogue inputs or the analogue inputs of optional modules.		

Setting values

Value		**Description**
00	Off	The analogue input has no function. After the FI has been enabled via the control terminals, it supplies the set minimum frequency **P104**.
01	Set point frequency	The specified analogue range (matching of analogue input) varies the output frequency between the set minimum and maximum frequencies **P104 / P105**.
02	Frequency addition [2]	The supplied frequency value is added to the setpoint.
03	Frequency subtract. [2]	The supplied frequency value is subtracted from the setpoint.
04	Minimum frequency	Setting of the frequency inverter's minimum frequency Lower limit value: 1 Hz Scaling: 0 … 100% of **P104**
05	Maximum frequency	Setting of the frequency inverter's maximum frequency Lower limit value: 2 Hz Scaling: 0 … 100% of **P105**
06	Cur.val process ctrl [1]	Activates the process controller. The analogue input is connected to the actual value encoder (compensator, pressurised can, flow volume meter, etc.). The mode is set via DIP switches of the I/O extension or set in **P401**.
07	Nom.val process ctrl [1]	Same as **P400 = 6**, but the setpoint is specified (e.g. by a potentiometer). The actual value must be specified using another input.
08	PI current freq. [1]	Needed to set 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 values **P413** ... **P414**).
09	PI ltd.current.freq [1]	Same as **P400 = 8**, but the output frequency cannot drop below the programmed "Minimum frequency" value in parameter **P104**. (No phase sequence reversal)
10	PI suprvsd.cur.freq [1]	Same as **P400 = 8**, but the FI switches off the output frequency when the minimum frequency **P104** is reached.
11	Torque current limit	*"Limiting torque current limit",* depends on parameter **P112**. This value corresponds to 100% setpoint. Achieving the set limit value results in an output frequency reduction on the torque current limit.

12	Torqu.curr.limit off	*"Switching-off torque current limit",* depends on parameter **P112.** This value corresponds to 100% setpoint. Achieving the set limit value results in switch-off with error code **E12.3**.
13	Current limit	*"Limiting current limit",* depends on parameter **P536.** This value corresponds to 100% setpoint. Achieving the set limit value results in an output voltage reduction to limit the output current.
14	Current limit off	*"Switching-off current limit",* depends on parameter **P536.** This value corresponds to 100% setpoint. Achieving the set limit value results in switch-off with error code **E12.4**.
15	Ramp time	Normally only used in conjunction with a potentiometer. Lower limit value: 50 ms Scaling: T_Ramp time = 10 s*U[V] / 10 V (U = Potentiometer voltage)
16	Pre-tension Torque	The function enables a value for the torque requirement to be entered in the controller beforehand (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring.
17	Multiplication	The setpoint is multiplied by the supplied analogue value. Here, the analogue value adjusted to 100% corresponds to a multiplication factor of 1.
18	Curve control	The master receives the current speed from the slave via the external analogue input **P400 [-03]** or **P400 [-04]**, or via a bus system **P546 [-01 … -03]**. From its own speed, the speed of the slave and the specified speed, the master calculates the current setpoint speed so that neither of the two drives travels faster than the specified speed in the curve.
19	Servo-Mode Torque	Setting also enables a torque mode without encoder in VFC mode, suitable for simple tension control, for example.
25	Ratio gearing	*"Ratio gearing"* is a multiplier for the consideration of a dynamic setpoint ratio. E.g.: Setting a speed ratio between master and slave using a potentiometer
26	Set position	tbd
30	Motor temperature	Motor temperature measurement with temperature sensor (e.g. KTY-84), see Section 4.4 "Temperature sensors"for details.
33	Setval.torque p.reg.	*"Setpoint Torque Process controller"*: For the even distribution of torques to coupled drives (e.g. S-roller drive). This function is also possible when using the ISD control.
34	d-corr. F Process	*"Diameter correction, PI process controller frequency"*
35	d-corr. Torque	*"Diameter correction, torque"*
36	d-corr. F+Torque	*"Diameter correction, PI process controller frequency and torque"*

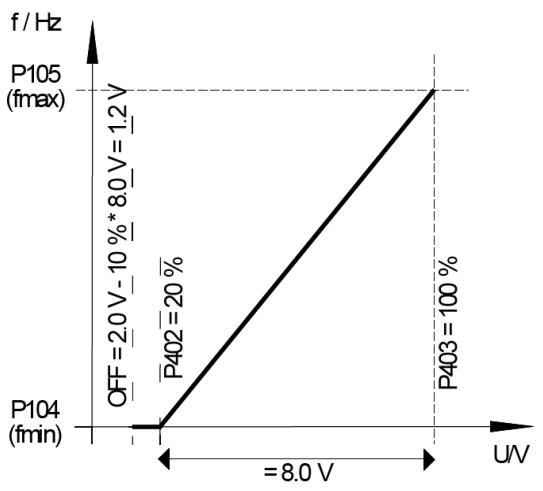
1 Process controller details: **P400** and (Chap. 8.2 "Process controller").

2 The limits of these values are set by parameter **P410** *"Minimal frequency auxiliary setpoints"* and parameter **P411** *"Maximum frequency auxiliary setpoints"*.

Note: Overview of scaling (see chapter 8.10 "Scaling of set-/actual values").

P401	**Mode analog in**		**S**
Setting range	0 … 5		
Arrays	[-01] = Ext. Analogue in 1	AIN1 of the first I/O extension	
	[-02] = Ext. Analogue in 2	AIN2 of the first I/O extension	
	[-03] = Ext.AI 1 2.IOE	*"External analogue input 1, 2nd IOE"*, AIN1 of the second I/O extension	
	[-04] = Ext.AI 2 2.IOE	*"External analogue input 2, 2nd IOE"*, AIN2 of the second I/O extension	
	[-05] = Analogue input 1	Analogue input 1 of the frequency inverter	
	[-06] = Analogue input 2	Analogue input 2 of the frequency inverter	
Factory setting	All { 0 }		
Description	"*Analogue input mode*". This parameter determines how the frequency inverter is to respond to an analogue signal which is less than the 0% adjustment (**P402**).		

Setting values

Value	Function	Description
0	0 - 10 V limited	An analogue setpoint smaller than the programmed adjustment 0% (**P402**) does not result in undershooting of the programmed minimum frequency **P104**, i.e. it does not result in a change in the direction of rotation.
1	0 - 10 V	If a setpoint smaller than the programmed adjustment 0% (**P402**) is present, then this can cause a change in the direction of rotation. This allows rotation direction reversal using a simple voltage source and potentiometer. E.g. internal setpoint with reversal of direction of rotation: **P402 = 50 %**, **P104 = 0 Hz**, potentiometer 0 … 10 V → Change in the direction of rotation at 5 V in mid-range setting of the potentiometer. At the moment of reversing (**hysteresis = ± P505**), the drive is at a standstill if the minimum frequency **P104** is smaller than the absolute minimum frequency **P505**. A brake that is controlled by the FI will be applied in the hysteresis range. If the minimum frequency **P104** is greater than the absolute minimum frequency **P505**, the drive reverses when the minimum frequency is reached. In the hysteresis range **± P104**, the FI supplies the minimum frequency **P104**; the brake controlled by the FI is not applied.
2	0 - 10 V controled	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. **Note**: A function for the relevant input must be assigned 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 range, 0.6 ... 1 V = minimum frequency setpoint, below 0.6 V (2.4 mA) the output is switched off.

3	-10V - 10V	If a setpoint smaller than the programmed “adjustment 0% “(**P402**) is present, this may cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer. E.g. internal setpoint with reversal of direction of rotation: **P402 = 50 %**, **P104 = 0 Hz**, potentiometer 0 … 10 V → Change in the direction of rotation at 5 V in mid-range setting of the potentiometer. At the moment of reversing (**hysteresis = ± P505**) the drive is at a standstill if the minimum frequency **P104** is smaller than the absolute minimum frequency **P505**. A brake which is controlled by the FI has not been applied in the hysteresis range. If the minimum frequency **P104** is greater than the absolute minimum frequency **P505**, the drive reverses when the minimum frequency is reached. In the hysteresis range **± P104**, the FI supplies the minimum frequency **P104**; the brake controlled by the FI is not applied. **NOTE**: The function -10 V … 10 V is a description of the method of function and not a reference to a physical bipolar signal (see example above).
4	0-10V with error 1	“*0 - 100 % with error switch-off 1*”: If the value of the 0% adjustment value in **P402** is undershot, the error message **E12.8** “*AI minimum undershot*” is activated. If the value of the 100% adjustment value in **P403** is exceeded, the error message **E12.9** “*AI maximum exceeded*” is activated. Even if the analogue value is outside the limits defined in **P402** and **P403**, the setpoint 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 control takes place via a field bus, for example, and the analogue input is not controlled.
5	0-10V with error 2	“*0 - 100 % with error switch-off 2*”: See **P401 = 4**, 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**.

Information

Use of DIP switches

If the device was ordered with an IO extension SK CU4-IOE, the DIP switches on the IO extension are configured according to the customer's requirements on delivery.

Subsequent changes to the settings are no longer possible after delivery.

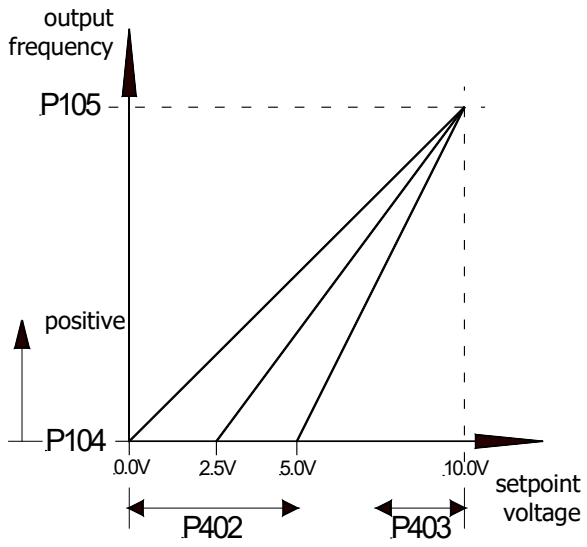
P402	**Adjust: 0%**		**S**
Setting range	-50.00 ... 50.00 V		
Arrays	[-01] = Ext. Analogue in 1	AIN1 of the first I/O extension	
	[-02] = Ext. Analogue in 2	AIN2 of the first I/O extension	
	[-03] = Ext.AI 1 2.IOE	*"External analogue input 1, 2nd IOE"*, AIN1 of the second I/O extension	
	[-04] = Ext. A. in.1 2.IOE	*"External analogue input 2, 2nd IOE"*, AIN2 of the second I/O extension	
	[-05] = Analogue input 1	Analogue input 1 of the frequency inverter	
	[-06] = Analogue input 2	Analogue input 2 of the frequency inverter	
Factory setting	All { 0.00 }		
Description	This parameter sets the voltage that should correspond with the minimum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint), this value corresponds to the setpoint that is set in **P104** "*Minimum frequency*".		
Note	When using the SK xU4-IOE, scaling to typical signals, such as 0(2) … 10 V or 0(4) … 20 mA, is carried out via DIP switches on the I/O extension module. Additional adjustment of parameters **P402** and **P403** is therefore not required for these cases.		

P403	**Adjust: 100%**		**S**
Setting range	-50.00 ... 50.00 V		
Arrays	[-01] = Ext. Analogue in 1	AIN1 of the first I/O extension	
	[-02] = Ext. Analogue in 2	AIN2 of the first I/O extension	
	[-03] = Ext.AI 1 2.IOE	*"External analogue input 1, 2nd IOE"*, AIN1 of the second I/O extension	
	[-04] = Ext. A. in.1 2.IOE	*"External analogue input 2, 2nd IOE"*, AIN2 of the second I/O extension	
	[-05] = Analogue input 1	Analogue input 1 of the frequency inverter	
	[-06] = Analogue input 2	Analogue input 2 of the frequency inverter	
Factory setting	All { 10.00 }		
Description	This parameter sets the voltage that should correspond with the maximum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint), this value corresponds to the setpoint that is set in **P105** "*Maximum frequency*".		
Note	When using the SK xU4-IOE, scaling to typical signals, such as 0(2) … 10 V or 0(4) … 20 mA, is carried out via DIP switches on the I/O extension module. Additional adjustment of parameters **P402** and **P403** is therefore not required for these cases.		

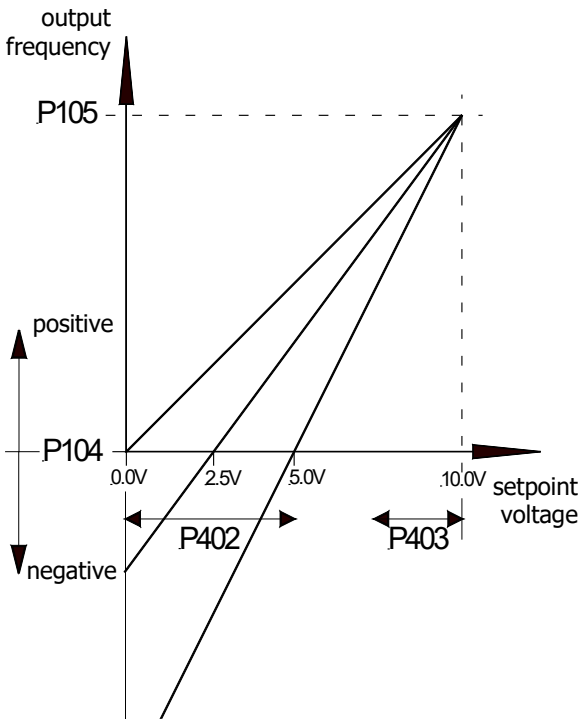
P404	Analog input filter		S
Setting range	10 ... 400 ms		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter	
Factory setting	All { 100 }		
Description	Adjustable digital low-pass filter for the analogue signal. Interference peaks are hidden, the response time is extended.		
Note	The filter time of the analogue inputs of the optional, external IO extension modules is set in the parameter set of the respective module **P161**.		

P400 ... P403

P401 = 0 → 0 - 10V limited



P401 = 1 → 0 - 10V not limited



P410	Min. freq. aux. setpoint	P
Setting range	-400.0 ... 400.0 Hz	
Factory setting	{ 0.0 }	
Description	"*Minimum frequency auxiliary setpoints*". 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 via analogue setpoint (potentiometer)	

P411	Max. freq. a-in 1/2		P
Setting range	-400.0 ... 400.0 Hz		
Factory setting	{ 50.0 }		
Description	"*Maximum frequency auxiliary setpoints*". 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 • Max. frequency via analogue setpoint (potentiometer)		

P412	Nom.val process ctrl	S	P
Setting range	-10.0 ... 10.0 V		
Factory setting	{ 5 }		
Description	"*Process controller setpoint*". Fixed specification of a setpoint for the process controller that will only be occasionally altered. Only with **P400 = 14 ... 16** (process controller), (see chapter 8.2 "Process controller").		

P413	PI-control P comp.	S	P
Setting range	0.0 ... 400.0%		
Factory setting	{ 10.0 }		
Description	This parameter is only effective when the function *"PI current freq."* 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 controller deviation of 50%, 5% is added to the actual setpoint.		

P414	PI-control I comp.	S	P
Setting range	0.0 ... 3000.0% s^{-1}		
Factory setting	{ 10.0 }		
Description	This parameter is only effective when the function *"PI current freq."* is selected. The I-component of the PI controller determines the frequency change depending on time.		
Note	Compared to some other series from NORD, parameter **P414** is smaller by a factor of 100 (reason: better setting options for small I components).		

P415	PID control D comp.	S	P
Setting range	0 ... 400.0%		
Factory setting	{ 10.0 }		
Description	This parameter is only effective when the function *"PI current freq."* is selected. It determines the controller limitation (%) after the PI controller. For further details see (chapter 8.2)		

P416	Ramptime PI setpoint	S	P
Setting range	0.00 ... 99.99 s		
Factory setting	{ 2.00 }		
Description	"*Ramp time PI setpoint*". This parameter is only effective when the function *"PI current freq."* is selected. Ramp for PI setpoint		

P417	Offset analog output		S	P
Setting range	-10.0 ... 10.0 V			
	[-01] = IOE-1	*"External analogue output of the 1st IOE".* Analogue output of the first IO extension		
	[-02] = IOE-2	*"External analogue output of the 2nd IOE".* Analogue output of the second IO extension		
Scope of application	Only in connection with SK CU4-IOE or SK TU4-IOE			
Factory setting	All { 0.0 }			
Description	In the "*Offset analog output*" function, an offset can be set in order to simplify processing of the analogue signal in further devices. 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	Analog output func.			P
Setting range	0 ... 60			
	[-01] = IOE-1	*"External analogue output of the 1st IOE".* Analogue output of the first IO extension		
	[-02] = IOE-2	*"External analogue output of the 2nd IOE".* Analogue output of the second IO extension		
Scope of application	Only in connection with SK CU4-IOE or SK TU4-IOE			
Factory setting	All { 0 }			
Description	"*Analogue output function*".(Max. load: 5 mA analogue, 20 mA digital)**:** An analogue voltage (0 … 10 V) can be obtained at the control terminals (max. 5 mA). Various functions are available, where the following basically applies: • 0 V analogue voltage always corresponds to 0% of the selected value. 10 V always corresponds to the nominal motor value (unless otherwise • stated) multiplied by the **P419** scaling factor, e.g.: $\Rightarrow 10\ \mathrm{V} = \frac{\text{Motor rating value} \bullet \text{P419}}{100\%}$			
Note	For analogue functions, the maximum load is 5 mA.			
Setting values	**Value**	**Description**		

00	No function	No output signal at terminals.
01	Actual frequency [1]	The analogue voltage is proportional to the device output frequency. (**100% = P201**)
02	Actual speed [1]	This is the synchronous speed calculated by the device based on the present 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**)
03	Current [1]	The effective value of the output current supplied by the device. (**100% = P203**)
04	Torque current [1]	Displays the motor load torque calculated by the device. (**100% = P112**).
05	Voltage [1]	The output voltage supplied by the device. (**100% = P204**)
06	D.c. link voltage	"*DC link voltage*". The DC voltage in the device. This is not based on the nominal motor data. 10 V with 100% standardisation, corresponds to 450 V DC (230 V mains) or 850 VDC (480 V mains)!
07	Value of P542	The analogue output can be set independently of the actual operating status of the device using parameter **P542**. With bus control, e.g. an analogue value from the controller can be directly tunnelled to the analogue output of the device.
08	Apparent power [1]	The current apparent power calculated by the device. (**100% = P203*P204** or **= P203*P204*√3**)
09	Real Power [1]	The current effective power calculated by the device. (**100% = P203*P204*P206** or **= P203*P204*P206*√3**)

10	Torque [%] [1]	The current torque calculated by the device. (100% = nominal motor torque)
11	Field [%] [1]	The current field in the motor calculated by the device.
12	Actual frequency ± [1]	The analogue voltage is proportional to the output frequency of the device, whereby the zero point is shifted to 5 V. For CW direction of rotation, values from 5 V to 10 V are output, and for CCW direction of rotation, values from 5 V to 0 V.
13	Speed ± [1]	The synchronous rotation speed calculated by the device based on the present setpoint, whereby the zero point has been shifted to 5 V. For CW direction of rotation, values from 5 V to 10 V are output, and for CCW direction of rotation, values of 5 V to 0 V. The measured speed is output via this function if servo mode is used.
14	Torque [%] ± [1]	Is the current torque calculated by the device, whereby the zero point is shifted to 5 V. For motor torques, values between 5 V and 10 V are output, and for generator torque, values between 5 V and 0 V.
29	Current position	Reserved POSICON
30	Set freq. befor ramp	"*Setpoint frequency before ramp*". Displays the frequency produced by any upstream controllers (ISD, PID, etc.). This is then the setpoint frequency for the power level after it has been adjusted by 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	Set freq Motorpot	*"Motor potentiometer setpoint frequency"*
60	Value of PLC	The analogue output is set by the integrated PLC, independently of the current operating status of the FI.

1 Values are based on the motor data (**P201** ...) or have been calculated from them.

P419	**Analog output scal.**		**S**	**P**
Setting range	-500 ... 500%			
	[-01] = IOE-1	*"External analogue output of the 1st IOE".* Analogue output of the first IO extension		
	[-02] = IOE-2	*"External analogue output of the 2nd IOE".* Analogue output of the second IO extension		
Factory setting	All { 100 }			
Description	"*Scaling of analogue output*". Analogue functions **P418** (= 0 ... 6 and 8 … 14, 30) Using this parameter, the analogue output can be adjusted to the selected operating range. The maximum analogue output (10 V) corresponds to the scaled value of the appropriate selection. Therefore, if this parameter is raised from 100% to 200% at a constant operating point, the analogue output voltage is halved. 10 V 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	Digital inputs		
Setting range	0 … 80		
Arrays	[-01] = Digital input 1	Digital input 1 (DIN1) integrated into the device	
	[-02] = Digital input 2	Digital input 2 (DIN2) integrated into the device	
	[-03] = Digital input 3	Digital input 3 (DIN3) integrated into the device	
	[-04] = Digital input 4	Digital input 4 (DIN4) integrated into the device	
	[-05] = Digital input 5	Digital input 5 (DIN5) integrated into the device	
	[-06] = Digital fct Analog 1	Analogue input 1 (DIN6 / AIN1) (digital function) integrated into the device	
	[-07] = Digital fct Analog 2	Analogue input 2 (DIN7 / AIN2) (digital function) integrated into the device	
Factory setting	[-01] … [-04] = { 0 }	[-05] … [-07] = { x }	x = depends on the configuration level (🕮 2.2.2.1 "Configuration of option slots of the control level"
Description	Due to an “OR” linking between the parameterised functionalities and the encoder evaluation, which is always active in the inverter, it is absolutely necessary that the digital inputs **DIN2** and **DIN3** are deactivated when using an encoder (parameter (**P420 [-02, -03]**)). The additional digital inputs of the I/O extensions (SK xU4-IOE) are managed via parameter “Bus I/O In Bit (4…7)” - (**P480 [-05]** … **[-08]**) for the first I/O extension and via 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 device 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.		
	The default values of parameter **P420 [-05]**, **[-06]** and **[-07]** depend on the control elements that are available on option slots **H1** and **H2** 🕮 .		
	Function 42 / 43 With firmware version V 2.0 R0 and higher, the synchronisation of an HTL encoder’s zero track is activated via parameter **P337**. Parameterisation **P420 [-01]** = 42 or 43 is therefore not required. Digital input 1 is available for parameterisation of other functions. For reasons of compatibility with older firmware versions, the synchronisation of an HTL encoder’s zero track can still be activated via **P420 [-01]** = 42 or 43.		

