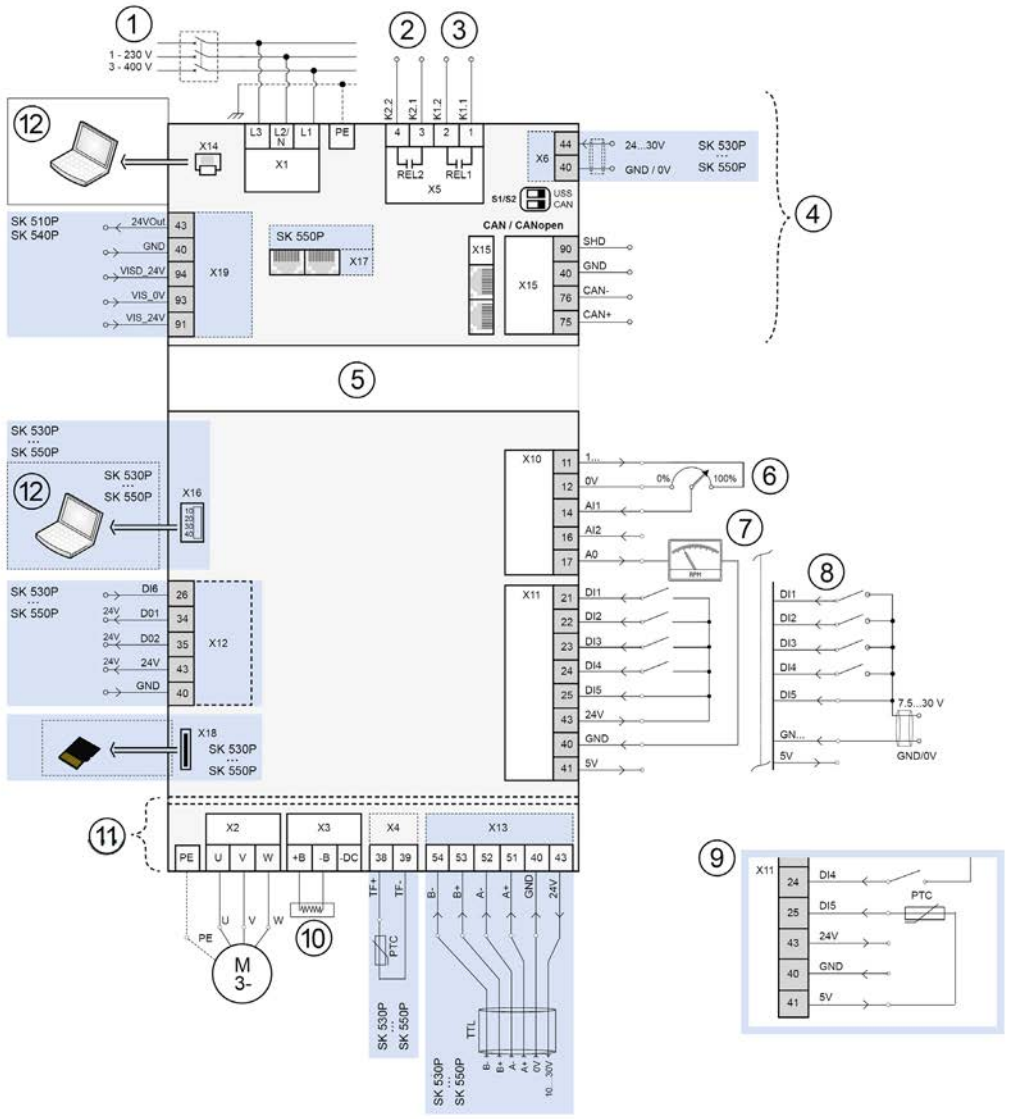
BU 0600 – en

NORDAC *PRO* (SK 500P series)

Manual with installation instructions

NORD DRIVESYSTEMS

Wiring diagram



1	Power supply suitable for the device (see technical data)	8	Alternative example “Digital input power supply via external power source (24 V DC)”
2	Connection message “Inverter ready” (default)	9	Alternative example “PTC connected to D15”
3	Electromechanical brake connection (default)	10	Optional braking resistor
4	Top view	11	Bottom view
5	Slot for optional modules SK CU5-…, SK TU5-…	12	Customer unit (NORDCON, Bluetooth stick, ControlBox)
6	Setpoint (e.g. speed)	M	Motor
7	Actual value (e.g. speed)		

Important: Please note the detailed description of the control terminals in the manual.

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.

Product information

The document describes the following devices:

Designation:	**BU 0600**
Part no.:	6076002
Series:	NORDAC *PRO*
Device series:	SK 500P, SK 510P, SK 530P, SK 540P, SK 550P
Device types:	SK 5xxP-250-123- ... SK 5xxP-221-123-
	SK 5xxP-250-340- ... SK 5xxP-163-340-

Version list

Title, Date	Order number	Software version of device	Remarks
BU 0600, June 2019	6076002 / 2319	V 1.0 R1	Field test version
BU 0600, March 2020	6076002 / 1020	V 1.1 R1	First edition
BU 0600, July 2021	6076002 / 3021	V 1.1 R1	• Update of “Standards and approvals” • Update of EU Declaration of Conformity • Supplementation of data according to the Ecodesign Directive
BU 0600, August 2021	6076002 / 3221	V 1.3 R0	• Circuit diagram integrated • Parameters revised – Indication of visibility via mains voltage – Setting values / arrays adjusted • Operating status messages revised • Rotor position identification via dwell method for PMSM • Motor chokes supplemented • Supplements to EMC kits
BU 0600, September 2021	6076002 / 3921	V 1.3 R0	• Supplementation of sizes 4 and 5

Title, Date	Order number	Software version of device	Remarks
BU 0600, October 2022	6076002 / 4022	V 1.3 R5	• Supplement to the section on the motor data • Supplement to the standby values for the UKCA • General corrections • Supplementation of disposal notes
BU 0600, June 2024	6076002 / 2324	V 1.4 R0	• General corrections • Supplementation of sizes 6 – 10 including accessories • SK 540P added • Addition of sections “FAQ operational problems“ and “Motor temperature monitoring” • New SK TU5-PAR module • Adjustment of parameters P327, P328, P336, P535, P718, P719, P722 • Addition of parameters P221, P337 – P342, P765

Table 1: Version list

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 0,25 kW to 160,0 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 ...).

Information

Processor compatibility

As of firmware version 1.3 R0, only processors with large memories are supported. This version is therefore not compatible with older devices and hardware status AAA (Chap. 1.8.1 "Name plate").

1.1 Device characteristics

The NORDAC *PRO* series is available in various device variants. The following gives an overview of the essential device characteristics of the individual variants.

		Basic Drive	Advanced Drive		
Characteristic	**SK …**	**500P/510P**	**530P/540P**	**550P**	**Additional information**
Operating manual		**BU 0600**			
Legend					
x =	Present	- =	Not present	O =	Optionally available
Sensorless current vector control (high starting torque and precise control of motor speed)		x	x	x	
Asynchronous motor operation		x	x	x	
Operation of PMSM (Permanent Magnet Synchronous Motor)		x	x	x	
Operation permissible on network types: TN, TT, IT [1)]		x	x	x	(Chap. 2.5.3.2)
DC coupling / link circuit coupling		x	x	x	(Chap. 2.5.3.5)
Brake management for mechanical holding brake		x	x	x	(Chap. 2.5.3.1)
Brake chopper (braking resistor optional)		x	x	x	(Chap. 2.5.3.4)
Integrated EMC mains filter for Class A1 / Category C2 / C3 limits		x	x	x	(Chap. 8.3)
Can be mounted next to each other without additional spacing		x	x	x	(Chap. 2)
Extensive monitoring functions		x	x	x	(Chap. 7)
Status LEDs (device / bus)		x / x	x / x	x / x	(Chap. 6.1)
Status LEDs ((Industrial Ethernet)		-	-	x	🕮 BU 0620
Stator resistance measurement		x	x	x	(Chap. 5.1.4), P220
Automatic optimisation of precise motor data		x	x	x	
Internal 24 V power supply unit to supply the control board		x	x	x [2)]	An additional power supply is required for the bus communication.

Characteristic	SK …	Basic Drive 500P/510P	Advanced Drive 530P/540P	Advanced Drive 550P	Additional information
Operating manual		BU 0600			

Legend

x =	Present	- =	Not present	O =	Optionally available

External connection to supply the control board's 24 V DC supply voltage with automatic switching between the external and internal 24 V DC power supply and supply for the Ethernet interface. **Note:** Observe the restrictions for individual parameters.	–	x	x	(Chap. 2.5.4)
RS-232 / -485 diagnostic interface via RJ12 connection	x	x	x	
RS-232 diagnostic interface via USB-C connection [3)]	–	x	x	
USS and Modbus RTU on board	x	x	x	
System bus (CANopen) on board	x	x	x	
Industrial Ethernet on board	–	–	x	🕮 BU 0620
Plug-in data storage via microSD card (for exchange of parameters)	–	x	x	See "microSD-card X18"/ "P550"
Parameters pre-set with standard values	x	x	x	(Chap. 5)
4 switchable parameter sets	x	x	x	
Parameterisation with NORDCON software, NORDCON *APP* or external parameterisation unit via RJ12	x	x	x	🕮 BU 0000 🕮 BU 0040
Parameterisation is possible with NORDCON software via USB interface without mains connection or 24 V DC power supply [3)].	–	x	x	
Programmable direct current braking	x	x	x	(Chap. 5.1.3), P108
Energy-saving function (automatic load-dependent flux optimisation)	x	x	x	(Chap. 8.7)
Water-repellent coating of electronic components	O[12)]	O[12)]	O[12)]	Used to increase operational reliability in case of condensation.