Setting values

Value		Description	Signal
00	No function	Input switched off.	---
01	Enable right	The device delivers an output signal with the rotating field “right” if a positive setpoint is present. 0 → 1 edge (**P428 = 0**)	High
02	Enable left	The device delivers an output signal with the rotating field “left” if a positive setpoint is present. 0 → 1 edge (**P428 = 0**)	High

Note
If the drive is to start up automatically when the mains voltage is switched on (**P428 = 1**) a permanent high level for enabling must be provided. If the functions “Enable right” and “Enable left” are controlled simultaneously, the device is blocked.
If the device is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a 1 → 0 edge.

03	Phase seq. reversal	Causes the rotating field to change direction (combined with enable “right” or “left”).	High
04 [1]	Fixed frequency 1	The frequency from **P465 [-01]** is added to the current setpoint.	High
05 [1]	Fixed frequency 2	The frequency from **P465 [-02]** is added to the current setpoint.	High
06 [1]	Fixed frequency 3	The frequency from **P465 [-03]** is added to the current setpoint.	High
07 [1]	Fixed frequency 4	The frequency from **P465 [-04]** is added to the current setpoint.	High
Note If several fixed frequencies are controlled simultaneously, they are added with the correct sign. In addition, the analogue setpoint (**P400**) and, if necessary, the minimum frequency (**P104**) are added.			
08 [5]	Param. set switching	*“Parameter set switching 1“*: First bit of the parameter set switching, selection of the active parameter set 1 … 4 (**P100**).	High
09	Maintain the freq.	During the acceleration or deceleration phase, a “Low” level will cause the actual output frequency to be “maintained”. A “High” level allows the ramp to continue.	Low
10 [2]	Voltage disable	The frequency inverter output voltage is switched off; the motor runs down freely.	Low
11 [2]	Quick stop	The device reduces the frequency according to the quick stop time from **P426**.	Low
12 [2]	Fault acknowledgem.	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 edge
13 [2]	PTC resistor input	Analogue evaluation of the signal applied. Switching threshold approx. 2.5 V, switch-off delay = 2 s, warning after 1 s. There are separate connections to terminals 38 and 39 which cannot be disabled. If the motor is not equipped with a PTC resistor, both terminals must be bridged in in order to deactivate the function (status as delivered).	Level
14 [2.4]	Remote control	With bus system control, Low level switches the control to control via control terminals.	High
15 [1]	Jog frequency	The fixed frequency value can be adjusted using the HIGHER/LOWER and ENTER keys (**P113**), if control is via the ControlBox or ParameterBox.	High
16	Motor potentiometer	As for setting value {09}, however, the frequency is not maintained below the minimum frequency **P104** and above the maximum frequency **P105**.	Low
17 [5]	ParaSetSwitching 2	Second bit of the parameter set switching, selection of the active parameter set 1 … 4 (**P100**).	High
18 [2]	Watchdog	The input must see a high edge cyclically (**P460**), otherwise error **E012** will cause a switch-off. The function starts with the 1st high edge.	0→1 edge
19	Setpoint 1 on / off	Switch-on and switch-off of analogue input 1/2 (High = ON) The Low signal sets the analogue input to 0% which does not lead to shutdown when the minimum frequency **P104** > than the absolute minimum frequency **P505**.	High
20	Setpoint 2 on / off		High
21	Reserved	---	
22	Reserved	Reserved for POSICON.	
…			
25			

Note
The functions { 26 } … { 27 } can only be used for digital input **3 (P420 [-03]**).

26	Analog fct. Dig 3	With this setting, pulses which are proportional to an analogue signal can be evaluated using **DIN 3**. The function of this signal is determined in parameter **P400 [-06]** or **[-07]**. The conversion of 0-10 V to pulses can be carried out via customer unit SK CU/TU4-24V-... 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 < 5 V.	Pulses ≈ 1.6-16 kHz
27	A.fct.2-10V Dig.3		
28	A.fct.5-10V Dig.3		
29	Enable SK SSX-box	The enable signal is delivered by the *Simple Setpoint Box* (setpoint unit) SK SSX-3A. Hereby, the unit must be operated in **IO-S** mode. 🕮 BU0040	
30	Inhibit PID	Switches the PID controller / process controller function on and off (High = PID ON)	Low
31 [2.6]	Inhibit turn right	Blocks *"Enable right/left"* via a digital input or bus control. Does not depend on the actual direction of rotation of the motor (e.g. following negated setpoint).	Low
32 [2.6]	Inhibit turn left		Low
33	Enable jog right	Parameterisation of the corresponding inputs with these functions determines the jog frequency and direction which is enabled.	High
34	Enable jog left		High
36	Jog freq selection		High

Function			Resulting function
33	34	36	
x	-	-	Enable right, jog frequency 1 (**P113[-01]**)
x	-	x	Enable right, jog frequency 2 (**P113[-02]**)
-	x	-	Enable left, jog frequency 1 (**P113[-01]**)
-	x	x	Enable left, jog frequency 2 (**P113[-02]**)

35	2nd jog freq	Frequency value from (**P113 [-02]**) If the device is operated with jog frequency, any active bus control is disabled.	High
37 [2, 4]	Manual control	With bus system control, a High level switches to control via the control terminals.	High
42	0-track HTL cycl DI1	Activates the evaluation of the zero track of an encoder. Synchronisation to zero pulse after each enabling.	High
43	0-pulse HTL enc. DI1	Activates the evaluation of the zero track of an encoder. Synchronisation to zero pulse after first enabling after "Power ON".	High
44	3-Wire-Direction	"*3-Wire-Control*". This control function provides an alternative to "Enable right"/"Enable left" {01, 02}, for which permanently applied levels are required. Here, only a control pulse is required to trigger the function. Control of the device can therefore be performed entirely with switches. A pulse on the function *"Phase seq. reversal"* (see function 65) inverts the present phase sequence. This function is reset with a "Stop signal" or by activating a switch for the functions {45, 46, 49}.	0→1 edge
45	3-W-Ctrl.Start-Right		0→1 edge
46	3-W-Ctrl.Start-Left		0→1 edge
49	3-Wire-Ctrl.Stop		0→1 edge
47	Motorpot. Freq. +	In combination with "Enable right"/"Enable left", the output frequency can be continuously varied. To save a current value in **P113**, both inputs must be at a High voltage for 1.5 s. This value is then used as the next starting value for the same preselection of direction ("Enable right"/"Enable left"), otherwise start at f_{MIN}. Values from other setpoint sources (e.g. fixed frequencies) are not taken into account.	High
48	Motorpot. Freq. -		High
50	Bit0 fixedfreq.Array	Fixed frequency array. Binary-coded digital inputs to generate up to 15 fixed frequencies. **P465 [-01] ... [-15]**	High
51	Bit1 fixedfreq.Array		High
52	Bit2 fixedfreq.Array		High
53	Bit3 fixedfreq.Array		High
54	Reserved	---	
55	Reserved	Reserved for POSICON.	
…			
64			
65 [2]	Brake man/auto rel.	The brake is automatically released by the frequency inverter (automatic brake control) or if the digital input parameterised with this function is set.	High
66 [2]	Brake man Release	The brake is only released if the digital input parameterised with this function is set.	High

67	Dig.out man/auto set	Set digital output 1: manually or via the set function in (**P434**)	High
68	Dig.out manual set	Set digital output 1: manually	High
69	Speed meas.with ini.	Simple speed measurement (pulse measurement) with initiator	Pulses
70	Evacuation mode	This provides the option of operation with a very low DC link voltage (e.g. from batteries). With this function, the charging relay is energised and the existing monitoring functions are disabled. **NOTICE!** No overload monitoring! (e.g. lifting gear)	
71 [3]	Motorpot.F+ and Save	"*Motor potentiometer function frequency +/- with automatic saving*". With this motor potentiometer function, a setpoint (amount) is set and saved via the digital inputs. With controller enable right/left, this is then started up in the corresponding enable direction of rotation. The frequency is retained on change of direction. Simultaneous activation of the +/- functions causes the frequency setpoint to be set to zero. The frequency setpoint can also be displayed in the operating value display (**P001 = 30**, 'Cur. set value MP-S') or in **P718**, and can be pre-set in the "Ready to switch-on" operating mode. A set minimum frequency **P104** is still effective. Other setpoints, e.g. analogue or fixed frequencies, can be added or subtracted. Adjustment of the frequency setpoint is performed with the ramps from **P102 / 103**.	High
72 [3]	Motorpot.F- and Save		High
73 [2.6]	Inhibit right+quick	Same as setting {31}, but coupled to the "Quick stop" function.	Low
74 [2.6]	Inhibit left + quick	Same as setting {32}, but coupled to the "Quick stop" function.	Low
75	DO 2 man/auto set	Set digital output 2: manually or via the set function in (**P434**)	High
76	DO 2 man. set	Set digital output 2: manually	High
77	Reserved	Reserved for POSICON.	
78	Reserved	Reserved for POSICON.	
79	Rotorpos. 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 to switch-on". • The rotor position is not known (see **P434**, **P481**, function {28}), • Function {2} is selected in **P336**.	0→1 edge
80	PLC stop	The program execution of the internal PLC is stopped for as long as the signal is present.	High

1 If no digital input is parameterised to "Enable right" or "Enable left" and with devices from SK 270E-FDS and higher, all AS-i relevant BUS In Bits (**P480**) are deactivated, then the control of a fixed frequency or the jog frequency results in enabling of the frequency inverter. The rotating field direction depends on the sign of the setpoint.

2 Also effective for control via BUS (e.g. RS232, RS485, CANopen, AS-Interface, …)

3 For devices without an integrated power supply unit (integrated power supply unit: option "-HVS"), the frequency inverter's control unit must be supplied with power for a further 5 minutes after the last change to the motor potentiometer in order to permanently save the data.

4 Function cannot be selected via BusIO In Bits

5 The operating parameter set is selected via correspondingly parameterised digital inputs or the bus control. Switching can take place during operation (online). Coding is binary according to the following pattern.

When enabled via the keyboard (SimpleBox or ParameterBox), the operating parameter set will match the setting in **P100**.

Setting		Digital input	Digital input
0 =	Parameter set 1	LOW	LOW
1 =	Parameter set 2	HIGH	LOW
2 =	Parameter set 3	LOW	HIGH
3 =	Parameter set 4	HIGH	HIGH

6 Notice! When using this function for limit switch monitoring, it must be ensured that the limit switch cannot be overrun, because as soon as the limit switch has been left, the blocking of the phase sequence is automatically cancelled. The frequency inverter therefore accelerates again when the enable signal is applied.

P425	Function PTC input		
Setting range	0 … 1		
Factory setting	{ 1 }		
Description	A connected PTC resistor is evaluated by the device. This function must be disabled if no PTC resistor is connected. Otherwise, the device will enter a fault state with an overtemperature message (**E2.0**).		
Note	If monitoring is deactivated, the device no longer provides direct overtemperature protection for the motor.		
Setting values	**Value**	**Meaning**	
	0	Off	Thermistor input not monitored.
	1	On	Thermistor input monitoring active

P426	Quick stop time	P
Setting range	0 ... 320.00 s	
Factory setting	{ 0.10 }	
Description	Setting of the braking time for the quick stop function which can be triggered either via a digital input, the bus control, the keyboard or automatically in case of a fault. The quick stop time is the time for the linear frequency decrease from the set maximum frequency P105 to 0 Hz. If an actual setpoint <100 % is used, the quick stop time is reduced correspondingly.	

P427	Quick stop on Error	S
Setting range	0 ... 2	
Factory setting	{ 0 }	
Description	“*Quick stop on error*”. Activation of automatic quick stop in case of an error. A quick stop can be triggered by error **E002.x**, **E007.0**, **E010.x**, **E012.8**, **E012.9** and **E019.0**.	
Setting values	**Value**	**Meaning**
	0	Switched off	Automatic quick stop in case of fault is deactivated
	1	Reserved	
	2	Switched on	Automatic quick stop in case of fault

P428	Automatic starting	S
Setting range	0 … 1	
Factory setting	{ 0 }	
Description	**WARNING!** Danger of injury due to unexpected movements of the drive. Switch-on after an earth fault/short-circuit. Do **NOT** parameterise this parameter to “On” (**P428 = 1**), if “Automatic acknowled.” (**P506 = 6** “Always”) has been parameterised! Secure drive against movements. This parameter defines how the FI responds to a static enable signal when the mains voltage is applied (mains voltage On). In the standard setting **P428 = 0** “Off”, the FI requires an edge to enable (signal change from “Low” → “High”) at the relevant digital input. **P428 = 1** “On” can be set if the FI must start immediately when the mains voltage is switched on. If the enable signal is permanently switched on, or equipped with a wire jumper, the FI starts up immediately.	
Note	The setting “On” (**P428 = 1**) can only be enabled if the frequency inverter has been parameterised to local control (**P509 = 0** or **P509 = 1**).	
Setting values	**Value**	**Meaning**
	0 Off	The device expects a flank (signal change “low → high”) at the digital input which has been parametrised to “Enable” in order to start the drive. If the device is switched on with an active enable signal (mains voltage on), it immediately switches to “Switch-on inhibit”.
	1 On	The device expects a signal level (“high”) at the digital input which has been parametrised to “Enable” in order to start the drive. **NOTICE! Risk of injury! Drive starts up immediately!**

P434	Digital out function		P
Setting range	0 … 40		
	[-01] = Digital out 1	Digital output 1 of the frequency inverter	
	[-02] = Digital out 2	Digital output 2 of the frequency inverter	
Factory setting	All { 7 }		
Description	“*Digital output function*“. Up to two digital outputs are available, which can be freely programmed with digital functions. These can be seen in the following table.		
Note	The digital outputs are assigned to bits 11 and 12 of BusIO (**P480**) with the factory settings. The digital outputs must be deactivated in **P480** so that they are not permanently overwritten. **“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”). Compare an evaluation of the output signals by, for example, a PLC with the operational readiness of the frequency inverter! **Hysteresis** Settings **P480 = 3 … 5** and **11** work with 10% hysteresis, i.e. the output delivers (**P480 = 11** does not deliver) upon reaching the 24 V limit and switches it off again when the value drops to a value that is 10% lower (**P480 = 11** on again). This behaviour can be inverted with a negative value in **P435**.		
Setting values	**Value**	**Description**	**Signal**
	00 No function	No function	Low
	01 External brake	For control of a mechanical brake on the motor. The relay switches at a programmed absolute minimum frequency **P505**. For typical brakes, a setpoint delay of 0.2 ... 0.3 s (see **P107**) should be programmed. For typical brakes, a setpoint delay of 0.2-0.3 s (see also **P107** / **P114**) should be programmed. Devices with an optional integrated brake rectifier (e.g. option “-HWR”, 🕮 Section 1.7 “Type code /	Low

		nomenclature") can directly control a typical motor brake (□ Section 2.3.2.4 "Electromechanical brake". A mechanical brake can be directly switched with AC. (Note the technical specification of the relay contact!)	
02	Inverter is working	The closed relay contact indicates voltage at the inverter output (U – V – W) (as well as DC run-on **P559**).	High
03	Current limit	Based on the nominal motor current setting in **P203**. This value can be adjusted via scaling **P435**.	High
04	Torque current limit	Based on the motor data settings in **P203** and **P206**. Signals a corresponding torque load on the motor. This value can be adjusted via scaling **P435**.	High
05	Frequency limit	Based on the nominal motor frequency setting in **P201**. This value can be adjusted via scaling **P435**.	High
06	Level with setpoint	Indicates that the device has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz → Setpoint not reached, signal low.	High
07	Fault	General fault message, fault is active or not yet acknowledged. Fault: Contact opens, ready for operation: Contact closes.	Low
08	Warning	General warning. A limit value was reached, which could result in a later switch-off of the device.	Low
09	Overcurrent warning	At least 130% of the nominal device current was supplied for 30 seconds.	Low
10	Mot.overtemp.warning *	"*Motor overtemperature (warning)*". The motor temperature is evaluated via the PTC resistor input or a digital input. → Motor is too hot. The warning is issued immediately; overtemperature switch-off after 2 seconds.	Low
11	Torque current limit *	"*Torque current limit/current limit active (warning)*". The limit value in **P112** or **P536** was reached. A negative value in **P435** inverts the behaviour. Hysteresis = 10%	Low
12	Value of P541	The output can be set using parameter **P541**, irrespective of the current operating status of the device.	High
13	Torq.curr. limit gen *	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 device is ready for operation. After being enabled, it delivers an output signal.	High
19	Mains voltage ok	Mains voltage is present.	High
20	… 27	Reserved POSICON	
28	Rotorpos PMSM ok	The PMSM rotor position is known.	High
29	Reserved		High
30	Status dig in 1		High
31	Status dig in 2		High
32	Status dig in 3		High
33	Status dig in 4		High
34	Status dig in 5		High
35	State isolator swtch		High
36	Remote control	Switching state of the switch in option slot **H1**: High = Remote control active, Low = Manual control active	High
37	Fault or manual mode		High
38	Value Bus Setpoint	Value from bus setpoint (**P546** …)	High
39	STO inactive	The relay/bit drops, if STO or the safe stop is active.	High
40	Output via PLC	The output is set by the integrated PLC	High

P435	Dig. out scaling		P
Setting range	-400 … 400%		
	[-01] = Digital out 1	Digital output 1 of the frequency inverter	
	[-02] = Digital out 2	Digital output 2 of the frequency inverter	
Factory setting	All { 100 }		
Description	"*Digital output scaling*". Adjustment of the limit values of the digital functions. With a negative value, the output function is output negated. Reference to the following values: Current limit (**P434 = 3**) = x [%] × **P203** Torque current limit (**P434 = 4**) = x [%] × **P203** × **P206** (calculated nominal motor torque) Frequency limit (**P434 = 5**) = x [%] × **P201**		

P436	Dig.out. hysteresis		S	P
Setting range	1 … 100%			
	[-01] = Digital out 1	Digital output 1 in the frequency inverter		
	[-02] = Digital out 2	Digital output 2 in the frequency inverter		
Factory setting	All { 10 }			
Description	"*Digital output hysteresis*". Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

P460	Watchdog time	S
Setting range	-250.0 ... 250.0 s	
Factory setting	{ 10.0 }	
Setting values	**Value** / **Meaning**	

Value	Meaning
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 an impulse 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 registered on a digital input (Function 18), the FI switches off with error message **E012**.
-0.1 … -250.0	**Rotor run watchdog:** In this setting the rotor run watchdog is active. The time is defined by the set value. There is no watchdog message when the FI is switched off. After each enable, a pulse must first come before the watchdog is activated.

P464	Fixed frequency mode	S
Setting range	0 … 1	
Factory setting	{ 0 }	
Description	This parameter determines the form in which fixed frequencies are to be processed.	
Note	The highest active fixed frequency is added to the setpoint value of the motor potentiometer if functions 71 or 72 are selected for two digital inputs.	
Setting values	**Value** / **Meaning**	

Value		Meaning
0	Add to main setvalue	Fixed frequencies and the fixed frequency array are added to each other. That means, they are added together, or added to an analogue setpoint to which limits are assigned according to **P104** and **P105**.
1	Equal main setvalue	Fixed frequencies are not added - neither together, nor to main analogue setpoints. If for example, a fixed frequency is switched to an existing analogue setpoint, the analogue setpoint will no longer be considered. Programmed frequency addition or subtraction to one of the analogue inputs or bus setpoints 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 (example: **20** > 10 or **20** > -30).

P465	Fixed freq. Array				
Setting range	-400.0 … 400.0 Hz				
Arrays	[-01] = Fixed frequency array 1				
	[-02] = Fixed frequency array 2				
	… …				
	[-15] = Fixed frequency array 15				
Factory setting	[-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 }
Description	You can set up to 15 different fixed frequencies, which in turn can be selected with the functions 50 … 53 in binary code for the digital inputs.				

P466	Minimum freq. proc. control	S	P
Setting range	0.0 … 400.0 Hz		
Factory setting	{ 0.0 }		
Description	"*Minimum freq. proc. control*". With the aid of the minimum process controller frequency the control ratio can also be kept to a minimum ratio, even with a master value of “zero”, in order to enable adjustment of the compensator. Further details can be found in **P400** and (chapter 8.2).		