Characteristic	SK …	Basic Drive 500P/510P	Advanced Drive 530P/540P	Advanced Drive 550P	Additional information
Operating manual		BU 0600			
Legend: x = Present; - = Not present; O = Optionally available					
Load monitor		x	x	x	(Chap. 5.1.7), P525-P529
Lifting gear functionality		x	x	x	(Chap. 5.1.3), P107, P114
Process controller / PID controller		x	x	x	(Chap. 8.2)
Safe pulse block (STO / SS1-t) [4], two channel [5]		– [5]	O [5]	O	🕮 BU 0630
PLC functionality		x	x	x	🕮 BU 0550
Integrated POSICON positioning control		x	x	x	🕮 BU 0610
2 x Industrial Ethernet via RJ45 plug		–	–	x	🕮 BU 0620
CANbus/CANopen interface via connection terminals		x	x	x	(Chap. 2.5.4)
HTL encoder connection [6.7]		x	x	x	(Chap. 2.5.4)
Speed feedback via incremental encoder input (TTL) [6]		–	x	x	
CANopen absolute encoder evaluation		x	x	x	🕮 BU 0610
Universal encoder interface (SSI, BISS, Hiperface, EnDat and SIN/COS) [8]		–	O	O	
Number of digital inputs / outputs [9]		5 / –	6 / 2	6 / 2	(Chap. 2.5.4)
Number of analogue inputs / outputs		2 / 1	2 / 1	2 / 1	
Number of relay messages		2	2	2	
PTC resistor input with potential isolation [10]		–	1	1	
Removable control panel (SK TU5-CTR, SK TU5-PAR)		O	O	O	(Chap. 3.1)
Function extension with customer unit SK CU5-… [11]		-	x [13]	x	(Chap. 3.1)

1) IT network: manual adaptation of hardware configuration required
2) Connection terminal X6 for external 24-V-supply
3) No access to Ethernet parameters without external 24-V-supply
4) Optional SK CU5-STO or CU5-MLT interface
5) SK 510P or SK 540P: STO and SS1-t, single channel, on board
6) For speed control and/or positioning (POSICON)
7) Max. length of 10 m for ASM
8) Optional SK CU5-MLT interface
9) PTC resistor evaluation via digital input (DI5) possible
10) PTC resistor evaluation via digital input (DI5) also possible
11) 1 x per device
12) Included as standard with size 6 and higher
13) Only SK 530P

Table 2: Overview of device characteristics

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

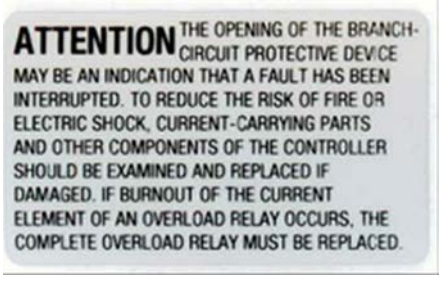
Use of unauthorised accessories and options, e.g. options for other device series, may result in defects of connected components.

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

Standard version:

- IP20
- Integrated brake chopper
- Integrated EMC mains filter for limit curve A1, Category C2 / C3
- Blank cover for technology unit slot
- Cover for the control terminals
- Standard control connection shielding plate (fitted)
- Standard motor connection shielding plate (enclosed with SK 530P and higher)
- Operating instructions on CD
- Accessory bag with electrical connection material (size 7 and higher)

- Warning signs as addition for assembly near to the device according to UL/cUL, 1x each in the languages English and French:



Content of accessory bag for size 7 and higher*:*

	Size 7	Size 8	Size 9	Size 10	
	Tubular cable lug 50 mm² M8, straight 8 pieces (L1, L2, L3, U, V, W, +B, -B)	Tubular cable lug 95 mm² M8, straight 8 pieces (L1, L2, L3, U, V, W, +B, -B)	Tubular cable lug 120 mm² M8, straight 8 pieces (L1, L2, L3, U, V, W, +B, -B)	Tubular cable lug 150 mm² M10, straight 8 pieces (L1, L2, L3, U, V, W, +B, -B)	
	Tubular cable lug 35 mm² M8, straight 3 pieces (PE)	Tubular cable lug 50 mm² M8, straight 3 pieces (PE)	Tubular cable lug 95 mm² M8, straight 3 pieces (PE)	Tubular cable lug 120 mm² M8, straight 3 pieces (PE)	
	–	–	–	–	
	DIN 6796 conical spring washer 8 11 pieces	DIN 6796 conical spring washer 8 11 pieces	–	–	–
	Disc/washer DIN 934 M8 11 pieces	Disc/washer DIN 934 M8 11 pieces	–	–	–
	Self-tapping screw 2.9 X 9.5 DIN 7981 GAL.ZN 1 piece	Self-tapping screw 2.9 X 9.5 DIN 7981 GAL.ZN 1 piece	Self-tapping screw 2.9 X 9.5 DIN 7981 GAL.ZN 1 piece	Self-tapping screw 2.9 X 9.5 DIN 7981 GAL.ZN 1 piece	
	Heat shrink D25,4/D12,7 L = 400 mm 1 piece	Heat shrink D25,4/D12,7 L = 400 mm 1 piece	Heat shrink D25,4/D12,7 L = 700 mm 1 piece	Heat shrink D25,4/D12,7 L = 1 m 1 piece	

Optional accessories

An overview on options and accessories can be found in the “NORDAC – Electronic drive technology” (E3000) catalogue. This catalogue is available for download on our website www.nord.com.

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

1.4 Safety, installation and application information

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

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

These safety instructions must be kept in a safe place!

1. General

Do not use defective devices or devices with defective or damaged housings or missing covers. 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 required covers, improper use, incorrect installation or operation causes a risk of serious personal injury or material damage.

During operation, depending on their protection class, devices may have live bare components as well as hot surfaces.

The device 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 also be present at 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 such dangerous voltage, there is a risk of an electric shock, which can lead to serious or fatal injuries.

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

The heat sink and all other metal components 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 high voltage systems (e.g. VDE) must be complied with, as must the regulations concerning correct use of tools and the use of personal protection equipment.

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

Under certain setting conditions, the device or the motor connected to it may start up automatically when the mains are switched on. A machine drive by it (press / chain hoist / roller / fan etc.) may then initiate 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

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. They must only be operated inside an enclosed control cabinet.

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

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

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

a. Supplement: Intended use within the European Union

When installed in machines, commissioning of the devices (i.e. commencement of proper use) is prohibited until it has been ensured that the machine fulfils the provisions of EC Directive 2006/42/EC (Machinery Directive); EN 60204-1 must also be complied with.
Commissioning (i.e. start-up of proper use) is only permitted if the EMC directive (2014/30/EU) has been complied with.

b. Supplement: 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 for all connection terminal contacts the connections are voltage-free.

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

Information regarding EMC-compliant installation such as shielding, earthing, location of filters and routing of cables can be found in the documentation for the device and in the technical information manual TI 80-0011. This information must always be observed even for 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 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 Warning information on the product

The following warning symbols are used on the product.

Warning symbol	Supplement to warning symbol [1]	Meaning
	DANGER 300 s	**DANGER** **Electric shock** The device contains powerful capacitors. Because of this, a hazardous voltage may be present 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!
	HOT SURFACE	**CAUTION** **Hot surfaces** The heat sink and all other metal components may heat up to temperatures above 70 °C. Risk of local burns on contact • Allow sufficient cooling time before starting work on the device. • Check the surface temperatures with suitable measuring equipment. • Keep an adequate distance from adjacent components or provide protection against contact.
		***NOTICE*** **ESD** The device contains electrostatically sensitive components that can be easily damaged by incorrect handling. • Avoid all contact (indirect contact through tools or similar, or direct contact) with PCBs and their components.

1) Texts are written in English.

Table 3: Warning symbols on the product

1.7 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	C310601	
	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	
CSA *(Canada)*			C22.2 No.274-13	E171342	
RCM *(Australia)*	F2018L00028		EN 61800-3	87133520966	
EAC *(Eurasia)*	TR CU 004/2011, TR CU 020/2011		IEC 61800-5-1 IEC 61800-3	ЕАЭС N RU Д-DE.HB27.B.02718/20	
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	C350601	

Table 4: Standards and approvals

1.7.1 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.

Additional adhesive labels with supplementary warning information

Attach the signs enclosed with the device and listed according to Section (see chapter 1.3 "Scope of 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 the Manufacturer Instructions, National Electrical 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 60 °C Copper Conductors Only”, or “Use min. 60 °C rated Copper Conductors Only”, or equivalent. Higher temperature ratings are acceptable.
- For installations according to Canadian National Standard C22.2 No. 274:
  “For use in Pollution Degree 2 and Overvoltage Category III environments only”, or equivalent.
- “Maximum surrounding air Temperature 40 °C.”
- The devices are not allowed for use in corner grounded supplies, with that the maximum working voltage to ground is considered to be 240 V ac or 277 V ac.