P475	Delay on/off switch		S
Setting range	-30,000 ... 30,000 s		
Arrays	[-01] = Digital input 1	Digital input 1 (DI1) integrated into the device	
	[-02] = Digital input 2	Digital input 2 (DI2) integrated into the device	
	[-03] = Digital input 3	Digital input 3 (DI3) integrated into the device	
	[-04] = Digital input 4	Digital input 4 (DI4) integrated into the device	
	[-05] = Digital input 5	Digital input 4 (DI4) integrated into the device	
	[-06] = Digital fct Analog 1	Analogue input 1 (AIN1) integrated into the device	
	[-07] = Digital fct Analog 2	Analogue input 2 (AIN2) integrated into the device	
Factory setting	All { 0,000 }		
Description	"*Digital function switch-on/switch-off delay*". Adjustable switch-on/switch-off delay for the digital inputs and digital functions of the analogue inputs. Use as a switch-on filter or simple process control is possible.		
Setting values	**Value**	**Meaning**	
	Positive values	Switch-on delayed	
	Negative values	Switch-off delayed	

P480	Funct. BusIO In Bits				S
Setting range	0 … 80				
Arrays	[-01] = Bus / AS-i Dig In1	BusIO In Bit 0 + AS-i 1 or DI 1 of the **second** SK xU4-IOE (DigIn 09)			
	[-02] = Bus / AS-i Dig In2	BusIO In Bit 1 + AS-i 2 or DI 2 of the **second** SK xU4-IOE (DigIn 10)			
	[-03] = Bus / AS-i Dig In3	BusIO In Bit 2 + AS-i 3 or DI 3 of the **second** SK xU4-IOE (DigIn 11)			
	[-04] = Bus / AS-i Dig In4	BusIO In Bit 3 + AS-i 4 or DI 4 of the **second** SK xU4-IOE (DigIn 12)			
	[-05] = Bus / 1.IOE Dig In1	BusIO In Bit 4 + AS-i 5 or DI 1 of the **first** SK xU4-IOE (DigIn 05)			
	[-06] = Bus / 1.IOE Dig In2	BusIO In Bit 5 + DI 2 of the **first** SK xU4-IOE SK xU4-IOE (DigIn 06)			
	[-07] = Bus / 1.IOE Dig In3	BusIO In Bit 6 + DI 3 of the **first** SK xU4-IOE SK xU4-IOE (DigIn 07)			
	[-08] = Bus / 1.IOE Dig In4	BusIO In Bit 7 + DI 4 of the **first** SK xU4-IOE (DigIn 08)			
	[-09] = Marker 1 [-10] = Marker 2	Marker function only possible for control via control terminals. See "Use of markers" at the end of the description of parameter **P481**			
	[-11] = Bit8 bus controlword [-12] = Bit9 bus controlword	Assignment of a function for Bit 8 or 9 of the control word			
Factory setting	[-01] = { 33 }	[-02] = { 34 }	[-03] = { 36 }	[-04] = { 12 }	[-05] = { 65 }
	[-06] …[-10]= { 0 }		[-11] = { 68 }	[-12] = { 76 }	
Description	"*BusIO In Bits function*". The BusIO In Bits are considered to be digital inputs. They can be set to the same functions (**P420**). For devices with integrated AS-Interface, these IO Bits can sometimes also be used by the AS-Interface itself or in conjunction with IO extensions (SK xU4-IOE). The priority for AS-i devices is AS-i. In this case, the respective BusIO Bits cannot be used by the IO extensions.				
Note	The possible functions for the BusIO In Bits can be found in the table of functions for the digital inputs in parameter **P420**. **P420 = 14** and **P420 = 29** are not possible.				

P481	Funct-BusIO Out Bits				S
Setting range	0 … 40				
Arrays	[-01] = Bus / AS-i Dig Out1	BusIO Out Bit 0 + AS-i 1			
	[-02] = Bus / AS-i Dig Out2	BusIO Out Bit 1 + AS-i 2			
	[-03] = Bus / AS-i Dig Out3	BusIO Out Bit 2 + AS-i 3			
	[-04] = Bus / AS-i Dig Out4	BusIO Out Bit 3 + AS-i 4			
	[-05] = Bus / AS-i Dig Out5	BusIO Out Bit 4 + AS-i 5 + DO 1 of the **first** SK xU4-IOE (DigOut 02)			
	[-06] = Bus / AS-i Dig Out6	BusIO Out Bit 5 + AS-i 6 + DO 2 of the **first** SK xU4-IOE (DigOut 03)			
	[-07] = Bus / 2.IOE Dig Out 1	Marker 1 [1)]+ DO 1 of the **second** SK xU4-IOE (DigOut 04)			
	[-08] = Bus / 2.IOE Dig Out 2	Marker 2 [1)]+ DO 2 of the **second** SK xU4-IOE (DigOut 05)			
	[-09] = Bus statusword Bit10	Assignment of a function for Bit 10 or 13 of the status word.			
	[-10] = Bus statusword Bit13				
Factory setting	[-01] = { 18 }	[-02] = { 8 }	[-03] = { 30 }	[-04] = { 33 }	[-05] = { 36 }
	[-06] = { 39 }	[-07] = { 0 }	[-08] = { 0 }	[-09] = { 30 }	[-10] = { 33 }
Description	"*BusIO Out Bits function*". Die BusIO Out Bits are considered to be digital outputs **P434**. They can be set to the same functions. For devices with integrated AS-Interface, these IO Bits can also be used by the AS-Interface itself or in conjunction with IO extensions (SK xU4-IOE).				
Note	The possible functions of the BusIO Out Bits can be found in the table of functions for the digital outputs (**P434**).				

[1)] Marker function only possible for control via control terminals.

P480 … P481 Use of markers

With the aid of the two markers, it is possible to define simple logical sequences of functions.

For this purpose, in the [-07] "Marker 1" and [-08] "Marker 2" arrays of parameter **P481**, the "triggers" of a function are defined (e.g. Motor overtemperature PTC warning).

In the [-09] and [-10] arrays of parameter **P480**, the function is assigned, which the frequency inverter is to perform, if the "trigger" is active. That is, parameter **P480** determines the response of the frequency inverter.

Example:

In an application, if the motor is in the overtemperature range (*"Motor overtemp.PTC"*), the frequency inverter is to reduce the current speed to a specific speed immediately (e.g. with an active fixed frequency). This will be implemented by activating the *"Fixed frequency 1"*.

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 switch-off occurs.

Step	Description	Function
1	Specify trigger, Set Marker 1 to function *"Mot.overtemp.warning"*	**P481 [-07] = 10**
2	Specify response, Set Marker 1 to function *"Fixed frequency 1"*	**P480 [-09] = 4**

Depending on the functions selected in **P481**, the function must be inverted by adjusting the **P482** scaling.

P482	**Norm. BusIO Out Bits**		**S**
Setting range	-400 … 400%		
Arrays	[-01] = Bus / AS-i Dig Out1	BusIO Out Bit 0 + AS-i 1	
	[-02] = Bus / AS-i Dig Out2	BusIO Out Bit 1 + AS-i 2	
	[-03] = Bus / AS-i Dig Out3	BusIO Out Bit 2 + AS-i 3	
	[-04] = Bus / AS-i Dig Out4	BusIO Out Bit 3 + AS-i 4	
	[-05] = Bus / 1.IOE Dig Out 1	BusIO Out Bit 4 + DO 1 of the **first** SK xU4-IOE (DigOut 02)	
	[-06] = Bus / 1.IOE Dig Out 2	BusIO Out Bit 5 + DO 2 of the **first** SK xU4-IOE (DigOut 03)	
	[-07] = Bus / 2.IOE Dig Out 1	Marker 1+ DO 1 of the **second** SK xU4-IOE (DigOut 04)	
	[-08] = Bus / 2.IOE Dig Out 2	Marker 2+ DO 2 of the **second** SK xU4-IOE (DigOut 05)	
	[-09] = Bus statusword Bit10	Assignment of a function for Bit 10 or 13 of the status word.	
	[-10] = Bus statusword Bit13		
Factory setting	All { 100 }		
Description	"*BusIO Out Bits scaling*". Adjustment of the limit values of the BusIO Out Bits. With a negative value, the output function is output negated.		

P483	Hyst. BusIO Out Bits		S
Setting range	1 … 100%		
Arrays	[-01] = Bus / AS-i Dig Out1	BusIO Out Bit 0 + AS-i 1	
	[-02] = Bus / AS-i Dig Out2	BusIO Out Bit 1 + AS-i 2	
	[-03] = Bus / AS-i Dig Out3	BusIO Out Bit 2 + AS-i 3	
	[-04] = Bus / AS-i Dig Out4	BusIO Out Bit 3 + AS-i 4	
	[-05] = Bus / 1.IOE Dig Out 1	BusIO Out Bit 4 + DO 1 of the **first** SK xU4-IOE (DigOut 02)	
	[-06] = Bus / 1.IOE Dig Out 2	BusIO Out Bit 5 + DO 2 of the **first** SK xU4-IOE (DigOut 03)	
	[-07] = Bus / 2.IOE Dig Out 1	Marker 1+ DO 1 of the **second** SK xU4-IOE (DigOut 04)	
	[-08] = Bus / 2.IOE Dig Out 2	Marker 2+ DO 2 of the **second** SK xU4-IOE (DigOut 05)	
	[-09] = Bus statusword Bit10	Assignment of a function for Bit 10 or 13 of the status word.	
	[-10] = Bus statusword Bit13		
Factory setting	All { 10 }		
Description	"*BusIO Out Bit hysteresis*". Difference between switch-on and switch-off point to prevent oscillation of the output signal.		
Note	Details on the use of bus systems can be found in the respective supplementary bus manual.		

5.1.6 Additional parameters

P501	Inverter name			
Setting range	A … Z (char)			
Arrays	[-01] … [-20]			
Factory setting	{ 0 }			
Description	Free input of a designation (name) for the device (max. 20 characters). With this, the frequency inverter can be uniquely identified for setting with NORDCON software or within a network.			

P502	Value Masterfunction			S	P
Setting range	0 … 57				
Arrays	[-01] = Master value 1	[-02] = Master value 2	[-03] = Master value 3		
Factory setting	All { 0 }				
Description	Selection of master values of a master for output to a bus system (see **P503**). These master values are assigned to the slave via **P546**. Definition of the frequencies: (📖 Section 8.10 "Scaling of set-/actual values")				
Note	Details regarding the processing of set-/actual values (see chapter 8.11 "Definition of set and actual value processing (frequencies)")				
Setting values	**Value | Meaning**				

0	Off	17	Value Analog In 1
1	Actual frequency	18	Value Analog In 2
2	Actual speed	19	Freq. Master Value
3	Current	20	Set Freq. After Ramp
4	Torque current	21	Act. Freq. w/o Slip
5	State digital-IO	22	Speed encoder
6	Reserved POSICON	23	Act. freq. With slip
7	Reserved POSICON	24	Lead.act.freq.+slip
8	Set point frequency	53	Actual value 1 PLC
9	Error code	…	…
10	Reserved POSICON	57	Actual value 5 PLC
11	Reserved POSICON		
12	BusIO Out Bits 0-7		
13	Reserved POSICON		
…			
16			

P503	Leading func. output		S	
Setting range	0 ... 3			
Factory setting	{ 0 }			
Description	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.			
Setting values	**Value**		**Meaning**	
	0	Off	No output of CTW and master values. ***If*** not a single BUS option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox/NORDCON is visible.	
	1	CANopen systembus	Output of CTW and master values to the system bus. ***If*** not a single BUS option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox/NORDCON is visible.	
	2	Systembus active	No output of CTW and master values, but all participants, which are set to “Systembus active” are visible via the ParameterBox or NORDCON. This also applies if no BUS option is connected.	
	3	CANop+Systbus active	Output of CTW and master values to the system bus. All participants, which are set to “Systembus active” are visible via the ParameterBox or NORDCON. This also applies if no BUS option is connected.	

P504	Pulse frequency	S
Setting range	4.0 ... 16.0 kHz / 16.1 ... 16.4	
Factory setting	{ 6.0 }	
Description	With this parameter, the internal pulse frequency for controlling the power section can be changed. A higher setting value reduces motor noise, but leads to increased EMC emissions and reduction of the possible motor torque.	
Note	The best possible degree of interference suppression for the device is achieved by using the default value and taking the wiring directives into consideration.	
	Raising the pulse frequency leads to a reduction of the possible output current, depending on the time (I^2t characteristic curve). When the temperature warning limit **C001** is reached, the pulse frequency is gradually lowered to the default value (see also **P537**). If the frequency inverter temperature drops by a sufficient amount, the pulse frequency is increased to the original value.	
	With setting **P300 = 3**, a constant pulse frequency (6 kHz) is used in the lower speed range (injection mode).	
	Setting values > 16.0 do not define a frequency value but map a function (see “Setting values”).	
	If a sinusoidal filter is used, the pulse frequency must not change. Otherwise, “Module errors” (**E004.0**) can be triggered. For this, see **P504 = 16.2** and **P504 = 16.3**.	

Setting values

Value		Meaning
min. … 16.0	Pulse frequency min.… 16.0 kHz	The value which is set is used as the standard pulse frequency. With increasing overload the frequency inverter automatically gradually reduces the pulse frequency to the default value.
16.1	Automatic setting of the maximum possible pulse frequency	The frequency inverter continuously determines and automatically sets the highest possible pulse frequency.
16.2	Pulse frequency 6 kHz	Fixed pulse frequency setting. This value remains constant even in case of overload (suitable for operation with a sine filter). **NB:** With these settings, short circuits at the output which occur before enabling may possibly not be detected correctly.
16.3	Pulse frequency 8 kHz	
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 % rated power, the high pulse frequency is set.

P505	Absolute mini. freq.	S	P
Setting range	0.0 … 10.0 Hz		
Factory setting	{ 2.0 }		
Description	"*Absolute minimum frequency*". Specifies the frequency value that cannot be undershot by the FI. If the setpoint becomes smaller than the absolute minimum frequency, the FI switches off or changes to 0.0 Hz. At the absolute minimum frequency, braking control **P434** and setpoint delay **P107** are executed. If a setting value of "Zero" is selected, the brake relay or the digital output (**P434 = 1)** does not switch during reversing. When controlling lifting gears without speed feedback, this value should be set to a minimum of 2 Hz. With 2 Hz and higher, the current control of the FI operates and a connected motor can supply sufficient torque.		
Note	Output frequencies < 4.5 Hz result in current limitation (chapter 8.4.3).		

P506	Automatic acknowled.	S	
Setting range	0 … 7		
Factory setting	{ 0 }		
Description	*"Automatic fault acknowledgement".* In addition to the manual fault acknowledgement, an automatic one can also be selected.		
Note	Automatic fault acknowledgement is performed 3 s after the fault can be acknowledged.		
	NOTICE! Parameter must not be set to **P506 = 6** if **P428 = 1** is set. Otherwise, after an active fault (e.g. earth fault/short circuit), the device continually switches on again. This can endanger persons and the system and destroy the device.		

Setting values

Value	Meaning	
0	**No automatic** fault acknowledgement	When using the control terminals to control the FI, the error message is acknowledged by removing the enabling signal.
1 … 5	**Number** of permissible automatic fault acknowledgements within one mains-on cycle. After mains off and switch on again, the full amount is available again.	
6	**Always**, a fault message will always be acknowledged automatically if the cause of the error is no longer present, see note.	
7	**Quit disable**, acknowledgement is only possible using the OK / ENTER key or by switching off the mains. No acknowledgement is implemented by removing the enable!	

P509	**Control word source**
Setting range	0 ... 5
Factory setting	{ 0 }
Description	Selection of the interface via which the frequency inverter receives its control word (for enabling, direction of rotation, etc.).
Note	Note P510! For parameterisation via the bus: Set P509 and if necessary P899 to the relevant bus system.

Setting values

Value		Meaning
0	Contr.term. or keyb. [1]	*"Control terminals or keyboard control"*. Control is via the optional control display (SK TU5-CTR) (if **P510 = 0**) or via the digital and analogue inputs or via BUS I/O Bits.
1	Contr. terminal only [2]	Control is via the digital and analogue inputs or via Bus I/O Bits.
2	USS [2]	The control signals are expected via the RS485 interface and the setpoint via the analogue input or the fixed frequencies.
3	Systembus [2]	Setting for control by master via a bus interface.
4	Systembus broadcast [2]	The control word is expected via the USB interface.
5	AS-i [2]	Control via AS-Interface with CTT2 protocol (double slave).

1) With keyboard control: In case of a communication fault (timeout 0.5 s), the FI is disabled without an error message.

2) Keyboard control (SK TU5-CTR) is disabled; parameterisation is still possible.

P510	Source Setpoints		S
Setting range	0 ... 5		
Arrays	Selection of the setpoint source. [-01] = Source main setpoint [-02] = Source 2nd setpoint		
Factory setting	all { 0 }		
Description	Selection of the interface, from which the frequency inverter receives its setpoints.		
Setting values	**Value**	**Meaning**	
	0	Auto (= P509)	The setpoint source corresponds to the control word (**P509**).
	1	Contr. terminal only	Digital and analogue inputs control the frequency, including fixed frequencies.
	2	USS	The setpoint is expected via the RS485 interface, see **P509**.
	3	Systembus	Control by master via a bus interface, see **P509**.
	4	Systembus broadcast	Control by a master drive, see **P509**.
	5	AS-i	Control via AS-Interface, see **P509**.

P511	USS baud rate			S
Setting range	0 … 3			
Factory setting	{ 3 }			
Description	Setting of the transfer rate (transfer speed) via the RS485 interface. The same baud rate must be set for all bus participants.			
Setting values	**Value**	**Meaning**	**Value**	**Meaning**
	0	4800 baud	2	19200 baud
	1	9600 baud	3	38400 baud

P512	USS address
Setting range	0 … 30
Factory setting	{ 0 }
Description	Setting of the bus address of the frequency inverter for USS communication.

P513	Telegram time-out		S
Setting range	-0.1 / 0.0 / 0.1 ... 100.0 s		
Factory setting	{ 0.0 }		
Description	Monitoring function of the active bus interface. Following receipt of a valid telegram, the next telegram must arrive within the set period. Otherwise, the FI reports a fault and switches off with the error message **E010** "*Bus Time Out*". A communication failure during remote control with NORDCON shuts down the frequency inverter without triggering an error.		
Note	The parameter should normally be left in the factory setting {0.0}. Parameter (**P513**) should only be set to {-0.1}, if errors detected on the optional module side (e.g. communication errors at bus field level) do not lead to a switch-off of the drive.		
Setting values	**Value**		**Meaning**
	-0.1	No error	Even if communication between the bus interface and the FI is interrupted, the FI continues to operate without change.
	0	Off	Monitoring is switched off.
	0.1 … 100		Setting of telegram downtime

P514	CAN bus baud rate
Setting range	0 … 7
Factory setting	{ 5 }
Description	Used to set the transfer rate (transfer speed) via the CAN bus interface. All bus participants must be set to the same baud rate.
Note	Optional modules of the SK CU4-… or SK TU4-… series exclusively work with a transfer rate of 250 kBd. If the frequency inverter is connected to such a module, the factory setting (250 kBd) must be retained.

Setting values

Value	Meaning	Value	Meaning	Value	Meaning
0	10 kbaud	3	100 kbaud	6	500 kbaud
1	20 kbaud	4	125 kbaud	7	1 Mbaud [1] (Only for test purposes)
2	50 kbaud	5	250 kbaud		

1 Reliable operation cannot be guaranteed.

P515	CAN bus address	
Setting range	0 … 255	
Arrays	[-01] = Slave address	Receipt address for CAN and CANopen system bus
	[-02] = Broadcast slave adr.	Broadcast receipt address for CANopen system bus (slave)
	[-03] = Master address	Broadcast transmission address for CANopen system bus (master)
Factory setting	All { 32 }	
Description	Setting of the basic CANbus address for CAN and CANopen.	
Note	If several frequency inverters are to communicate with each other via the system bus, the addresses must be set as follows: FU1 = 32, FU2 = 34 …	

P516	Skip frequency 1	S	P
Setting range	0.0 … 400.0 Hz		
Factory setting	{ 0.0 }		
Description	The output frequency around the frequency in the range between **+P517** and **-P517** set here is not displayed. This range is transmitted with the set deceleration and acceleration ramp; it cannot be continuously supplied to the output.		
Note	Frequencies below the absolute minimum frequency should not be set.		
Setting values	0.0 Skip frequency inactive		

P517	Skip freq. area 1	S	P
Setting range	0.0 … 50.0 Hz		
Factory setting	{ 2.0 }		
Description	Skip range for "Skip freq. area 1" **P516**. This frequency value is added and subtracted from the skip frequency. Skip range 1: (**P516 - P517**) ... (**P516**) … (**P516 + P517**)		

P518	Skip frequency 2	S	P
Setting range	0.0 … 400.0 Hz		
Factory setting	{ 0.0 }		
Description	The output frequency around the set frequency in the range between **+P519** and **-P519** set here is not displayed. This range is transmitted with the set deceleration and acceleration ramp; it cannot be continuously supplied to the output.		
Note	Frequencies below the absolute minimum frequency should not be set.		
Setting values	0.0 Skip frequency inactive		

P519	Skip range 2	S	P
Setting range	0.0 … 50.0 Hz		
Factory setting	{ 2.0 }		
Description	Skip range for "Skip frequency 2" **P518**. This frequency value is added to and subtracted from the skip frequency. Skip range 2: (**P518 - P519**) … (**P518**) ... (**P518 + P519**)		

P520	Flying start	S	P
Setting range	0 … 4		
Factory setting	{ 0 }		
Description	This function is required to actuate the FI to already rotating motors, e.g. for fan drives.		
Note	For physical reasons, flying start only operates above 1/10 of the nominal frequency **P201**, however not below 10 Hz.		

	Example 1	Example 2
P201	50 Hz	200 Hz
f = 1/10 × P201	F = 5 Hz	F = 20 Hz
Result × f_{Fang} =	The flying start operates from f_{Fang} = 10 Hz upwards.	The flying start operates from f_{Fang} = 20 Hz upwards.

ASM: Motor frequencies > 100 Hz are only caught in speed-controlled mode (**P300 = 1**).

PMSM: The catch function automatically determines the direction of rotation. Therefore, with **P520 = 2**, the device behaves identically to **P520 = 1**. With **P520 = 4**, the device behaves identically to **P520 = 3**.

PMSM: In CFC closed-loop mode, flying start can only be executed if the rotor position is known in relation to the incremental encoder. For this purpose, the motor must not initially rotate when it is switched on for the first time after a “Mains on” of the device.

This restriction does not apply if the zero track of the incremental encoder is used.

PMSM: The flying start does not work if **P504 = 16.2** or **P504 = 16.3** is used.