Frame Size	description
all	“Suitable For Use On A Circuit Capable Of Delivering Not More Than 5000 DC Symmetrical Amperes, 410 Volts (-123 Devices) or 715 Volts (-340 Devices) Max., When Protected by R/C Semiconductor fuses, type_____, manufactured by _____”, as listed in [1)]
all	“Suitable For Use On A Circuit Capable Of Delivering Not More Than _____ rms Symmetrical Amperes, 240 (1-phase) or 480 (3-phase) Volts Max., When Protected by High-Interrupting Capacity, Current Limiting Class ____Fuses or faster, rated _____Amperes, and ____Volts”, as listed in [1)]
all	“Suitable for Use On A Circuit Capable Of Delivering Not More Than _____ rms Symmetrical Amperes, ____ Volt maximum” (240 V for 1-phase models or 480 V 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)]
1, 2	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 (1-phase) or 480 (3-phase) V max, when Protected by High-Interrupting Capacity, Current Limiting Class RK5 Fuses or faster, rated max. 15 Amperes.
3	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 (1-phase) or 480 (3-phase) V max, when Protected by High-Interrupting Capacity, Current Limiting Class RK5 Fuses or faster, rated max. 30 Amperes”.
4	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 480 (3-phase) V max, when Protected by High-Interrupting Capacity, Current Limiting Class J Fuses or faster, rated max. 125 Amperes”.
1, 2	“Suitable for motor group installation on a circuit capable of delivering not more than 20000 rms symmetrical amperes, 240 (1-phase) or 480 (3-phase) V max, when Protected by High-Interrupting Capacity, Current Limiting Class J Fuses or faster, rated max. 15 Amperes”.

Frame Size	description
1, 2	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 (1-phase) or 480 (3-phase) V max, when Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 15 Amperes and respectively 240 or 480 Volts min.”.
3	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 (1-phase) or 480 (3-phase) V max, when Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 30 Amperes and respectively 240 or 480 Volts min.”.
4	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 480 (3-phase) V max, when Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated max. 125 Amperes and 480 Volts min.”.
1	“Suitable for motor group installation on a circuit capable of delivering not more than 5000 rms symmetrical amperes, DC 715 V max, when Protected by 50 215 26 from SIBA rated max. 20 Amperes”

1) 7.3 "Electrical data "

UL / CSA for devices from 30 kW to 90 kW nominal power:

For devices with a nominal power from 30 kW / 40 hp to 90 kW / 125 hp, the certification according to UL / CAS is **in preparation**.

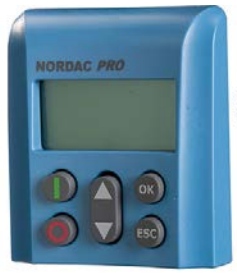
UL / CSA for devices from 110 kW nominal power:

Devices with a nominal power from 110 kW / 150 hp or 132 kW / 180 hp or 163 kW / 220 hp are **not** certified according to UL / CSA.

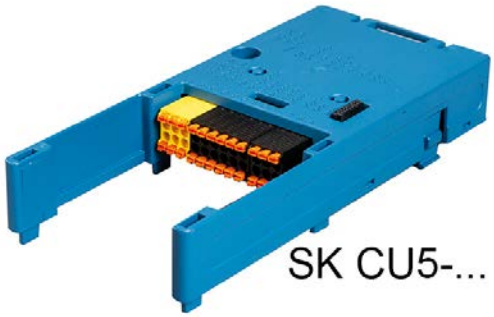
1.8 Type code / nomenclature

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

	Frequency inverters



SK TU5-...

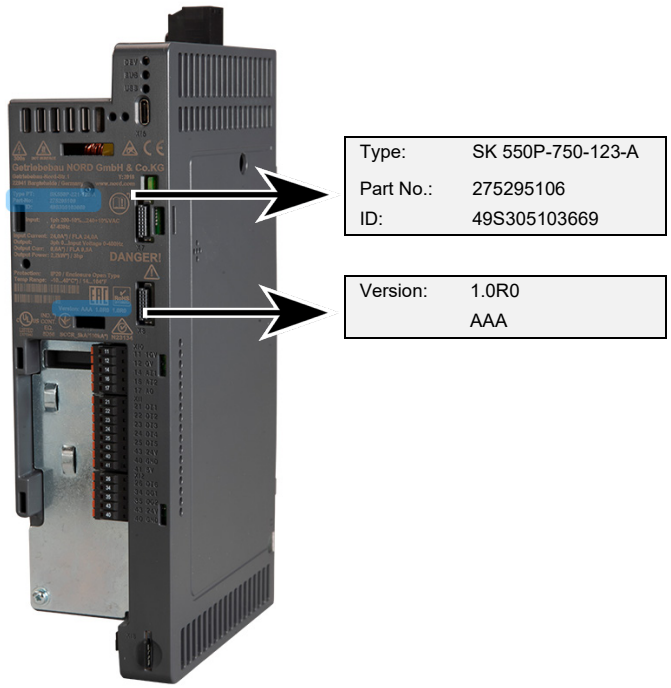


SK CU5-...

	Optional modules

1.8.1 Name plate

All information relevant to the device, including information for the identification of the device, can be obtained from the name plate.



Type:	Type / designation
Part-No:	Part number
ID:	Identification number
Version:	Software / hardware version
Input	Mains voltage
Input Current	Input current
Output	Output voltage
Output Current	Output current
Output Power	Output power
Protection	Protection class
Temp Range	Temperature range
Dissipation	Energy efficiency

Frequency inverter type code

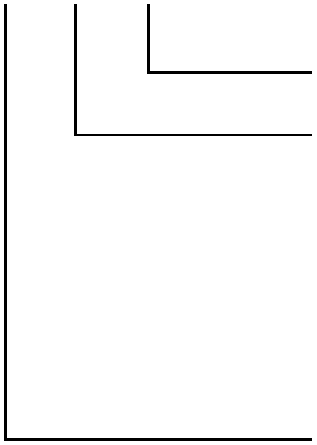
SK 530P-370-340-A(-xxx)

- Version variant or special version [1)]
- Radio interference suppression: O = without, **A** = Class **A1 (C2)**, Class A2 (C3) from 30 kW
- Mains voltage: x23 = 230 V, x**40** = **400** V
- Number of mains phases: 1xx = single-phase, **3**xx = **3**-phase
- Digits before decimal point for power: **0** = **0**.xx, 1 = 0x.x0, 2 = 0xx.0
- Device rated power: 250 = 0.25 kW, **37**0 = 0.**37 kW**, ... 163 = 160 kW
- Device series: SK 500P, SK 510P, **SK 530P**, **SK 540P**, SK 550P

1) Optional. Only stated if relevant.

Type code for option modules

SK TU5-CTR(-xxx)



Version variant or special version [1)]

Option type:[2)]

CTR =	**ControlBox** (removable control unit)
PAR =	ParameterBox (removable control unit)
STO =	Interface for STO functionality
MLT =	Universal encoder interface with STO functionality
FSx- =	x=1 (2, 3) different variants of interfaces for safety functions

Group: **TU5** = **Technology unit**, CU5 = Customer unit

1) Optional. Only stated if relevant.

2) Option types **CTR/CTR** are designed as **TU5** (technology unit). All other options are designed as **CU5** (customer unit).

2 Assembly and installation

The frequency inverters are available in various sizes depending on their output. Attention must be paid to a suitable position when installing.

The devices require sufficient ventilation as protection against overheating. Minimum distances from adjacent components above and below the frequency inverter, which could obstruct the air flow, apply. (**above > 100 mm, below > 100 mm**)

Distance from device: Mounting can be immediately next to each other.

Information

Special circumstance for size 1 and size 2 devices with a SK CU5 module

For devices of these sizes that are equipped with an SK CU5 module or shall be equipped with it later, a lateral minimum distance of 30 mm is recommended. This makes it possible to remove/attach the SK CU5 from/to the mounted frequency inverter. If the devices are mounted directly next to each other, this would require the complete frequency inverter to be disassembled.

Installation position: Always install the frequency inverter vertically on a flat surface.

Warm air must be vented above the device!

Figure 1: Installation spacings

If several inverters are arranged above each other, it must be ensured that the upper air intake temperature limit is not exceeded ((Chap. 7 "Technical data")). If this is the case, it is recommended that an “obstacle” (e.g. a cable duct) is mounted between the frequency inverters so that the direct air flow (rising warm air) is interrupted.

Heat dissipation: For installation in a control cabinet, sufficient ventilation must be ensured. The dissipated heat produced during operation is approx. 5% of the frequency inverter’s nominal power (according to the size and equipment of the device).

2.1 Frequency inverter installation

Install the frequency inverter directly on the rear wall of a control cabinet. Sizes 1 and 2 have two mounting holes, size 3 has four mounting holes.

Care must be taken that the rear of the cooling element is covered with a flat surface and that the device is mounted vertically. This enables optimum convection, which ensures fault-free operation.