Setting values

Value		Meaning
0	Switched off	No flying start
1	Both directions	The FI searches for a speed in both directions.
2	Directio.of setpoint	Searches only in the direction of the present setpoint.
3	Both dir.after fault	Same as **P520 = 1**, but only after a mains failure or fault.
4	Dir.of set. a. fault	Same as **P520 = 2**, but only after a mains failure or fault.

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	Flying start Resolution	S	P
Setting range	0.02 … 2.50 Hz		
Factory setting	{ 0.05 }		
Description	"*Flying start resolution*“. The flying start circuit search increment size can be adjusted using this parameter. Values that are too large affect accuracy and cause the FI to cut out with an overcurrent message. If the values are too small, the search time is greatly extended.		

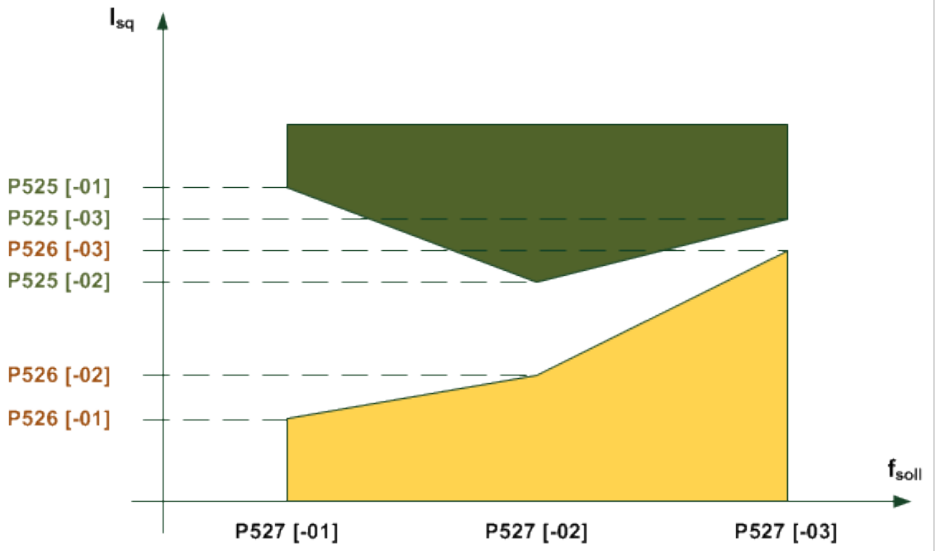
P522	Flying start offset	S	P
Setting range	-10.0 … 10.0 Hz		
Factory setting	{ 0.0 }		
Description	"*Flying start offset*". A frequency value that can be added to the frequency value found, e.g. to remain in the motor range and so avoid the generator range and therefore the chopper range.		

P523	Factory setting
Setting range	0 ... 3
Factory setting	{ 0 }
Description	With the selection and activation of the relevant value, the selected parameter range is set to the factory setting. Once this setting is made, the parameter value automatically changes back to 0.
Note	The default values of parameter **P420** [-05], [-06] and [-07] depend on the control elements that are available on option slots **H1** and **H2**.

Setting values

Value		Meaning
0	No change	Does not change the parameterisation.
1	Load factory setting	*"Load factory setting"*. The entire parameterisation of the FI is reset to the factory setting. All originally parameterised data is lost.
2	Fact.setng.w.out bus	*"Load factory setting without bus"*. All parameters of the FI, but *not* the bus parameters, are reset to the factory setting (including Ethernet).
3	Fact set w/o motor	*"Load factory setting without motor parameter"*. All parameters of the FI, but *not* the motor data parameters (P201 ... P209, P240 ... P246), are reset to the factory setting.

Up to firmware version V 1.3 R0, the PMSM-relevant parameters (**P240** to **P246**) have also been reset. This does no longer apply to the current firmware version. The parameter settings of these parameters now also remain unchanged.

P525 … P529	Load control
	With load control, 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 three auxiliary values. No control is carried out below the first and above the third frequency. In addition, control can be deactivated for minimum and maximum values. As standard, control is deactivated.
	
	The time after which a fault is triggered can be set with a parameter (**P528**). If the permissible range is exceeded *(Example diagram: Infringement of the area marked in yellow or green*), the error message **E012.5** is generated if parameter **P529** does not suppress error triggering.
	A warning **C012.5** is always issued after the elapse of half of the set error triggering time **P528**. This also applies if a mode is selected for which no fault is generated. If only a maximum or minimum value is to be controlled, the other limit must be deactivated or must remain deactivated. The torque current and not the calculated torque is used as the reference value. This has the advantage that control outside of the “field weakening range” without servo mode is usually more accurate. Naturally however, it cannot map more than the physical torque in the field weakening range.
	All parameters depend on parameter sets. No differentiation is made between motor and generator torque; therefore the amount of the torque is considered. As well as this, there is no differentiation between “left-hand” and “right-hand” rotation. The control is therefore independent of the sign of the frequency. There are four different load control 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 elements 0, 1 and 2. This is performed automatically by the frequency inverter.

P525	Load monitoring max						S	P
Setting range	1 ... 400 % / 401							
Arrays	Selection of up to 3 auxiliary values:							
	[-01] =	Auxiliary value 1	[-02] =	Auxiliary value 2	[-03] =	Auxiliary value 3		
Factory setting	All { 401 }							
Description	"*Load monitoring maximum 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.							
Note	Setting **401 = Off** → Monitoring is not performed.							

P526	Load monitoring min.						S	P
Setting range	0 / 1 ... 400 %							
Arrays	Selection of up to 3 auxiliary values:							
	[-01] =	Auxiliary value 1	[-02] =	Auxiliary value 2	[-03] =	Auxiliary value 3		
Factory setting	All { 0 }							
Description	*"Load monitoring, minimum value"* 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.							
Note	Setting **0 = Off** → Monitoring is not performed.							

P527	Load control freq.				S	P
Setting range	0.0 ... 400.0 Hz					
Arrays	Selection of up to 3 auxiliary values:					
	[-01] =	Auxiliary value 1	[-02] =	Auxiliary value 2	[-03] =	Auxiliary value 3
Factory setting	All { 25.0 }					
Description	"*Load control frequency*" Definition of up to 3 frequency points, which define the monitoring range for load control. 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	S	P
Setting range	0.10 ... 320.00 s		
Factory setting	{ 2.00 }		
Description	"*Load control delay*". Parameter **P528** defines the delay time in seconds with which an error message **E012.5** is suppressed if the defined control range **P525 … P527** is infringed. A warning **C012.5** is triggered after half of this time has elapsed. According to the selected control mode **P529**, a fault message can also be generally suppressed.		

P529	Mode load control	S	P
Setting range	0 … 3		
Factory setting	{ 0 }		
Description	Specifies the response on infringement of the monitoring range (**P525 … P527**).		
Setting values	**Value**	**Meaning**	
	0 Fault & Warning	Infringement of the control range results in a fault **E012.5** after the elapse of the time defined in parameter **P528**. A warning **C012.5** is triggered after half of this time has elapsed.	
	1 Warning	After the elapse of half of the time defined in **P528**, infringement of the control range generates a warning **C012.5**.	
	2 Fault&Warn.const.mov	"*Fault and warning during constant movement*". Same as **P529 = 0**, but control is inactive during acceleration phases.	
	3 Warning Const. Move	"*Warning only during constant movement*". Same as **P529 = 1**, but control is inactive during acceleration phases.	

P533	Factor I^2t Motor	S	
Setting range	50 … 150 %		
Factory setting	{ 100 }		
Description	Weighting of motor current for I^2t motor monitoring (**P535**). Larger factors permit larger currents.		

P534	Torque disconn.limit			S	P
Setting range	0 ... 400% / 401				
Arrays	[-01] = Motoring Limit		[-02] = Regenerative Limit		
Factory setting	All { 401 }				
Description	"*Torque disconnection limit*". Setting for a maximum permissible torque limit. From 80% of the set limit value, a warning (**C012.1** or **C012.2**) is issued. The drive switches off at 100% of the set limit value. An error message (**E012.1** or **E012.2**) is issued.				
Note	Setting **401 = Off** → The function is disabled.				

P535	I^2t motor
Setting range	0 … 24
Factory setting	{ 0 }
Description	The motor temperature is calculated depending on the output current, the time and the output frequency (cooling). If the temperature limit value is reached, switch-off occurs with error message **E2.1**. Possible positive or negative ambient conditions are not taken into account. Eight characteristic curves with trigger times < 60 s, 120 s and 240 s are available for the function I^2t motor. The triggering times are based on classes 5, 10 and 20 for semiconductor switching devices. The recommended setting for standard applications is **P535 = 5**. All characteristic curves run from 0 Hz to half of the nominal frequency **P201**. The full nominal current is always available from above half of the nominal frequency.

Switch-off class 5, 60 s at (1.5 × I_N × P533)		Switch-off class 10, 120 s at (1.5 × I_N × P533)		Switch-off class 20, 240 s at (1.5 × I_N × P533)	
I_N at 0 Hz	**P535**	**I_N at 0 Hz**	**P535**	**I_N at 0 Hz**	**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	Switch-off classes 10 and 20 are provided for applications with heavy starting. When using these switch-off classes, it must be ensured that the FI has a sufficiently high overload capacity.
	Disable control for multiple motor operation.
	P535 = 0 → No control performed.
	With **P535 ≠ 0**, the determination of the approximate motor start temperature is activated at the same time (see chapter 8.12 "Motor temperature monitoring"). Depending on the parameterisation in parameter **P336**, this can lead to a delay in motor start-up of approx. 0.2 s after enabling.

P536	Current limit	S
Setting range	0.1 ... 2.0 × I_N / 2.1	
Factory setting	{ 1.5 }	
Description	The FI output current is limited to the set value. If this limit value is reached, the FI reduces the current output frequency. With the analogue input function in **P400 = 13** and **P400 = 14**, this limit value can also be varied and an error message (**E012.4**) can be generated.	
Setting	0.1 ... 2.0 = Multiplier **P536 = 2.1** → This parameter is without function.	

P537	Pulse Disconnection	S	
Setting range	10 ... 200% / 201		
Factory setting	{ 150 }		
Description	This function prevents rapid switch-off of the FI under load. With the pulse disconnection enabled, the output current is limited to the set value. This limitation is implemented by brief switch-off of individual output stage transistors; the current output frequency remains unchanged.		
Note	The value set here can be undershot by a smaller value in **P536**. For smaller output frequencies (< 4.5 Hz) or higher pulse frequencies (> 6 kHz or 8 kHz, **P504**), pulse switch-off by power reduction (see chapter 8.4 "Reduced output power")can be undershot.		
	If the function is disabled and a high pulse frequency is selected in parameter **P504**, the frequency inverter automatically reduces the pulse frequency when the power limits are reached. If the load on the inverter is reduced, the pulse frequency increases back to the original value.		
Setting values	**Value**	**Meaning**	
	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.	

P539	Check output voltage	S	P
Setting range	0 ... 7		
Factory setting	{ 4 }		
Description	The output current at the U-V-W terminals is monitored and checked for plausibility. In case of error, fault message **E016** is issued. Settings { 0 } – { 3 } are identical to settings { 4 } – { 7 }, however, a mechanical brake is **not** checked with settings { 0 } – { 3 } (only relevant for equipment code “-BWRN”).		
Note	This function can be used as an additional protective function for lifting gear applications, but is **not permissible on its own as protection for persons!**		
Setting values	**Value**	**Meaning**	
	0 Off	No check of output voltage.	
	1 Motor Phases only	The output current is measured and checked for symmetry. If an asymmetry is present, the frequency inverter switches off with fault message **E16.0**.	
	2 Magnetisation only	When the frequency inverter is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the frequency inverter switches off with fault message **E16.0**. A motor brake is not released in this phase.	
	3 Motor Phas.+Magnet.	Combination of settings {5} and {6}: Phase and magnetisation errors result in fault message **E16.0**.	
	4 Mechanic. Brake	Only the mechanical brake is monitored. If the protective function detects an overcurrent at the MB+ and MB- terminals, the frequency inverter switches off with fault message **E4.5**.	
	5 MBrake + motorphases	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 with fault message **E16.0**.	
	6 Mbrake+Magnetisation	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 frequency inverter switches off with fault message **E16.0**. A motor brake is not released in this phase.	
	7 MBR+Motorph.+Magnet.	In addition to monitoring of the mechanical brake, the motor phases and excitation are monitored – as 1 and 2 combined.	

P540	Mode phase sequence	S	P
Setting range	0 ... 7		
Factory setting	{ 0 }		
Description	For safety reasons, this parameter can be used to prevent a phase sequence reversal and therefore prevent an incorrect phase sequence.		
Note	This function influences the function of the position control (**P600 ≠ 0**).		

Setting values

Value		Meaning
0	No limitation	No limitation of the phase sequence
1	Disable phaseseq.key	The phase sequence key of the ControlBox SK TU5-CTR is disabled.
2	To the right only [1]	Only phase sequence “right” is possible. Selection of the “incorrect” phase sequence results in the output of the minimum frequency **P104** with the rotating field R.
3	To the left only [1]	Only phase sequence “left” is possible. Selection of the “incorrect” phase sequence results in the output of the minimum frequency **P104** with the rotating field L.
4	Enabl. Direct. only	Phase sequence is only possible according to the enable signal, otherwise 0 Hz is output.
5	Right Orient. Contr. [1]	*“Only right orientation controlled”.* Only phase sequence “right” is possible. Selection of the “incorrect” phase sequence leads to the FI switching off (controller block). If necessary, an adequately large setpoint (> fmin) must be observed.
6	Left Orient. Contr. [1]	*“Only left orientation controlled”.* Only phase sequence “left” is possible. Selection of the “incorrect” phase sequence leads to the FI switching off (controller block). If necessary, an adequately large setpoint (> fmin) must be observed.
7	Enab. Direct. Contr.	*“Only enable direction controlled”* Phase sequence is only possible according to the enable signal; otherwise the FI is switched off.

1 Applies to control via control terminals and keyboard (SK TU5-CTR). In addition, the phase sequence key of the ControlBox is disabled.

P541	Set relays		S
Setting range	0000h … FFFFh		
Factory setting	{ 0000h }		
Description	"*Set digital output*". This function provides the option of controlling the relay and the digital outputs independently of the frequency inverter status. For this, the relevant output (e.g. digital output 1: **P434 [-01]**) must be set to function { 12 }, "Value of **P541**". This function can either be used manually or in combination with a bus control.		
Note	The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off! Setting the value via: Bus: The relevant hex value is written into the parameter, setting the relays or digital outputs. SimpleBox: When using the SimpleBox, the hexadecimal code is entered directly. ParameterBox: Each individual output can be called up in plain text and activated separately.		
Setting values	Bit 0	Digital output 1	Bit 6	Bus/An/Dig Out Bit 5
	Bit 1	Bus / AS-i Out Bit 0	Bit 7	Bus dig out 7
	Bit 2	Bus / AS-i Out Bit 1	Bit 8	Bus dig out 8
	Bit 3	Bus / AS-i Out Bit 2	Bit 9	Bus statusword Bit10
	Bit 4	Bus / AS-i Out Bit 3	Bit 10	Bus statusword Bit13
	Bit 5	Bus/An/Dig Out Bit 4	Bit 11	Digital output 2

	Bit 8 … 11	Bit 7 … 4	Bit 3 … 0	
Min. value	0000 **0**	0000 **0**	0000 **0**	Binary **hex**
Max. value	1111 **F**	1111 **F**	1111 **F**	Binary **hex**

P542	Set analog out		S
Setting range	0.0 … 10.0 V		
Arrays	[-01] = IOE-1	AOUT of the **first** I/O extension (SK xU4 IOE)	
	[-02] = IOE-2	AOUT of the **second** I/O extension (SK xU4 IOE)	
Scope of application	Only in connection with IO extension(s) SK CU4-IOE or SK TU4-IOE		
Factory setting	All { 0 }		
Description	"*Set analogue output*". This function enables the setting of the analogue outputs of the FI or the connected IO extension modules, irrespective of their current operating statuses. For this, the relevant analogue output must be set to the function *"External control"* (e.g.: **P418 = 7**). This function can either be used manually or in combination with a bus control. After confirmation, the value set here is output at the analogue output.		
Note	The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off!		

P543	Bus actual value			S	P
Setting range	0 … 57				
Arrays	[-01] = Bus actual value 1	[-02] = Bus actual value 2	[-03] = Bus actual value 3		
Factory setting	[-01] = { 1 }	[-02] = { 4 }	[-03] = { 9 }		
Description	Selection of the return values for bus control				
Note	Further details can be found in the respective supplementary bus manual or in the description for (**P418**). (Values of 0% … 100% correspond to 0000h … 4000h) Regarding the scaling of actual values: 🕮 8.10 "Scaling of set-/actual values". Regarding the definition of frequencies: 🕮 8.11 "Definition of set and actual value processing (frequencies)")				

Setting values

Value / Meaning

0	Off	17	Value Analog In 1
1	Actual frequency	18	Value Analog In 2
2	Actual speed	19	Freq. Master Value
3	Current	20	Set Freq. After Ramp
4	Torque current	21	Act. Freq. w/o Slip
5	State digital-IO	22	Speed encoder
6	Reserved POSICON	23	Act. freq. With slip
7	Reserved POSICON	24	Lead.act.freq.+slip
8	Set point frequency	53	Actual value 1 PLC
9	Error code	…	…
10	Reserved POSICON	57	Actual value 5 PLC
11	Reserved POSICON		
12	BusIO Out Bits 0-7		
13	Reserved POSICON		
…			
16			

Digital input assignments (*"State digital-IO"*)

Bit 0	DIN 1 (FI)	Bit 8	DI1 (1st SK xU4-IOE)
Bit 1	DIN 2 (FI)	Bit 9	DI2, (1st SK xU4-IOE)
Bit 2	DIN 3 (FI)	Bit 10	DI3 (1st SK xU4-IOE)
Bit 3	DIN 4 (FI)	Bit 11	DI4, (1st SK xU4-IOE)
Bit 4	DIN 5 (FI)	Bit 12	DOUT 1 (FI)
Bit 5	DIN 6 (FI)	Bit 13	Mechanic. Brake (FI)
Bit 6	DIN 7 (FI)	Bit 14	DOUT 2 (FI)
Bit 7	PTC input (FI)	Bit 15	Reserved

P546	Func. bus-setpoint			S	P
Setting range	0 … 36				
Arrays	[-01] = Bus-setpoint 1	[-02] = Bus-setpoint 2	[-03] = Bus-setpoint 3		
Factory setting	[-01] = { 1 }	All other { 0 }			
Description	Assignment of a function to a bus setpoint.				
Note	Further details can be found in the respective supplementary bus manual or in the description for **P400**. (Values of 0% … 100% correspond to 0000_{hex} … 4000_{hex},) Regarding the scaling of setpoints: 🕮 8.10 "Scaling of set-/actual values".				
Setting values	**Value / Meaning**				

0	Off	16	Pre-tension Torque, (**P214**)
1	Set point frequency	17	Multiplication
2	Frequency addition	18	Curve control
3	Frequency subtract.	19	Servo-Mode Torque
4	Minimum frequency	20	BusIO In Bits 0-7
5	Maximum frequency	21	Reserved
6	Cur.val process ctrl	22	Reserved
7	Nom.val process ctrl	23	Reserved
8	PI current freq.	24	Reserved
9	PI ltd.current.freq	25	Reserved
10	PI suprvsd.cur.freq	31	Digital output IOE, sets DOUT status of the 1st IOE
11	Torque current limit *"Limiting torque current limit"*	32	Analog output IOE Sets AOUT value of the 1st 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.
12	Torqu.curr.limit off *"Switching-off torque current limit"*	33	Setval.torque p.reg. *"Set value torque process controller"*
13	Current limit *"Limiting current limit"*	34	d-corr. F Process
14	Current limit off *"Switching-off current limit"*	35	d-corr. Torque
15	Ramp time, (**P102 / 103**)	36	d-corr. F+Torque

P549	Pot Box Function				S
Setting range	0 … 16				
Factory setting	{ 0 }				
Description	This parameter provides the option of adding a correction value to the current setpoint (fixed frequency, analogue value, bus) via the SimpleBox/ParameterBox keyboard. The setting range is determined via the auxiliary setpoint **P410** / **P411**.				
Setting values	**Value**	**Meaning**	**Value**	**Meaning**	
	0	Off	2	Frequency addition	
	1	Set point frequency For (**P509**)≠ 1, control via USS is possible	3	Frequency subtract.	

P550	EEPROM Copy Order		
Setting range	0 … 3		
Factory setting	{ 0 }		
Scope of application	Only with "**-EEP**" device option		
Description	In addition to the internal EEPROM, devices with the "**-EEP**" option have an additional plug-in EEPROM ("memory module") for storing and managing the parameter data. The device manages the data on both storage media in parallel. This enables quick replacement of parameter settings in case of commissioning or servicing.		
Note	The data sets stored on the internal EEPROM and the memory module can be copied to each other. This includes a PLC program on the device. The device always uses the data record, which is saved on the internal EEPROM.		
Setting values	**Value**		**Meaning**
	0	No change	The function is not carried out.
	1	External -> Internal	Data set is copied from the memory module (external EEPROM) to the internal EEPROM
	2	Internal -> External	Data set is copied from the internal EEPROM to the memory module (external EEPROM)
	3	External<->Internal	Data sets are exchanged between the two EEPROMs

P552	CAN master circle		S
Setting range	0 … 100 ms		
Arrays	[-01] =	CAN master function, CAN master circle 1	
	[-02] =	CANopen abs. encoder, CANopen absolute encoder, CAN master circle 2	
Factory setting	All { 0 }		
Description	This parameter is used to set the cycle time in CAN/CANopen master mode and to the CANopen encoder (see **P503**/ **P514**/ **P515**). Depending on the set baud rate, there are different minimum values for the actual cycle time.		
Note	The range of values which can be set is between 0 and 100ms. With **P552 = 0***"Auto"*, the default value (see table) is used. In this setting the monitoring function for the CANopen absolute encoder is no longer triggered at 50 ms but rather at 150 ms.		