Power in kW		Device type SK 5xxP-...		Size	Overall dimensions (as delivered)			Fixing dimensions (wall mounting)					Weight approx. [kg][2]
					A	B	C	D	E1	E2	∅		
From	To	From	To		Height	Width	Depth	Hole spacing length	Hole spacing width	Hole spacing edge	Diameter	Screws (ISO 4762)	
0.25	0.75	250-123	750-123	1	200	66	141	180	22	–	5.5	2xM6	1.2
		250-340	750-340										
1.1	2.2	111-123	221-123	2	240[1]	66	141	220	22	–	5.5	2xM6	1.6
		111-340	221-340										
3.0	5.5	301-340	551-340	3	286	91	175	266	20	50	5.5	4xM6	2.6
7.5	11	751-340	112-340	4	331	91	175	311	20	50	5.3	4xM6	3.8
15	22	152-340	222-340	5	371	126	232	351	22	83	5.3	4xM6	7.1
30	37	302-340	372-340	6	495	185	246	485	–	130	8.0	4xM8	15.0
45	55	452-340	552-340	7	598	265	286	582	–	210	8.0	4xM8	20.0
75		752-340		8	636	265	286	620	–	210	8.0	4xM8	25.0
90		902-340		8	636	265	286	620	–	210	8.0	4xM8	30.0
110		113-340		9	720	395	292	704	–	360	8.0	6xM8	46.0
132		133-340		9	720	395	292	704	–	360	8.0	6xM8	49.0
160		163-340		10	799	395	292	783	–	360	8.0	6xM8	52.0
					All dimensions in mm								

1) SK 5xxP-221-123: Mains connection terminal protrudes approx. 15 mm beyond the stated overall dimension H

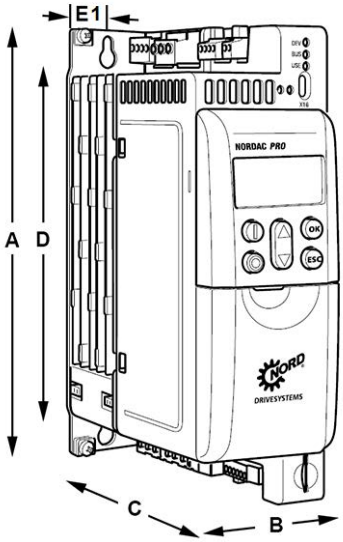
2) Depending on configuration

Information

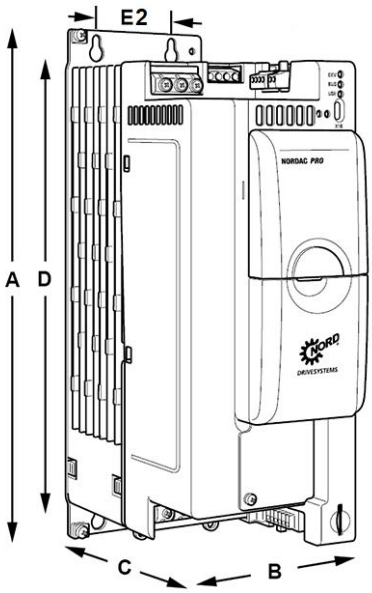
Functional extension

Frequency inverters with configuration variant SK 530P and higher can be functionally extended with a plug-in option module. This increases the installation depth by 23 mm.

Sizes 1 and 2



For size 3 and above



2.2 EMC kit

Depending on size and configuration level, various EMC kits are optionally available. A shielding plate for the motor connection is supplied as standard for advanced devices (SK 530P and higher).