Baud rate	Minimum value t_Z	Default CAN master	Default CANopen abs.
10 kbaud	10 ms	50 ms	20 ms
20 kbaud	10 ms	25 ms	20 ms
50 kbaud	5 ms	10 ms	10 ms
100 kbaud	2 ms	5 ms	5 ms
125 kbaud	2 ms	5 ms	5 ms
250 kbaud	1 ms	5 ms	2 ms
500 kbaud	1 ms	5 ms	2 ms
1000 kbaud	1 ms	5 ms	2 ms

P553	PLC set values		
Setting range	0 … 36		
Arrays	[-01] = Bus-setpoint 1	[-02] = Bus-setpoint 2	[-03] = Bus-setpoint 3
	[-04] = Bus-setpoint 4	[-05] = Bus-setpoint 5	
Factory setting	All { 0 }		
Description	Assignment of functions for the various PLC control bits.		
Note	Condition: **P350 = 1** and **P351 = 0** or **1**.		

Setting values

Value	Meaning	Value	Meaning
0	Off	17	Multiplication
1	Set point frequency	18	Curve control
2	Frequency addition	19	Servo-Mode Torque
3	Frequency subtract.	20	BusIO In Bits 0-7
4	Minimum frequency	21	Setpoint pos.LowWord
5	Maximum frequency	22	Setp. pos.HighWord
6	Cur.val process ctrl	23	Setp.pos.Inc.LowWord
7	Nom.val process ctrl	24	Set.pos.Inc.HighWord
8	PI current freq.	25	Ratio gearing
9	PI ltd.current.freq	26	… 30: Reserved
10	PI suprvsd.cur.freq	31	Digital output IOE
11	Torque current limit (limiting)	32	Analog output IOE
12	Torqu.curr.limit off	33	Setval.torque p.reg.
13	Current limit (limiting)	34	d-corr. F Process
14	Current limit off	35	d-corr. Torque
15	Ramp time	36	d-corr. F+Torque
16	Pre-tension Torque		

P555	P-limit chopper		S
Setting range	5 … 100%		
Factory setting	{ 100 }		
Description	"*Chopper power limit*". With this parameter, it is possible to program a manual (peak) power limit for the braking resistor. The switch-on duration (modulation level) for the brake chopper can only rise to a certain maximum specified limit. Once this value has been reached, the inverter switches off the current to the resistor, irrespective of the level of the DC link voltage. The result would be an overvoltage switch-off of the FI.		
Note	The correct percentage value is calculated as follows: $k[\%] = \frac{R * P_{\max BW}}{U_{\max}^2} * 100\%$		
	R =	Resistance of the braking resistor	
	P_{maxBW} =	Momentary peak power of the braking resistor	
	U_{max} =	FI chopper switching threshold	
		1~ 115/230 V	⇒ 440 V DC
		3~ 230 V	⇒ 500 V DC
		3~ 400 V	⇒ 1000 V DC

Note	If an **internal** braking resistor is used, the specific data for the braking resistor are set automatically. It is therefore no longer possible to change the parameter setting.

P556	Braking resistor	S
Setting range	20 ... 400 Ω	
Factory setting	{ 120 }	
Description	Value of the braking resistor for calculation of the maximum brake power in order to protect the resistor.	
Note	Once the maximum continuous power **P557** including overload (200% for 60 s) is reached, an I^2t limit error **E003.1** is triggered. For further details see **P737**.	

Note	If an **internal** braking resistor is used, the specific data for the braking resistor are set automatically. It is therefore no longer possible to change the parameter setting.

P557	Brake resistor type	S
Setting range	0.00 ... 20.00 kW	
Factory setting	{ 0.00 }	
Description	Continuous power (nominal power) of the resistor, to display the actual usage in **P737**. For a correctly calculated value, the correct value must be entered in **P556** and **P557**.	
Setting values	Value: Meaning	
	0.00: Monitoring disabled	
	0.01 … 20.00: Setting the continuous power (nominal power) of the resistor	

Note	If an **internal** braking resistor is used, the specific data for the braking resistor are set automatically. It is therefore no longer possible to change the parameter setting.

P558	Flux delay	S	P
Setting range	0 ... 5000 ms		
Factory setting	{ 1 }		
Description	ASM: 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 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 flux delay can be set or disabled.		
	PMSM: When used with PMSM, the dwell time can be set if parameter **P330** is set to **= 0**. Total dwell duration = 2.5 × **P558** [ms]		
Note	Setting values that are too low can reduce the dynamics and starting torque.		
Setting values	**Value**: **Meaning**		
	0: Off		
	1: Automatic calculation		
	2 … 5000: Setting of the flux delay		

P559	DC Run-on time	S	P
Setting range	0.00 ... 30.00 s		
Factory setting	{ 0.50 }		
Description	After a stop signal and elapse of the brake ramp, direct current is applied to the motor for a short time. This will completely shut down the drive. Depending on the inertia, the time of current application can be set in this parameter. The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic curve).		
Note	This function is not possible in closed-loop mode with PMSM!		

P560	Parameter, Saving mode	S
Setting range	0 … 2	
Factory setting	{ 1 }	
Description	"*Parameter saving mode*".	
Note	If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles to the EEPROM (100,000 x) is not exceeded.	
Setting values	**Value**	**Meaning**
	0 Only in RAM	Changes to the parameter settings are not written to the EEPROM. All saved settings which were made before changing the saving mode 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	Saving in RAM and EEPROM not possible. (No parameter changes are adopted)

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	S
Setting range	0 ... 32	
Factory setting	{ 0 }	
Scope of application	SK 270E-FDS, SK 280E-FDS, each from AS-i – version 1.3 (see **P745**)	
Description	With devices that communicate via the AS-interface, the AS-i profile to be used is configured via this parameter. After the configuration, the display switches back to the value 0. The configuration is only applied if the device is not enabled, no error is present, AS-i voltage is present and there is no cyclic communication with the AS-i master. Switching is only possible between AS-i configurations that match the hardware configuration of the device. For example, switching between a single-slave and a double-slave configuration is not technically possible. Any attempt is suppressed by the device and acknowledged by an error message. The factory setting of the AS-i configuration is made according to the version of the device and can be checked in **P746**.	
Note	Avoid changing the AS-i configuration more than 10 times. Frequent changes may damage the device. Changes are then no longer possible. Leave the slave addresses at 0 if the types are to be reconfigured!	
Setting values	**Value** **Meaning**	
	0 Off	No change
	1 4IO+CTT2=7.A.7+7.A.5	Double slave in the extended address range with data transfer for cyclic process data exchange CTT2 (2 * A/B slave)
	2 4IO+4IO=7.A.7+7.A.7	Double slave in the extended address range (2 * A/B slave)
	16 4IOStd=7.F	Single slave in the standard address range (1 * standard slave)
	32 4IOext=7.A.7	Single slave in the extended address range (1 * A/B slave)

P760	Input current	S
Display range	0.0 ... 999.9 A	
Description	Displays the current input current.	

P583	Motor phase sequence	S	P
Setting range	0 ... 2		
Factory setting	{ 0 }		
Description	The motor phase control sequence (U – V – W) can be changed with this parameter. This enables the direction of rotation of the motor to be changed without changing the motor connections.		
Note	If there is a voltage on the output terminals (U – V – W) (e.g. on enabling) the parameter setting or the parameter set may be changed by setting parameter **P583**. Otherwise the frequency inverter switches off with error message **E016.2**.		

Setting values

Value		Meaning
0	Normal	No change
1	Reversed	*"Invert motor phase sequence"* The phase sequence of the motor is changed. The counting direction of the encoder for speed detection (if present) remains unchanged.
2	With encod. reversed	Same as **P583= 1**, but the counting direction of the encoder is changed additionally.

5.1.7 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.

5.1.8 Information

P700	Actual Operating Status		
Display range	0.0 … 25.4		
Arrays	[-01] =	Current fault	Currently active (not acknowledged) fault message
	[-02] =	Actual warning	Currently existing warning message
	[-03] =	Reason FI blocked	Currently existing reason for active switch-on inhibit
Description	Display of current operating status messages		
Note	*SimpleBox/ControlBox:* The SimpleBox or ControlBox can be used to display the error numbers of the warning messages and faults. *ParameterBox:* The ParameterBox can be used to display the messages in plain text. Furthermore, the reason for a potential switch-on inhibit can be displayed. *Bus:* Bus-level error messages are displayed in decimal integer format. The displayed value must be divided by 10 to match the correct format. Example: Display: 20 → Error number: 2.0		
Display values	(see chapter 6.3 "Messages")		

P701	Last fault
Display range	0.0 … 25.4
Arrays	[-01] … [-05]
Description	"*Last fault 1 … 5*". This parameter stores the last 5 faults (see chapter 6.3 "Messages").
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved error code.

P702	Freq. last error	S
Display range	-400.0 … 400.0 Hz	
Arrays	[-01] … [-05]	
Description	"Frequency, l*ast error 1 … 5*". This parameter stores the output frequency that was supplied when the error occurred. The values of the last 5 errors are stored.	
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved value.	

P703	Current. last error	S
Display range	0.0 ... 999.9 A	
Arrays	[-01] … [-05]	
Description	"*Current, last error 1 … 5*". This parameter stores the output current that was supplied when the error occurred. The values of the last 5 errors are stored.	
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved value.	

P704	Volt. last error	S
Display range	0 ... 600 V AC	
Arrays	[-01] … [-05]	
Description	"*Voltage, last error 1 … 5*". This parameter stores the output voltage that was supplied when the error occurred. The values of the last 5 errors are stored.	
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved value.	

P705	Dc.lnk volt.last er	S
Display range	0 ... 1000 V DC	
Arrays	[-01] … [-05]	
Description	"*DC link voltage, last error 1 … 5*". This parameter stores the DC link voltage that was supplied when the error occurred. The values of the last 5 errors are stored.	
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved value.	

P706	P set last error	S
Display range	0 ... 3	
Arrays	[-01] … [-05]	
Description	"*Parameter set, last error 1 … 5*". This parameter stores the parameter set code that was active when the error occurred. Data for the previous 5 errors is saved.	
Note	With the SimpleBox/ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK/ENTER key to read the saved error code.	

P707	Software-Version	
Display range	0.0 … 9999.0	
Arrays	[-01] = Version	Version number (e.g.: V1.0)
	[-02] = Revision	Revision number (e.g.: R1)
	[-03] = Special version	Special version of hardware/software (e.g. 0.0). The value "0" means "Standard version".
Description	Display of software version (firmware version) of device	

P708	State of digital in.	
Display range	0000h … FFFFh	0000 0000 0000 0000b … 1111 1111 1111 1111b
Description	Display of the digital inputs' signal state	
Display values	Value | Meaning	

Bit 0	Digital input 1	Signal state digital input 1 … 5
…	…	
Bit 4	Digital input 5	
Bit 5	Digital fct Analog 1	Digital signal state analogue input 1
Bit 6	Digital fct Analog 2	Digital signal state analogue input 2
Bit 7	PTC resistor input	Signal state PTC resistor input
Bit 8	Digit. input 1/1.IOE	Signal state 1st IO extension digital input 1 … 4
…	…	
Bit 11	Digit. input 4/1.IOE	
Bit 12	Digit. input 1/2.IOE	Signal state 2nd IO extension digital input 1 … 4
…	…	
Bit 15	Digit. input 4/2.IOE	

Note		
	SimpleBox:	The binary bits are displayed as hexadecimal values.
	ParameterBox:	The bits are displayed in ascending order from right to left (binary).

P709	Analog input voltage	
Display range	-100.0 ... 100.0%	
Arrays	[-01] = Analog input 1	Value of analogue input 1 integrated into the FI
	[-02] = Analog input 2	Value of analogue input 2 integrated into the FI
	[-03] = Ext. Analogue in 1	AIN1 of the first I/O extension SK xU4-IOE
	[-04] = Ext. Analogue in 2	AIN2 of the first I/O extension SK xU4-IOE
	[-05] = Setpoint module	SK SSX-3A, 🕮 BU0040
	[-06] = Reserved	
	[-07] = Analog fct. Dig. 3	Analogue function of FI digital input 3
	[-08] = Ext.AI 1 2.IOE	*"External analogue input 1 2nd IOE"*, AIN1 of the second I/O extension (SK xU4-IOE) (= analogue input 3)
	[-09] = Ext.AI 2 2.IOE	*"External analogue input 2 2nd IOE"*, AIN2 of the second I/O extension (SK xU4-IOE) (= analogue input 4)
Description	"*Voltage of analogue inputs*". Displays the measured analogue input value.	
Note	100% = 10.0 V or 20.0 mA	

P710	Analog output volta.	
Display range	0.0 ... 10.0 V	
Arrays	[-01] = IOE-1	AOUT of the first I/O extension (SK xU4-IOE)
	[-02] = IOE-2	AOUT of the second I/O extension (SK xU4-IOE)
Description	"*Analogue output voltage*". Displays the output value of the analogue output.	

P711	State of relays	
Display range	0000h ... FFFFh	0000 0000 0000 0000b … 1111 1111 1111 1111b
Description	Display of the digital outputs' signal state	
Display values	Value | Meaning	

Bit 0	Digital output 1	Signal state digital output 1
Bit 1	Mechanical Brake	Signal state mechanical brake
Bit 2	Digital output 2	Signal state digital output 2
Bit 3	Reserved	Reserved
Bit 4	Digital out 1/1.IOE	Signal state 1st IO extension digital output 1
Bit 5	Digital out 2/1.IOE	Signal state 1st IO extension digital output 2
Bit 6	Digital out 1/2.IOE	Signal state 2nd IO extension digital output 1
Bit 7	Digital out 2/2.IOE	Signal state 1st IO extension digital output 2

Note		
	SimpleBox:	The binary bits are displayed as hexadecimal values.
	ParameterBox:	The bits are displayed in ascending order from right to left (binary).

P714	Operating time
Display range	0.00 ... 19 999 999.99 h
Description	Duration of the device's operational readiness and availability of mains voltage (cumulative value over the service life of the device).

P715	Running time
Display range	0.00 ... 19 999 999.99 h
Description	Period of time during which the device was enabled and supplied power at the output (cumulative value over the service life of the device).

P716	Actual frequency
Display range	-400.0 ... 400.0 Hz
Description	Displays the actual output frequency.

P717	Actual speed
Display range	-9999 ... 9999 rpm
Description	Displays the actual motor speed calculated by the FI.

P718	Current set freq.	
Display range	-400.0... 400.0 Hz	
Arrays	[-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
Description	Displays the frequency specified by the setpoint.	

P719	Actual current
Display range	0.0 ... 999.9 A
Description	Displays the actual output current.

P720	Act. torque current
Display range	-999.9 ... 999.9 A
Description	Displays the actual calculated torque-developing output current (active current). Basis for calculation is the motor data **P201... P209**. • Negative values = generator • Positive values = motor

P721	Actual field current
Display range	-999.9 ... 999.9 A
Description	Displays the actual calculated field current (reactive current). Basis for calculation is the motor data **P201 ... P209**.

P722	Actual voltage
Display range	0 ... 500 V
Description	Displays the actual AC voltage supplied by the FI output.

P723	Voltage -d	S
Display range	-500 ... 500 V	
Description	"*Actual voltage component Ud*". Displays the actual field voltage component.	

P724	Voltage -q	S
Display range	-500 ... 500 V	
Description	"*Actual voltage component Uq*". Displays the actual torque voltage component.	

P725	Present cos phi
Display range	0.00 ... 1.00
Description	Displays the actual calculated cos φ of the drive.

P726	Apparent power
Display range	0.00 ... 300.00 kVA
Description	Displays the actual calculated apparent power. Basis for calculation is the motor data **P201 ... P209**.

P727	Mechanical Power
Display range	-99.99 ... 99.99 kW
Description	Displays the actual calculated effective power of the motor. Basis for calculation is the motor data **P201 ... P209**.

P728	Input voltage
Display range	0 ... 1000 V
Description	"*Mains voltage*". Displays the actual mains voltage at the FI input. This is directly determined from the amount of the intermediate circuit voltage

Note	**Display of static value** For devices with separate 24 V supply, a static value is displayed if *no mains voltage* is applied (e.g.: for 1~ 230 V devices: P728 = 230 V). This value is used for internal initialisation purposes.

P729	Torque
Display range	-400 ... 400 %
Description	Displays the actual calculated torque. Basis for calculation is the motor data **P201 ... P209**.

P730	Field
Display range	0 ... 100 %
Description	Displays the actual field in the motor calculated by the inverter. Basis for calculation is the motor data **P201 ... P209**.

P731	Parameter set			
Display range	0 … 3			
Description	Displays the actual operating parameter set.			
Display values	**Value**	**Meaning**	**Value**	**Meaning**
	0	Parameter set 1	2	Parameter set 3
	1	Parameter set 2	3	Parameter set 4

P732	Phase U current	S
Display range	0.0 ... 999.9 A	
Description	Displays the actual U phase current.	
Note	Due to the measurement procedure used, this value can deviate from the value in **P719**, even with symmetrical output currents.	

P733	Phase V current	S
Display range	0.0 ... 999.9 A	
Description	Displays the actual V phase current.	
Note	Due to the measurement procedure used, this value can deviate from the value in **P719**, even with symmetrical output currents.	

P734	Phase W current	S
Display range	0.0 ... 999.9 A	
Description	Displays the actual W phase current.	
Note	Due to the measurement procedure used, this value can deviate from the value in **P719**, even with symmetrical output currents.	

P735	Speed encoder	S
Display range	-9999 … 9999 rpm	
Description	Displays the current speed supplied by the incremental encoder. **P301** must be set correctly for this.	

P736	Link voltage
Display range	0 … 1000 V
Description	"*Link voltage*". Displays the actual link circuit voltage.

Information

Display of atypical value

For devices with separate 24 V supply, a small atypical value is displayed if *no mains voltage* is applied (e.g.: **P736** ≈ 4 V). This value results from internal measuring and testing routines and depends, for example, on measuring errors, offset and signal noise.

P737	Usage rate brakeres.
Display range	0 … 1000%
Description	"*Actual braking resistor usage rate*". This parameter holds information on the actual duty cycle of the brake chopper or the actual usage of the braking resistor in generator mode. If parameters **P556** and **P557** are set correctly, the usage rate is displayed in relation to **P557**, the resistor type. If only **P556** is set correctly (**P557** = 0), then the duty cycle of the brake chopper is displayed. 100 means that the braking resistor is fully controlled. On the other hand, 0 means that the brake chopper is currently not active. If **P556** = 0 and **P557** = 0, this parameter also provides information about the duty cycle of the brake chopper in the FI.

P739	Temperature	
Display range	-40 ... 150 °C	
Arrays	[-01] = Heat sink temperatur	Current temperature of the heat sink
	[-02] = Ambient temperature	Current temperature of the interior of the power section of the inverter.
	[-03] = Temp. Motor KTY	Motor temperature via KTY, detection exclusively via IO extension, setting in parameter (**P400**) to function {30} "Motor temperature".
Description	Displays the current temperature values at various measuring points.	

P740	PZD bus in		S
Display range	0000h … FFFFh		
Arrays	[-01] = Control word	Control word, source from **P509**	
	[-02] = Set value 1 (P510/1) … [-04] = Set value 3 (P510/1)	Setpoint data from main setpoint **P510 [-01]**	
	[-05] = Res. stat.InBit P480	The displayed value depicts all Bus In Bit sources linked with an “OR”.	
	[-06] = Parameter data In 1 … [-10] = Parameter data In 5	Data during parameter transfer: Request ID (AK), parameter number (PNU), index (IND), parameter value (PWE 1/2)	
	[-11] = Set point 1 (P510/2) … [-13] = Set point 3 (P510/2)	Setpoint data of the master function value (broadcast) – (**P502**/**P503**) – , if **P509** = 4	
	[-14] = Control Word PLC		
	[-15] = Setvalue 1 PLC … [-19] = Setvalue 5 PLC	Control word + setpoint data of PLC	
Description	This parameter provides information about the current control word and the setpoints that are transferred via the bus systems.		
Note	For display values, a bus system must be selected in **P509**. Scaling: see (Chap. 8.10 "Scaling of set-/actual values")		

P741	PZD bus out		S
Display range	0000h … FFFFh		
Arrays	[-01] = Status word bus	Status word according to selection in **P509**	
	[-02] = Bus actual value 1 … … [-04] = Bus actual value 3	Actual values according to **P543**	
	[-05] = Res.stat.OutBit **P481**	The displayed value depicts all Bus OUT Bit sources linked with an “*OR*”.	
	[-06] = Parameter data Out1 … … [-10] = Parameter data Out5	Data during parameter transfer	
	[-11] = Act. Value1 leadfct. … … [-13] = Act. Value3 leadfct.	Actual value of master function **P502 / P503**.	
	[-14] = Statusword PLC	Status word via PLC	
	[-15] = Actual value 1 PLC … … [-19] = Actual value 5 PLC	Actual values via PLC	
Description	This parameter provides information about the current status word and the actual values that are transferred via the bus systems.		
Note	Scaling: 🕮 (see chapter 8.10 "Scaling of set-/actual values")		

P742	Data base version	S
Display range	0 ... 9999	
Description	Displays the internal database version of the FI.	

P743	Inverter type
Display range	0.00 ... 250.00 kW
Description	Displays the rated power of the frequency inverter.

P744	Configuration
Display range	0000h … FFFFh
Description	The configurations integrated into the FI are displayed in this parameter. The display is in hexadecimal code (SimpleBox, bus system). When using the ParameterBox, the display is in plain text.
Display values	Value | Meaning

		00h	Standard I/O	(SK 250E-FDS-…-A)
		01h	STO	(SK 260E-FDS-…-A)
00h	No extension	02h	AS-i	(SK 270E-FDS-…-A)
01h	Encoder	03h	STO and AS-i	(SK 280E-FDS-…-A)
02h	POSICON	04h	Standard I/O	(SK 250E-FDS-…-HVS-…-A)
03h	---	05h	STO	(SK 260E-FDS-…-HVS-…-A)
		06h	AS-i	(SK 270E-FDS-…-HVS-…-A)
		07h	STO and AS-i	(SK 280E-FDS-…-HVS-…-A)

P745	AS-i version
Display range	0 ... 9999
Description	Displays the software version of the AS-i interface.
Scope of application	SK 270E-FDS, SK 280E-FDS
Note	Have this data available in case of technical queries.

P746	AS-i status	
Display range	0000h ... FFFFh	0 … 65535
Description	Displays the current status (readiness, error, communication) of the AS-i interface.	
Scope of application	SK 270E-FDS, SK 280E-FDS	
Note	In the form described here, this parameter is only functional for AS-i version 1.3 and higher (see parameter **P745**). When using an older AS-i version, the above description applies to this parameter.	

[-01] Current 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.

Value Bit 8 … Bit 11	Status of 1st slave
0	AS-i voltage from
3	1st slave chip not present
4	Reset
6	ADR = 0
7	NODEX (No Data Exchange)
8	DEX (Data Exchange)
9	Reconfiguration active

Value Bit 0 … Bit 3	Status of 2nd slave
0	AS-i voltage from
3	2nd slave chip not present
4	Reset
6	ADR = 0
7	NODEX (No Data Exchange)
8	DEX (Data Exchange)
9	Reconfiguration active

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

Bit 0-5:	Active AS-i configuration
Bit 6-15:	Reserved

Value	AS-i mode
1	4IO+CTT2=7.A.7+7.A.5, double slave in the extended address range
2	4IO+4IO=7.A.7+7.A.7, double slave in the extended address range
16	4IOStd=7.F, single slave in the standard address range
32	4IOExt=7.A.7, single slave in the extended address range

[-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 by the AS-i master. The meaning of the individual bits depends on the selected profile.

Bit 0-3:	Parameter bits 0 to 3 of 2nd slave
Bit 4-7:	Reserved
Bit 8-11:	Parameter bits 0 to 3 of 1st slave
Bit 12-15:	Reserved

P747	Inverter Volt. Range
Display range	0 ... 2
Description	"*Inverter voltage range*". Indicates the mains voltage range for which this device is specified.
Display values	**Value | Meaning**

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

P748	Status CANopen	S
Display range	0000h … FFFFh	0 … 65535
Description	Displays the status of the system bus (CANopen).	

Value	Designation	Meaning
Bit 0	24 V bus supply	24 V supply (bus) is applied
Bit 1	Bus Warning	CANbus in "Bus Warning" status
Bit 2	Bus Off	CANbus in "Bus Off" status
Bit 3	System bus → Bus device online	External bus module (e.g. SK xU4-PBR) online
Bit 4	System bus → Additional module 1 online	External IO extension 1 (e.g. SK xU4-IOE) online
Bit 5	System bus → Additional module 2 online	External IO extension 2 (e.g. SK xU4-IOE) online
Bit 6	CAN module protocol	0 = CAN / 1 = CANopen
Bit 7	Reserved	
Bit 8	Bootup message sent	Initialisation complete
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 Dip-switches	
Display range	0000h ... FFFFh	0000 0000 0000 0000b … 1111 1111 1111 1111b
Description	This parameter displays various internal configurations.	

Bit 0: System bus address (Bit 0)
Bit 1: System bus address (Bit 1)

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

Bit 2: Systembus active
Bit 3-6: Reserve
Bit 7: Internal braking resistor present
Bit 8: EEPROM (memory module)
Bit 8 = 0: plugged / Bit 8 = 1: not plugged

P750	Stat. overcurrent	S
Display range	0 … 9999	
Description	Number of overcurrent messages during the operating time **P714**.	

P751	Stat. Overvoltage	S
Display range	0 ... 9999	
Description	Number of overvoltage messages during the operating time **P714**.	

P752	Stat. mains failure	S
Display range	0 ... 9999	
Description	Number of mains failures during the operating time **P714**.	

P753	Stat. overtemperatur	S
Display range	0 ... 9999	
Description	Number of overtemperature faults during the operating time **P714**.	

P754	Stat. parameter lost	S
Display range	0 ... 9999	
Description	Number of parameter losses during the operating time **P714**.	

P755	Stat. system error	S
Display range	0 ... 9999	
Description	Number of system errors during the operating time **P714**.	

P756	Stat. Timeout	S
Display range	0 ... 9999	
Description	Number of time-out errors during the operating time **P714**.	

P757	Stat. Customer error	S
Display range	0 ... 9999	
Description	Number of customer watchdog errors during the operating time **P714**.	

P760	Input current	S
Display range	0.0 ... 999.9 A	
Description	Displays the current input current.	

P780	Device ID
Display range	0 … 9 and A … Z
Arrays	[-01] = … [-12]
Description	Display of the serial number (12-digit) of the device.
Note	• Display via NORDCON: as a contiguous serial number of the device • Display via bus: ASCII code (decimal). Each array must be read out separately.

P799	Op.-time last error
Display range	0.00 … 19 999 999.99 h
Arrays	[-01] … [-05]
Description	“*Operating time, last error*”. This parameter displays the actual on-time count (**P714**) at the time of the last error. Array [01] ... [05] corresponds to the last error 1 ... 5.

6 Operating status messages

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

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

Start disabled, “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**	**Overcurrent I^2t-Lim.**	Inverter: I^2t limit has triggered, e.g. > 1.5 x I_n for 60 s (also note P504) • Continuous overload at FI output • Possible encoder fault (resolution, defect, connection)
	3.1	**Overcurrent chopper I^2t**	Brake chopper: I^2t limit has triggered, 1.5 time the value reached for 60 s (also note P554, if available, and P555, P556, P557) • Avoid overcurrent on braking resistor
	3.2	**Overcurrent IGBT** 125% monitoring	De-rating (power reduction) • 220 % Overcurrent • Brake chopper current too high • For fan drives: enable flying start (P520)
	3.3	**Overcurrent IGBTfast** 150% monitoring	De-rating (power reduction) • 230 % Overcurrent • Brake chopper current too high
	3.4	**Overcurrent chopper**	Overcurrent chopper triggering has triggered twice within 50 ms. • Brake chopper current too high • Short circuit, or braking resistance too low

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 Failure**	Error at mains connection side • A mains phase is not connected • Mains asymmetrical
	7.1	**Phasefailure dc-link**	DC link voltage too low • A mains phase is not connected • Load temporarily too high
	On 7.1		**Devices with external 24 V DC supply of the control unit:** If the mains voltage is switched off, but the control unit is still supplied with 24 V DC, this error message also occurs. If the mains voltage is switched on again, the error message must be acknowledged. It is not before until then that the frequency inverter can be enabled.

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 • If present, check *“Sense“* signal • Check supply voltage of encoder.
	13.1	**Speed slip error** *“Speed slip error”*	The slip speed error limit was reached. • Increase value in **P327** • Increase value in **P328**

	13.2	**Disconnect. control**	The disconnection control is active if: *required deceleration time > 1.5 x Deceleration time (P103) + 2 s* The slip error disconnection control was triggered; the motor could not follow the setpoint. • Check motor data **P201**-**P209**! (important for the current controller) • Check Star Delta connection • Check encoder settings **P300** and following in servo mode • Increase value for torque current limit in **P112** • Increase 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
E025	**25.1**	**RS485.Encod. communic.** *“RS485 encoder communication“*	RS485 encoder communication error (CRC checksum error) • Poor cable shielding • Incorrect encoder resolution (BISS, SSI) • SSI does not support Multiply Transmit (**P617**)
	25.2	**No adeq. RS485.encoder** “No corresponding universal encoder”	There is no connection to the selected RS485 encoder. • The encoder or data cable are not connected correctly • No voltage supply to the encoder • Servo mode in **P300** switched off or position control in **P600** switched off • Encoder incorrectly set, check **P604**
	25.4	**RS485.encoder fault** *“RS485 encoder error“*	The RS485 encoder reports an internal error to the frequency inverter. • Re-start encoder.

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 overtemperature PTC"*	Warning from the PTC resistor (trigger limit reached) • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Motor overtemp.I²t** *"Motor overtemperature I²t"* Only if I²t motor (P535) is programmed.	Warning: I²t motor monitoring (1.3 x the rated current reached for the time period set in (P535)) • Reduce motor load • Increase motor speed
	2.2	**Ext Resistor Temp** *"External braking resistor overtemperature"* Overtemperature via digital input (P420 […]) = {13}	Warning: Temperature sensor (e.g. braking resistor) has triggered • Digital input is low
C003	**3.0**	**Overcurrent, I²t limit**	Warning: Inverter: I²t 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 I²t**	Warning: I²t 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 3.0	• 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

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 frequency inverter data

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	> 95% according to size
Energy efficiency	IE2
Insulation resistance	> 5 MΩ
Leakage current	• ≤ 16 mA with standard configuration for operation with TN / TT network • ≤ 30 mA for configuration for operation in IT networks • The specifications apply to a pulse frequency from 4 kHz to 16 kHz (see also parameter P504)
Operating / ambient temperature	-25 °C … +40 °C, for detailed information (including UL values) on individual device types and operating modes, see (chapter 7.2).
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 Short-circuit, earth fault Overvoltage and undervoltage Overload, idling
Motor temperature monitoring	I^2t motor, PTC/bimetallic switch
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic curve, VFC open-loop, CFC open-loop, CFC closed-loop
Waiting period between two mains switch-on cycles	60 s for all devices in normal operating cycle
Interfaces	*Standard* RS485 (USS) (for parameterisation units only) RS232 (single slave) System bus *Option* 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 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.

7.2.1 Electrical data 3~400 V

Device type	SK 2xxE-FDS-…	-370-340-	-550-340-	-750-340-	-111-340-	-151-340-
	Size	0	1	1	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. braking resistor	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]

	Class	Isc [5] [A] 20 000	Isc [5] [A] 65 000		UL/CSA maximum permissible fuses and circuit breaker according to report (Individual fuse protection / group fuse protection)				
Fuse	CC, J, R, T, G, RK1, RK5		X		20 A	30 A	30 A	30 A	30 A
CB [6]	480 V		X		20 A	30 A	30 A	30 A	30 A
	500 V	X			20 A	30 A	30 A	30 A	30 A

1) Note the derating curve (🕮 Section (see chapter 8.4 "Reduced output power")).
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 fuse protection: maximum fuse size: 30 A
5) Maximum permissible mains short-circuit current. Note: Further restrictions are possible depending on the plug which is used (🕮 Section 1.6.1 "UL and CSA approval")
6) “Inverse time trip type” according to UL 489

Device 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. braking resistor	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	Isc [5] [A]	UL/CSA maximum permissible fuses and circuit breaker according to report (Individual fuse protection / group fuse protection)				
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 the derating curve (🕮 Section (see chapter 8.4 "Reduced output power")).
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 fuse protection: maximum fuse size: 30 A
5) Maximum permissible mains short-circuit current. Note: Further restrictions are possible depending on the plug 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

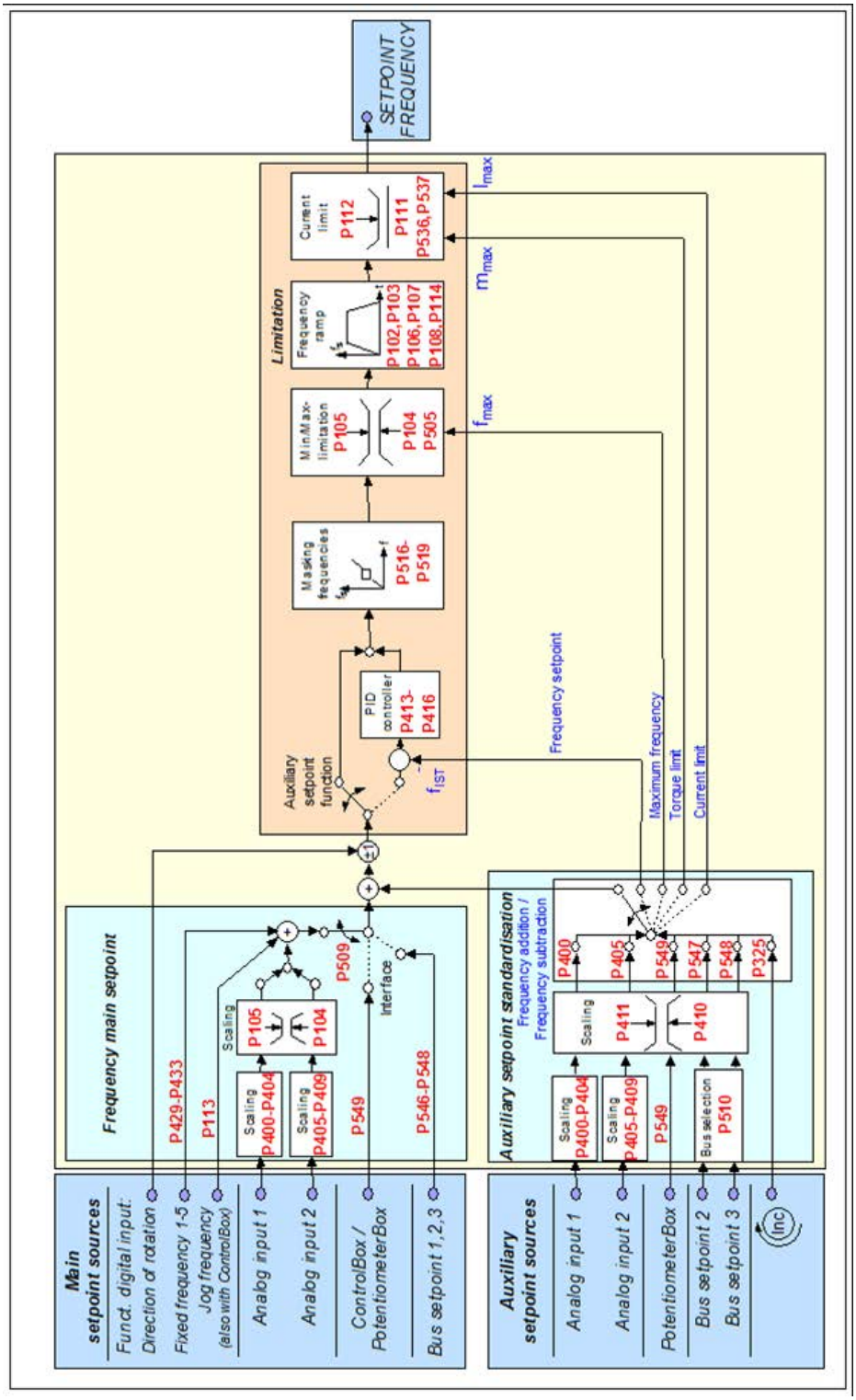
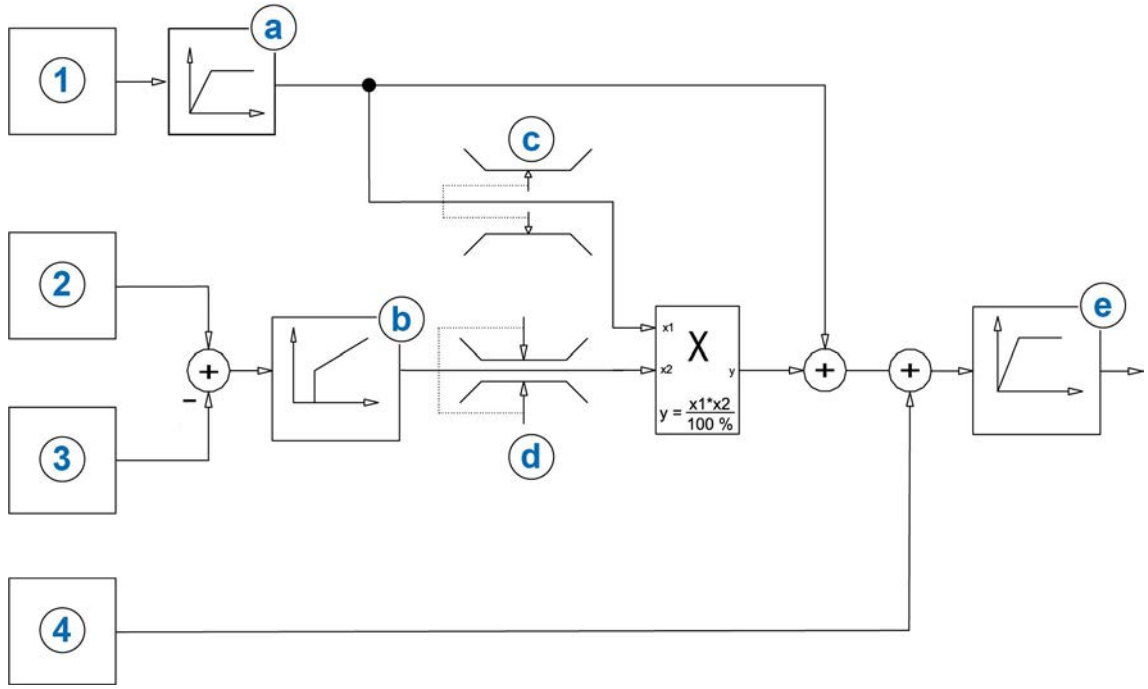


Figure 3 Setpoint processing

8.2 Process controller

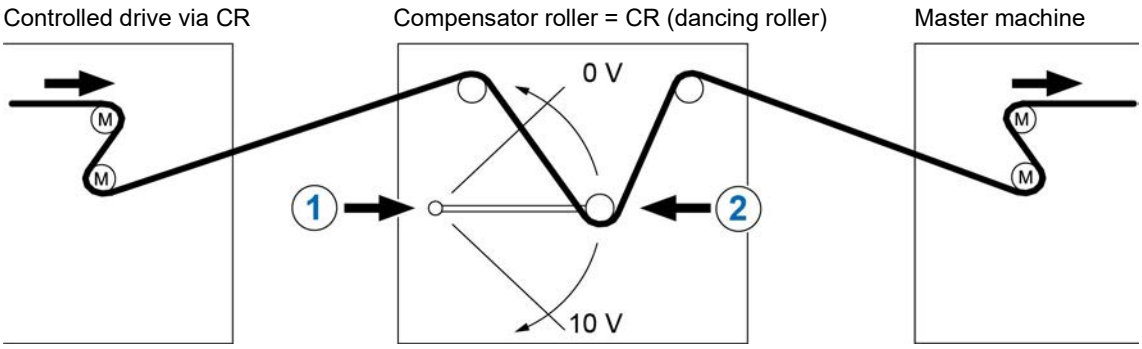
The process controller is a PI controller, with which the controller output can be limited. In addition, the output is scaled to a master setpoint on a percentage basis. This way, you can control a downstream drive with the master setpoint, and readjust with the PI controller.



1	Master setpoint	**P400**
2	Nom.val process ctrl	**P412**
3	Actual value	**P400**
4	Add. process control	**P400**
a	Ramptime PID control	**P416**
b	P factor I factor	**P413** **P414**
c	Min. limitation	**P466**
d	Max. limitation	**P415**
e	Acceleration time	**P102**

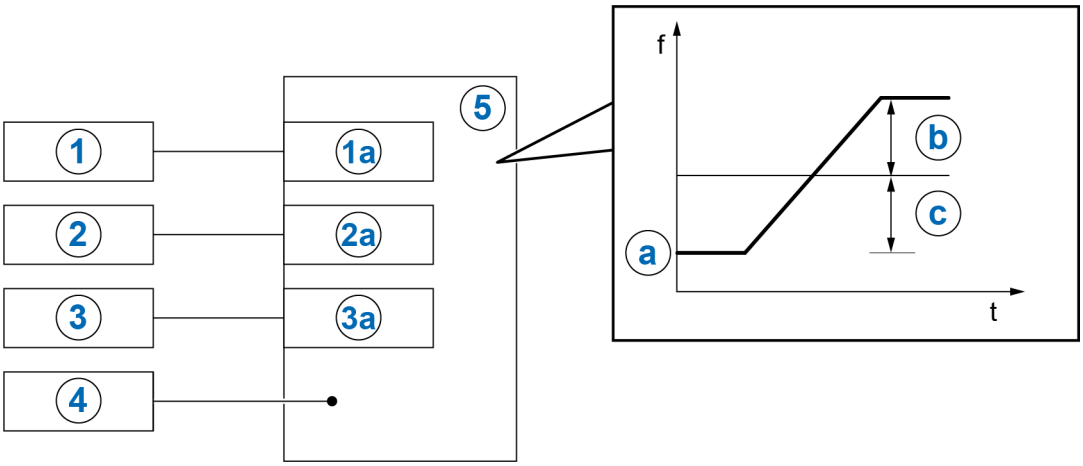
Figure 4: Flow chart: Process controller

8.2.1 Sample application: Process controller



1 Current position of CR via potentiometer 0 … 10 V

2 Centre = 5 V setpoint position



1	Setpoint of master machine	**1 a**	Analog input 1
2	Enable right	**2 a**	Digital input 1
3	Current position of compensator roller	**3 a**	Analog input 2
4	Correction factor Setpoint position of compensator roller via parameter **P412**	**5**	Frequency inverter
a	Setpoint of master machine		
b	Control limit **P415** in % of setpoint		
c	Control limit **P415**		

Figure 5: Sample application: Dancing roller

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 (environmental standard)***

   In this standard, the limit values are defined in dependence on the basic environment in which the product is operated. A distinction is made between two environments, where the ***first environment*** describes the non-industrial ***living and business area*** without its own high-voltage or medium-voltage distribution transformers. The ***second environment*** 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 limit values are subdivided into ***classes A1, A2 and B***.

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

   In this standard, the limit values are defined in dependence on the usage area of the product. The limit values are subdivided into ***categories C1, C2, C3 and C4***, where class C4 basically only applies to drive systems with higher voltage (≥ 1000 V AC) or higher current (≥ 400 A). However, class C4 can also apply to the individual device if it is incorporated in complex systems.

The same limit values apply to both standards. However, the standards differ with regard to an application that is extended in the product standard. The operator decides which of the two standards applies, whereby the environmental standard typically applies in the event of a fault remedy.

The main connection between the two standards is explained as follows:

Category according to EN 61800-3	C1	C2	C3
Limit value class according to EN 55011	B	A1	A2
Operation permissible in First environment (living environment)	X	X [1)]	-
Second environment (industrial environment)	X	X [1)]	X [1)]
Note required in accordance with EN 61800-3	-	[2)]	[3)]
Distribution channel	Generally available	Limited availability	
EMC expertise	No requirements	Installation and commissioning 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 8.3.2 "EMC evaluation".

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

The frequency inverter is designed for connection in industrial networks. In principle, it generates **harmonics** that exceed the harmonic limit values of EN IEC 61000-3-2 or EN IEC 61000-3-12. Additional external filtering measures are required to connect the individual frequency inverter to the public low-voltage network in accordance with IEC 61000-3-2 and IEC 61000-3-1.

If one or more frequency inverters are installed in a facility within the scope of IEC 61000-3-2 and IEC 61000-3-12, the requirements of these standards apply to the complete facility and not to the individual frequency inverter. The application of harmonic limit values to every frequency inverter is not recommended from neither a technical nor an economical point of view. Rather, a global approximation should be applied for filtering the entire system, which is based on the addition of all harmonic currents generated in the system. The system operator is responsible for this procedure.

Voltage fluctuations in a supply network essentially depend on the following factors:

- System design
- System impedance
- Load cycles

Therefore, the manufacturer of the machine or the system operator is responsible for evaluating the voltage fluctuations and ensuring compliance with the limit values according to IEC 61000-3-3 or IEC 61000-3-11.

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.

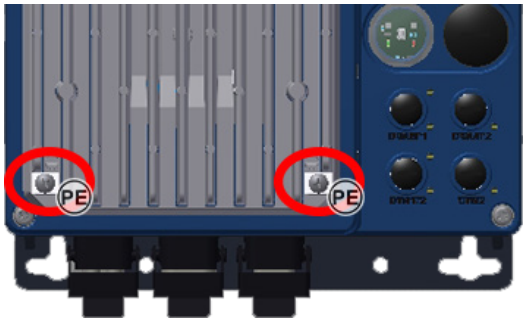
The limit value classes are only achieved if

- 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 Declarations 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

- **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

NORD GEAR LIMITED

Member of the NORD DRIVESYSTEMS GROUP

NORD Gear Limited
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DoC number C350900_0821_EN_UKCA

Declaration of Conformity

NORD Gear Limited hereby declares under sole responsibility that the product series as originally delivered:

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 functional variants:
SK 260E-FDS-..., SK 270E-FDS-..., SK 280E-FDS-...

and 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

complies with the following statutory requirements and carries the UKCA marking accordingly:	and conforms with the following designated standards:
Electrical Equipment (Safety) Regulations S.I. 2016/1101 (as amended)	EN 61800-5-1:2007+A1:2017 EN 61800-9-1:2017 EN 61800-9-2:2017 EN 60529:1991+A1:2000+A2:2013+AC:2016
Electromagnetic Compatibility Regulations S.I. 2016/1091 (as amended)	EN 61800-3:2004+A1:2012+AC:2014
Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations S.I. 2012/3032 (as amended)	BS EN IEC 63000:2018

According to the EMC directive, the listed devices are not independently operable products, they are intended for installation in machines. Compliance to the directive requires the correct installation of the product, it is necessary to take notice of the data and safety instructions in the installation and operating manual. Specifically take care regarding the correct EMC installation and cabling requirements.

Abingdon, 07.04.2021

Andrew Stephenson
Managing Director

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.

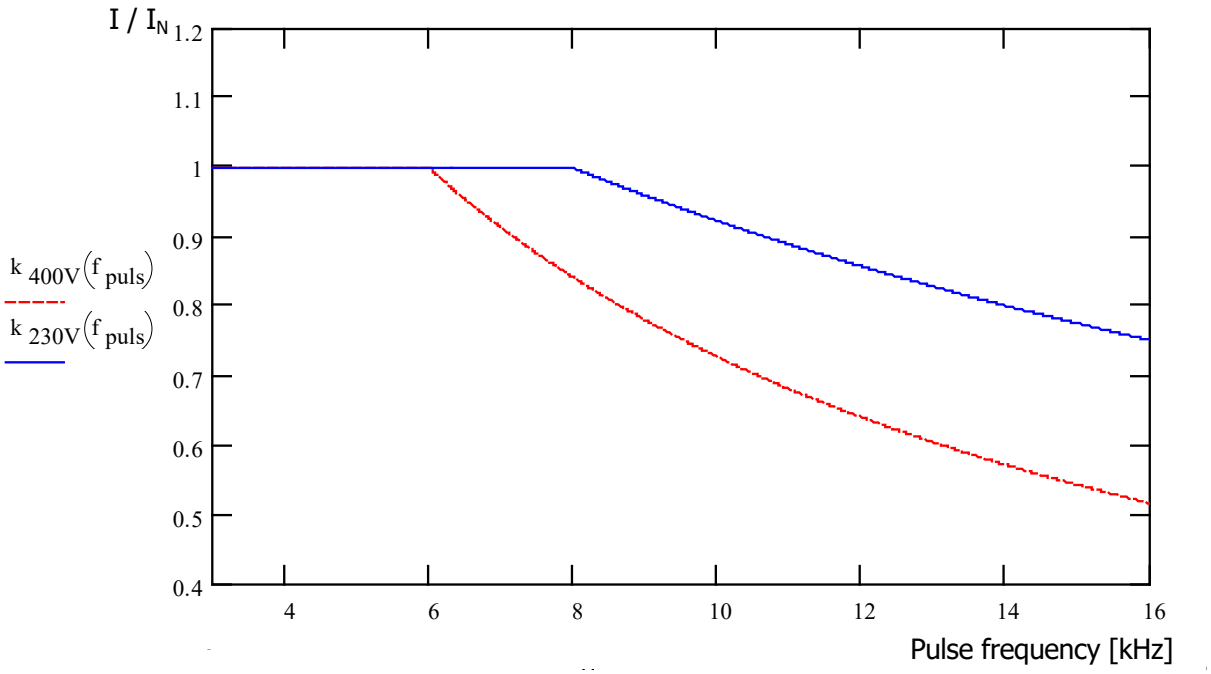


Figure 6: Heat losses due to pulse frequency

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.

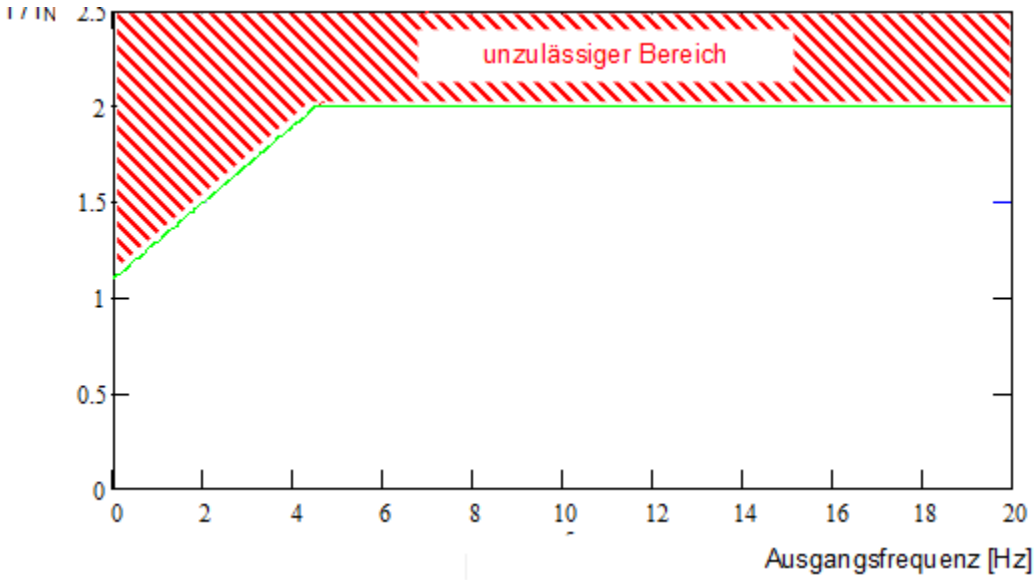
If operated repeatedly in the overload region at short intervals, the limiting values stated in the tables are reduced.

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 (< 4.5 Hz), monitoring is provided to determine the temperature of the IGBTs (*insulated-gate bipolar transistor*) due to high current. A pulse disconnection (P537) with variable limit is introduced so that no current can be accepted above the limit shown in the diagram. At standstill with 6 kHz pulse frequency, no current can thus be accepted above 1.1x the nominal current.



The resulting upper limit values for the pulse disconnection for the various pulse frequencies can be found in the following tables. The adjustable value (0.1 ... 1.9) that can be set in parameter P537 is in any case limited to the value specified in the tables depending on the pulse frequency. Values below the limit can be adjusted as required.

400 V devices: Reduced overload capability (approx.) due to pulse frequency (P504) and output frequency							
Pulse frequency [kHz]	Output frequency f_{out} [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 depending on 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.

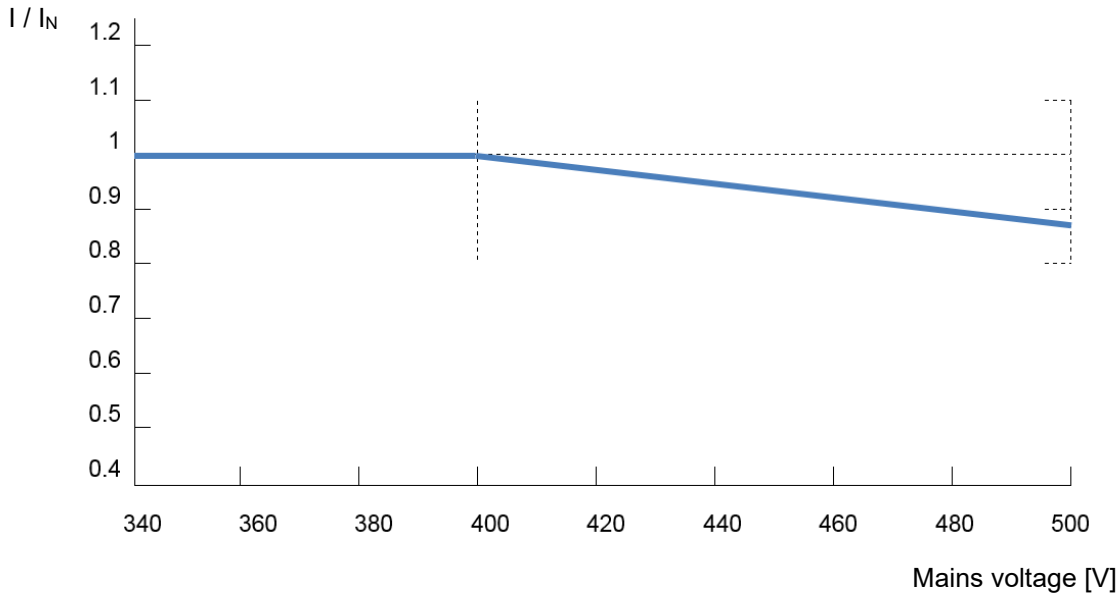


Figure 7: Reduced output current due to low voltage

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 RCD

When the mains filter is activated (standard configuration), the device is suitable for operation on a RCD (30 mA).

Only all-current sensitive RCDs (type B or B+) must be used.

Please also note the information on the leakage currents in the technical data (see chapter 7.1 "General frequency inverter data")and Chapter 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 optimisation when operating ASMs

⚠ 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, a “breakdown” of the motor may cause unexpected movement (e.g. dropping of loads by lifting equipment).

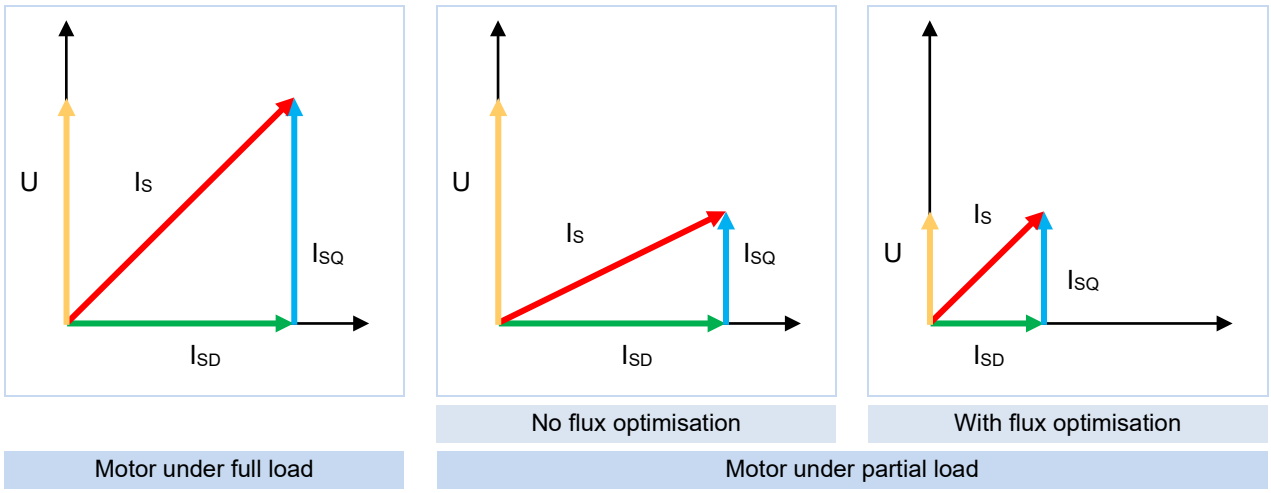
To prevent risk, the following must be observed:

- 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 protection against falling (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 Motor data – characteristic curves (Asynchronous motors)

The possible characteristic curves with which the motors can be operated are explained in the following. For operation with the 50 Hz or 87 Hz characteristic curve, the name plate data of the motor is relevant (🕮 Section). For operation with a 100 Hz characteristic curve, the use of specially calculated motor data is required (🕮 Section).

8.8.1 50 Hz characteristic curve

(→ Adjustment range 1:10)

For 50 Hz operation, the used motor can be operated up to its rating point at 50 Hz with nominal torque. Operation above 50 Hz is possible, but causes the torque output to reduce in a non-linear manner (see diagram). Above the rating point, the motor enters its field weakening range, as the voltage cannot be increased above the value of the mains voltage if the frequency is increased above 50 Hz.

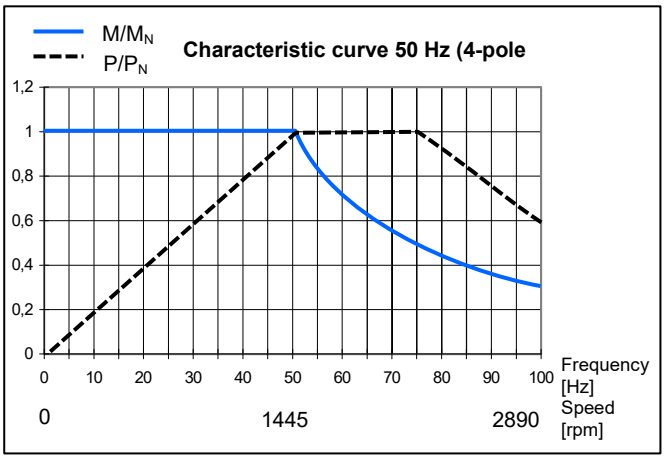


Figure 9: Characteristic curve 50 Hz

Information

Compare motor data with specifications on the name plate.

To be able to optimally adjust the frequency inverter to the motor used, the motor parameters must match with those of the motor.

- Select the motor used in the motor list in parameter **P200**. The motor list indicates the motor data of various NORD motors.
- When using motors of other energy efficiency classes than listed in **P200**, but in particular for use of third-party motors, compare the motor data in parameters **P201** … **P209** with the specifications on the name plate and correct them if necessary.
- Finally, you must calibrate the stator resistance, see **P220**, or enter it manually in **P208**.

400 V frequency inverter

The following data refer to a power of 2.2 kW on a 230/400 V winding of the motor.

It applies to IE1 and IE2 motors. Please note that these specifications may vary slightly, as the motors are subject to certain manufacturing tolerances. It is recommended to have the resistance of the connected motor calibrated by the frequency inverter (**P208 / P220**).

Motor (IE1) SK …	**Frequency inverter SK 2xxE-FDS-…**	**M_N 1) [Nm]**	**Motor data for parameterisation**							
			F_N [Hz]	n_N [min-1]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
80S/4	550-340-	3,82	50	1385	1,51	400	0,55	0,75	Y	15,79
80L/4	750-340-	5,21	50	1395	2,03	400	0,75	0,75	Y	10,49
90S/4	111-340-	7,53	50	1410	2,76	400	1,1	0,76	Y	6,41
90L/4	151-340-	10,3	50	1390	3,53	400	1,5	0,78	Y	3,99
100L/4	221-340-	14,6	50	1415	5,0	400	2,2	0,78	Y	2,78
100LA/4	301-340-	20,2	50	1415	6,8	400	3,0	0,78	Δ	5,12
112M/4	401-340-	26,4	50	1430	8,24	400	4,0	0,83	Δ	3,47
132S/4	551-340-	36,5	50	1450	11,6	400	5,5	0,8	Δ	2,14
132M/4	751-340-	49,6	50	1450	15,5	400	7,5	0,79	Δ	1,42

1) At the rating point

Motor (IE2) SK …	**Frequency inverter SK 2xxE-FDS-…**	**M_N 1) [Nm]**	**Motor data for parameterisation**							
			F_N [Hz]	n_N [rpm]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
80SH/4	550-340-	3,82	50	1415	1,38	400	0,55	0,7	Y	9,34
80LH/4	750-340-	5,21	50	1410	1,8	400	0,75	0,75	Y	6,30
90SH/4	111-340-	7,53	50	1430	2,46	400	1,1	0,8	Y	4,96
90LH/4	151-340-	10,3	50	1420	3,38	400	1,5	0,79	Y	3,27
100LH/4	221-340-	14,6	50	1445	4,76	400	2,2	0,79	Y	1,73
100AH/4	301-340-	20,2	50	1420	6,4	400	3,0	0,77	Δ	4,39
112MH/4	401-340-	26,4	50	1440	8,12	400	4,0	0,83	Δ	2,96
132SH/4	551-340-	36,5	50	1455	10,82	400	5,5	0,83	Δ	1,84
132MH/4	751-340-	49,6	50	1455	15,08	400	7,5	0,8	Δ	1,29

1) At the rating point

8.8.2 87 Hz characteristic curve (only 400V devices)

(→ Variation 01:17)

The 87 Hz - characteristic represents an extension of the speed adjustment range with a constant motor nominal torque. The following points must be met for realisation:

- Motor delta connection with a motor winding for 230/400 V
- Frequency inverter with an operating voltage 3~400 V
- Output current of frequency inverter must be greater than the delta current of the motor used (ref. value → frequency inverter power ≥ √3 motor power)

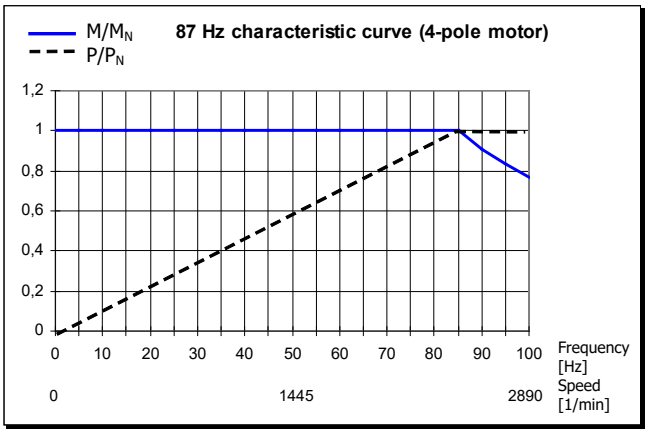


Figure 10: 87 Hz characteristic curve

In this configuration, the motor used has a rated operating point at 230 V/50 Hz and an extended operating point at 400 V/ 87 Hz. This increases the power of the drive by a factor of √3 The nominal torque of the motor remains constant up to a frequency of 87 Hz. Operation of a 230 V winding with 400 V is totally uncritical as the insulation is designed for test voltages of > 1000 V.

Information

The following motor data applies to standard motors with a 230 V/400 V winding.

Motor (IE1) SK …	Frequency inverter SK 2xxE-FDS-…	M_N 1) [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [min-1]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
71S/4	550-340-	1,73	50	1365	1,3	230	0,25	0,79	Δ	39,9
71L/4	750-340-	2,56	50	1380	1,89	230	0,37	0,71	Δ	22,85
80S/4	111-340-	3,82	50	1385	2,62	230	0,55	0,75	Δ	15,79
80L/4	151-340-	5,21	50	1395	3,52	230	0,75	0,75	Δ	10,49
90S/4	221-340-	7,53	50	1410	4,78	230	1,1	0,76	Δ	6,41
90L/4	301-340-	10,3	50	1390	6,11	230	1,5	0,78	Δ	3,99
100L/4	401-340-	14,6	50	1415	8,65	230	2,2	0,78	Δ	2,78
100LA/4	551-340-	20,2	50	1415	11,76	230	3,0	0,78	Δ	1,71
112M/4	751-340-	26,4	50	1430	14,2	230	4,0	0,83	Δ	1,11

1) At the rating point

Motor (IE2) SK …	Frequency inverter SK 2xxE-FDS-…	M_N [1] [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [rpm]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
80SH/4	111-340-	3,73	50	1415	2,39	230	0,55	0,7	Δ	9,34
80LH/4	151-340-	5,06	50	1410	3,12	230	0,75	0,75	Δ	6,30
90SH/4	221-340-	7,32	50	1430	4,26	230	1,1	0,8	Δ	4,96
90LH/4	301-340-	10,1	50	1420	5,85	230	1,5	0,79	Δ	3,27
100LH/4	401-340-	14,5	50	1445	8,25	230	2,2	0,79	Δ	1,73
100AH/4	551-340-	20,3	50	1420	11,1	230	3,0	0,77	Δ	1,48
112MH/4	751-340-	26,6	50	1440	14,1	230	4,0	0,83	Δ	1,00

1) At the rating point

Motor (IE3) SK …	Frequency inverter SK 2xxE-FDS-…	M_N [1] [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [min-1]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
63 SP/4	370-340-	0,84	50	1370	0,68	230	0,12	0,66	Δ	66,7
63 LP/4	370-340-	1,24	50	1385	1,02	230	0,18	0,62	Δ	39,7
71 SP/4	550-340-	1,69	50	1415	1,21	230	0,25	0,71	Δ	24,0
71 LP/4	750-340-	2,51	50	1405	1,58	230	0,37	0,76	Δ	17,7
80 SP/4	111-340-	3,70	50	1420	2,23	230	0,55	0,75	Δ	10,4
80 LP/4	151-340-	5,06	50	1415	3,10	230	0,75	0,72	Δ	6,50
90 SP/4	221-340-	7,35	50	1430	4,12	230	1,1	0,78	Δ	4,16
90 LP/4	301-340-	10,1	50	1415	5,59	230	1,5	0,79	Δ	3,15
100 LP/4 [2]	401-340-	14,4	50	1460	8,13	230	2,2	0,76	Δ	1,77
100 AP/4 [2]	551-340-	19,8	50	1450	10,9	230	3,0	0,8	Δ	1,29
112 MP/4	751-340-	26,5	50	1440	13,6	230	4,0	0,83	Δ	0,91

1) At the rating point

2) APAB series

8.8.3 100 Hz characteristic curve (only 400 V devices)

(→ adjustment range 1:20)

An operating point 100 Hz / 400 V can be selected for a large speed adjustment range up to a ratio of 1:20. This requires special motor data (see below) that deviates from the usual 50 Hz data. It must be noted that a constant torque is generated over the entire adjustment range, but that it is less than the nominal torque at 50 Hz operation.

The advantage, in addition to the large speed adjustment range, is the better temperature behaviour of the motor. An external fan is not necessarily required in low output speed ranges.

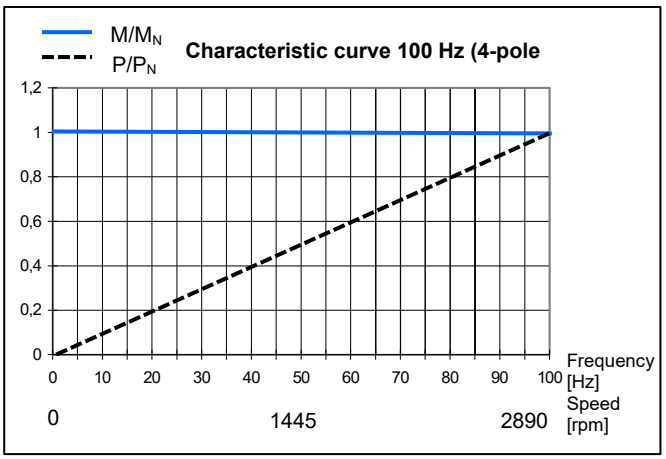


Figure 11: Characteristic curve 100 Hz

Information

The following motor data applies to standard motors with a 230 / 400 V winding. Please note that these specifications may vary slightly, as the motors are subject to certain manufacturing tolerances. It is recommended to have the resistance of the connected motor calibrated by the frequency inverter (P208 / P220).

Motor (IE1) SK …	Frequency inverter SK 2xxE-FDS-…	M_N 1) [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [min-1]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
63L/4	370-340-	1,23	100	2895	1,07	400	0,37	0,71	Δ	39,90
71L/4	550-340-	1,81	100	2900	1,59	400	0,55	0,72	Δ	22,85
80S/4	750-340-	2,46	100	2910	2,0	400	0,75	0,72	Δ	15,79
80L/4	111-340-	3,61	100	2910	2,8	400	1,1	0,74	Δ	10,49
90S/4	151-340-	4,90	100	2925	3,75	400	1,5	0,76	Δ	6,41
90L/4	221-340-	7,19	100	2920	4,96	400	2,2	0,82	Δ	3,99
100L/4	301-340-	9,78	100	2930	6,95	400	3,0	0,78	Δ	2,78
100LA/4	401-340-	12,95	100	2950	7,46	400	4,0	0,76	Δ	1,71
112M/4	551-340-	17,83	100	2945	11,3	400	5,5	0,82	Δ	1,11
132S/4	751-340-	24,24	100	2955	16,0	400	7,5	0,82	Δ	0,72

1) At the rating point

Motor (IE2) SK …	Frequency inverter SK 2xxE-FDS-…	M_N 1) [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [rpm]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
80SH/4	750-340-	2,44	100	2930	1,9	400	0,75	0,7	Δ	9,34
80LH/4	111-340-	3,60	100	2920	2,56	400	1,1	0,73	Δ	6,3
90SH/4	151-340-	4,89	100	2930	3,53	400	1,5	0,79	Δ	4,96
90LH/4	221-340-	7,18	100	2925	4,98	400	2,2	0,79	Δ	3,27
100LH/4	301-340-	9,69	100	2955	6,47	400	3,0	0,78	Δ	1,73
100AH/4	401-340-	13,0	100	2940	8,24	400	4,0	0,79	Δ	1,48
112MH/4	551-340-	17,8	100	2950	11,13	400	5,5	0,82	Δ	1,0
132SH/4	751-340-	24,2	100	2960	15,3	400	7,5	0,83	Δ	0,6

1) At the rating point

Motor (IE3) SK …	Frequency inverter SK 2xxE-FDS-…	M_N 1) [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [min-1]	I_N [A]	U_N [V]	P_N [kW]	cos φ	Y/Δ	R_{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
63 SP/4	370-340-	0,59	100	2885	0,58	400	0,18	0,61	Δ	66,7
63 LP/4	370-340-	0,82	100	2910	0,83	400	0,25	0,56	Δ	39,7
71 SP/4	370-340-	1,20	100	2920	1,01	400	0,37	0,69	Δ	24,0
71 LP/4	550-340-	1,79	100	2925	1,34	400	0,55	0,72	Δ	17,7
80 SP/4	750-340-	2,44	100	2935	1,77	400	0,75	0,73	Δ	10,4
80 LP/4	111-340-	3,58	100	2930	2,13	400	1,1	0,84	Δ	6,50
90 SP/4	151-340-	4,86	100	2945	3,1	400	1,5	0,79	Δ	4,16
90 LP/4	221-340-	7,17	100	2930	4,33	400	2,2	0,83	Δ	3,15
100 LP/4 2)	301-340-	9,65	100	2970	5,79	400	3,0	0,82	Δ	1,77
100 AP/4 2)	401-340-	12,9	100	2960	7,52	400	4	0,85	Δ	1,29
112 MP/4	551-340-	17,8	100	2950	10,3	400	5,5	0,85	Δ	0,91
132 SP/4	751-340-	24,1	100	2970	14,3	400	7,5	0,83	Δ	0,503

1) At the rating point

2) APAB series

8.9 Motor data – characteristic curves (synchronous motors)

When operating the motor on a NORDAC frequency inverter, use the motor data listed in the corresponding motor data sheet to parameterise the motor data. The motor data sheet is available from NORD or can be requested from NORD.

For the assignments of the motors to a frequency inverter, refer to 🕮 B5000.

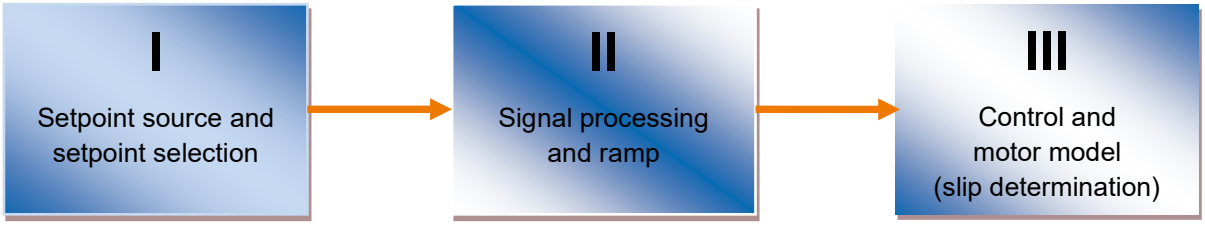
8.10 Scaling of set-/actual values

The following table contains details for the scaling of typical set-/actual values. These details relate to parameter (P400), (P418), (P543), (P546), (P740) or (P741).

Designation	**Analogue signal**		**Bus signal**					
Setpoints {Function}	Value range	Scaling	Value range	Max. value	100% =	-100% =	Scaling	Limit absolute
Set point frequency { 1 }	0-10 V (10 V = 100%)	P104 … P105 (min - max) P104+(P105-P104) *U_{AIN} [V]/10 V	±100%	16384	4000h 16384	C000h -16384	4000h * f_{soll} [Hz]/P105	P105
Frequency addition { 2 }	0-10 V (10 V = 100%)	P410 … P411 (min - max) P410+(P411-P410) *U_{AIN} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * f_{soll} [Hz]/P411	P105
Frequency subtract. { 3 }	0-10 V (10 V = 100%)	P410 … P411 (min - max) P410+(P411-P410) *U_{AIN} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * f_{soll} [Hz]/P411	P105
Minimum frequency { 4 }	0-10 V (10 V = 100%)	50 Hz* U_{AIN} [V]/10 V	0 … 200% (50Hz=100%)	32767	4000h 16384	/	4000h * f_{min} [Hz] / 50 Hz	P105
Maximum frequency { 5 }	0-10 V (10 V = 100%)	100 Hz* U_{AIN} [V]/10 V	0 … 200% (100Hz=100%)	32767	4000h 16384	/	4000h * f_{max} [Hz] / 100 Hz	P105
Cur.val process ctrl { 6 }	0-10 V (10 V = 100%)	P105* U_{AIN} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * f_{soll} [Hz]/P105	P105
Nom.val process ctrl { 7 }	0-10 V (10 V = 100%)	P105* U_{AIN} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * f_{soll} [Hz]/P105	P105
Torque current limit { 11 }, { 12 }	0-10 V (10 V = 100%)	P112* U_{AIN} [V]/10 V	0 … 100%	16384	4000h 16384	/	4000h * Torque [%] / P112	P112
Current limit { 13 }, { 14 }	0-10 V (10 V = 100%)	P536* U_{AIN} [V]/10 V	0 … 100%	16384	4000h 16384	/	4000h * Current limit [%] / (P536 * 100 [%])	P536
Ramp time { 15 }	0-10 V (10 V = 100%)	10 s* U_{AIN} [V]/10 V	0 … 200%	32767	4000h 16384	/	4000h * Ramp time [s] / 10 s	20s
When specified via bus, the ramp time must not be set at the same time as the enable removal. It must be set beforehand. Otherwise, the old ramp time is used to calculate the disconnection control. This may result in error 13.2.								
Actual values {Function}								
Actual frequency { 1 }	0-10 V (10 V = 100%)	P201* U_{AOut} [V]/10 V	±100%	16384	4000h 16384	C000h -16384	4000h * f [Hz]/P105	
Speed { 2 }	0-10 V (10 V = 100%)	P202* U_{AOut} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * n [rpm]/P202	
Current { 3 }	0-10 V (10 V = 100%)	P203* U_{AOut} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * I [A]/P203	
Torque current { 4 }	0-10 V (10 V = 100%)	P112* 100/ √((P203)²-(P209)²)* U_{AOut} [V]/10 V	±200%	32767	4000h 16384	C000h -16384	4000h * I_q [A]/(P112)*100/ √((P203)²-(P209)²)	
Freq. Master Value { 19 } … { 24 }	/	/	±100%	16384	4000h 16384	C000h -16384	4000h * f [Hz]/P105	
Speed from encoder { 22 }	/	/	±200%	32767	4000h 16384	C000h -16384	4000h * n [rpm]/ P201*(60 / number of pairs of poles)	

8.11 Definition of set and actual value processing (frequencies)

The frequencies used in <v>T - Parameter bei Soll-Ist-Verarbeitung</v> are processed in various ways according to the following table.



Func.	Name	Meaning	Output to ...			Without left/right	With slip
			I	II	III		
8	Set point frequency	Set point frequency from setpoint source	X				
1	Actual frequency	Set point frequency before motor model		X			
23	Act. freq. With slip	Actual frequency on the motor			X		X
19	Freq. Master Value	Set point frequency from setpoint source Master value (freed from enable direction)	X			X	
20	Set Freq. After Ramp	Set point frequency before motor model Master value (freed from enable direction)		X		X	
24	Lead.act.freq.+slip	Actual frequency on the motor Master value (freed from enable direction)			X	X	X
21	Act. Freq. w/o Slip	Actual frequency without slip Master value			X		

Table 10: Set and actual value processing in the frequency inverter

8.12 Motor temperature monitoring

Motors must be effectively protected against overload. The frequency inverter can take over this task by evaluating temperature sensors and by recording and evaluating various electrical operating values.

The following options are available.

1. **Measurement of the motor temperature with a temperature sensor**

   The motor winding's temperature is measured directly by temperature sensors integrated into the motor winding. A distinction is made between 2 function types:

   a. Threshold value monitoring by PTC resistor

      A PTC resistor is connected to a digital input that has been parameterised accordingly or, if available, to the terminals of the frequency inverter's PTC resistor input. When a defined threshold value is reached, the drive is switched off in time.

   b. Monitoring by temperature sensors with linear characteristic curve (e.g. KTY84 / PT1000)

      The temperature sensor is connected to an analogue input of the frequency inverter that has been parameterised accordingly. In this case, too, the drive is switched off when a defined temperature is reached.
      In addition, the measurement values recorded are also used to optimise the motor control.
      Details: See Chapter 4.4 "Temperature sensors"

2. **Sensorless motor temperature monitoring**

   Sensorless motor temperature monitoring is based on a mathematical calculation. The measured motor current is set in relation to the time (I^2t monitoring) and the change in motor temperature is calculated. The actual motor temperature is then concluded by adding the approximate motor start temperature, i.e. the temperature that the motor had at the time of initial switch-on ("Enable left" or "Enable right") after the "POWER ON" of the frequency inverter.

   From firmware version V 2.0 R1 and higher, the approximate motor start temperature is determined by measuring the stator resistance. The time of the measurement can be configured and is defined via parameter P336 "Mode Rotorpos ident".
   For older firmware versions, the approximate motor start temperature was assumed through a defined value, which affected the accuracy of the temperature monitoring.

   The sensorless monitoring function is inactive by default. It is activated by parameterising the function "I^2t motor" (parameter P535 ≠ "0").

8.13 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.

8.13.1 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 type: ***HARTING Q2/0+ (socket)***

Recommended product for mating connectors to the installed plug system

Plug HAN Q2/0 (pin)

Quantity	Designation	Manufacturer	Information
1 x	Sleeve housing HAN-Compact	Harting	Straight cable outlet, M25 (19 12 008 0429)
1 x	Contact insert HANQ2/0 (pin)	Harting	(09 12 002 3051)
3 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)***

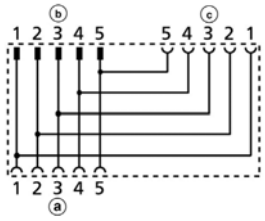
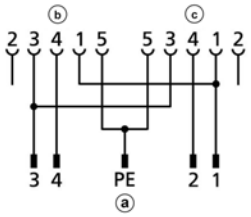
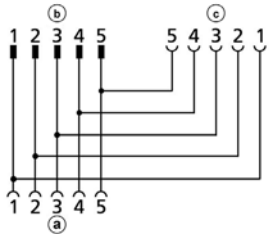
Recommended products for mating connectors to the installed plug connector system

Hybrid plug connector HAN Q8/0 (pin)

Quantity	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)
8 x	Crimp contact socket 1.5mm²	Harting	(09 33 000 6104)
1 x	HAN-Compact half cable gland	Harting	M25 – 14…17mm (19 12 000 5158)

8.13.2 M12 Y distributor

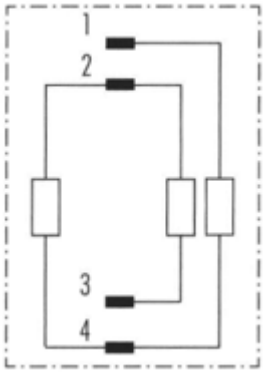
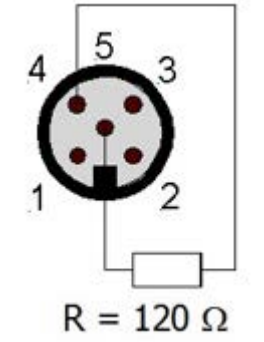
To create complex supply or communication lines, we recommend the use of Y distributors. These are mounted directly on the relevant M12 plug connector of the field distributor and enable direct connection to the particular line.

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

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

8.13.3 M12 terminating resistor

Depending on the bus participants installed, the mounted bus system must be fitted with an external terminating resistor at the open ends. The following M12 terminating resistors are suitable for this.

Designation	Bus system	Material number	Contact diagram
Terminating resistor, M12 plug connector, 4-pole, straight The resistance to the PROFIBUS termination is 220Ω.	PROFIBUS	275130076	
Terminating resistor, M12 plug connector, 5-pole, straight, IP67	CAN	275130083	

8.13.4 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

8.13.5 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

8.13.6 Daisy chain cable

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

NOTICE

Overload/destruction of the cables in the daisy chain

The maximum possible current for looping is limited by different plugs or cable cross-sections.

- It is essential to observe the resulting total currents and data sheets of the cables used.

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

8.13.7 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 information

NORD frequency inverters are *maintenance-free* in normal operation(chapter 7).

Dusty environments

If the device is operated in dusty air, the cooling surfaces must be cleaned with compressed air at regular intervals.

Long-term storage

Information

Climatic conditions for long-term storage

- Temperature: +5 to +35°C
- Relative humidity: < 75%

The device must be connected to the supply network for at least 60 minutes each year. During this time, the device must not be loaded at either the motor or control terminals.

If these steps are not taken, this may result in destruction of the device.

NOTICE

Load during the regeneration process

A load on the motor output or the 24 V output can destroy the device.

- Always provide an external 24 V supply for regeneration for devices without an integrated power supply unit (“-HVS” option).
- Never load the motor output or the 24 V output during the approx. 60-minute regeneration process.

9.2 Service notes

In case of service/repair, contact your NORD Service contact person. You will find your contact person listed on your order confirmation. Additionally, you will find further possible contact persons using the following link: https://www.nord.com/de/global/locator-tool.jsp.

When contacting our technical support please have the following information available:

- Device type (name plate / display)
- Serial number (name plate)
- Software version (parameter P707)
- Information regarding accessories and options used

If you would like to send the device in for repair please proceed as follows:

- Remove all non-original parts from the device.

  NORD accepts no liability for any attached parts such as power cables, switches or external displays!

- Back up the parameter settings before sending in the device.
- State the reason for sending in the component / device.
  - You can obtain a return note from our web site (Link) or from our technical support.
  - In order to rule out the possibility that the device fault is cause by an optional module, the connected optional modules should also be returned in case of a fault.
- Specify a contact person for possible queries.

Information

Factory settings of parameters

Unless otherwise agreed, the device is reset to the factory settings after inspection/repair.

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

9.3 Disposal

NORD products are made of high-quality components and valuable materials. Therefore, have faulty or defective appliances checked to see if they can be repaired and reused.

If repair and reuse is not possible, observe the following disposal notes.

9.3.1 Disposal according to German law

- The components are marked with the crossed-out waste bin according to the “Electrical and Electronic Equipment Directive – ElektroG3” (dated 20 May 2021, valid from 1 January 2022).

  The appliances must therefore not be disposed of as unsorted municipal waste, but must be collected separately and handed to a WEEE (Waste of Electrical and Electronic Equipment) registered collection point.

- The components do not contain any electrochemical cells, batteries or accumulators, which must be separated and disposed of separately.
- In Germany, NORD components can be handed in at the headquarters of Getriebebau NORD GmbH & Co. KG.

WEEE Reg. No.	Name of the manufacturer / authorised representative	Category	Appliance type
DE12890892	Getriebebau NORD GmbH & Co. KG	Appliances where at least one of the outer dimensions exceeds 50 cm (large appliances)	Large appliances for exclusive use in other than private households
		Appliances where none of the outer dimensions exceeds 50 cm (small appliances)	Small appliances for exclusive use in other than private households

- Contact: info@nord.com

9.3.2 Disposal outside of Germany

Outside Germany, please contact the local subsidiaries or distributors of the NORD DRIVESYSTEM Group.

9.4 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	Analogue output	**ISD**	Field current (current vector control)
AUX	Auxiliary voltage	**LED**	Light-emitting diode
BR + / BR -	Contacts for connecting a brake	**LPS**	List of configured slaves (AS-I)
BW	Braking resistor	**nc.**	not connected: Connection point is without function
DI (DIN) **DigIn**	Digital input	**PMSM**	Permanent magnet synchronous machine / motor
DS (LED)	Status LED – device status	**PLC**	Programmable logic controller
CFC	Current flux control (current-controlled, field-oriented control)	**PE**	Protective earth
DO (DOUT) **DigOut**	Digital output	**PELV**	Protective extra low voltage
I/O	Input / Output	**S**	Supervisor parameter, P003
EEPROM	Non-volatile memory	**SW**	Software version, P707
EMF	Electromotive force (induction voltage)	**TI**	Technical information / data sheet (Data sheet for NORD accessories)
EMC	Electromagnetic compatibility	**VFC**	Voltage flux control (voltage-controlled, field-oriented control)

Key word index

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