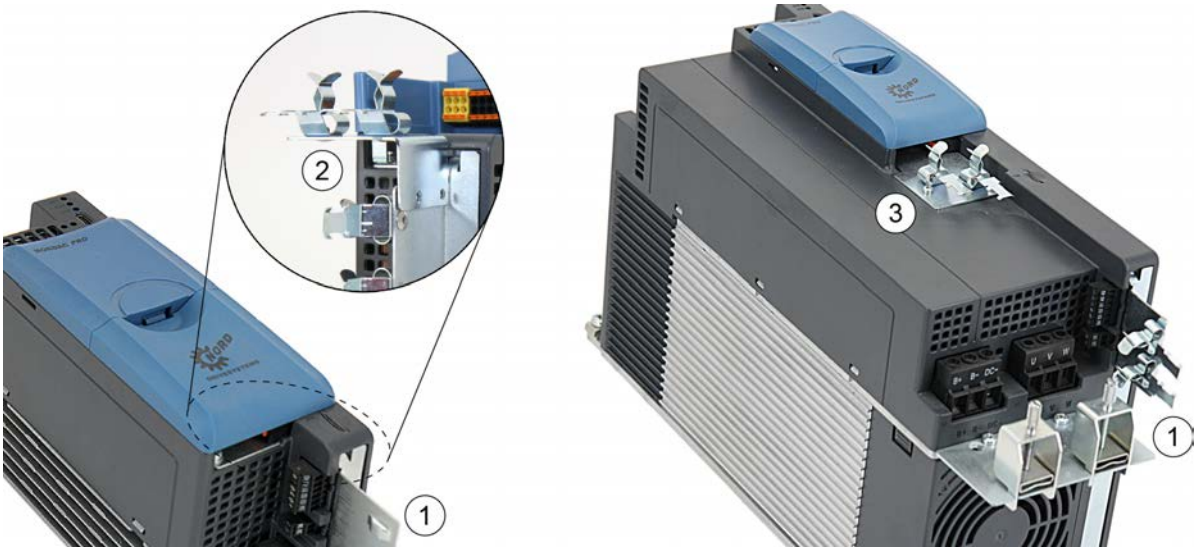


Figure 2: Exemplary arrangement of the EMC kit on the frequency inverter

1) Motor connection shield (MS)
2) Customer unit shield (SK CU5…) (CS)
3) IO port shield (IS)

SK 5xxP		EMC kit			
Size	**Device type**	**Motor connection shield (MS)**	**IO port shield (IS)**	**Customer unit shield (SK CU5…) (CS)** [2, 3]	**Document**
1	SK 5xxP-250-…-A SK 5xxP-370-…-A SK 5xxP-550-…-A SK 5xxP-750-…-A	SK HE5-EMC-MS-HS12 Part no.: 275 292 300	SK HE5-EMC-IS-HS1 Part no.: 275 292 304	SK HE5-EMC-CS-HS1 Part no.: 275 292 310	TI 27529**23**xx
2	SK 5xxP-111-…-A SK 5xxP-151-…-A SK 5xxP-221-…-A	SK HE5-EMC-MS-HS12 Part no.: 275 292 300	SK HE5-EMC-IS-HS2 Part no.: 275 292 305	SK HE5-EMC-CS-HS23 Part no.: 275 292 311	
3	SK 5xxP-301-340-A SK 5xxP-401-340-A SK 5xxP-551-340-A	SK HE5-EMC-MS-HS34 [1] Part no.: 275 292 301	SK HE5-EMC-IS-HS34 Material No.: 275 292 306	SK HE5-EMC-CS-HS23 Part no.: 275 292 311	
4	SK 5xxP-751-340-A SK 5xxP-112-340-A	SK HE5-EMC-MS-HS34 [1] Part no.: 275 292 301	SK HE5-EMC-IS-HS34 Part no.: 275 292 306	-	
5	SK 5xxP-152-340-A SK 5xxP-182-340-A SK 5xxP-222-340-A	SK HE5-EMC-MS-HS5 [1] Part no.: 275 292 302	SK HE5-EMC-IS-HS5 Part no.: 275 292 308	-	
6	SK 5xxP-302-340-A SK 5xxP-372-340-A	SK HE5-EMC-MS-HS6 [1] Part no.: 275 292 303	-	-	

SK 5xxP		EMC kit			
Size	**Device type**	**Motor connection shield (MS)**	**IO port shield (IS)**	**Customer unit shield (SK CU5…) (CS)** [2, 3]	**Document**
7/8	SK 5xxP-452-340-A SK 5xxP-552-340-A SK 5xxP-752-340-A SK 5xxP-902-340-A	SK EMC 2-6 Part no.: 275 999 061	-	-	TI 275999061
9/10	SK 5xxP-113-340-A SK 5xxP-133-340-A SK 5xxP-163-340-A	SK EMC 2-7 Part no.: 275 999 071	-	-	TI 275999071

1) Two-part

2) For SK 530P and higher with customer unit SK CU5-…

3) CS is only possible in combination with MS; CS and IS at the same time is not possible

2.3 Braking resistor (BR)

CAUTION

Hot surfaces

The braking resistor and all other metal components may heat up to temperatures above 70 °C. If touched, there is a risk of injury from local burns. Adjacent objects may be damaged by heat.

- Allow sufficient cooling time before starting work on the product.
- Check surface temperature with suitable measuring equipment.
- Maintain an adequate distance to adjacent components.

Information

Overload of the braking resistor

To protect the braking resistor against overload, the electrical data of the braking resistor used must be set in parameters **P555**, **P556** and **P557**.

During dynamic braking (frequency reduction) of a three-phase motor, electrical energy may be returned to the frequency inverter. An external braking resistor can be used to prevent the frequency inverter from being shut down due to overvoltage. The integrated brake chopper (electronic switch) pulses the link circuit voltage (switching threshold approx. 420 V / 775 V DC, depending on the mains voltage (230 V / 400 V)) to the braking resistor. Here, the excess energy is converted into heat.

For inverter powers **up to 11 kW** (230 V up to 2.2 kW), a standard bottom-mounted resistor **(SK BRU5-..., IP40)** can be used. Approval: UL recognised

SK BRU5-…

Figure 3: Frequency inverter with bottom-mounted braking resistor SK BRU5-...

For frequency inverters **above 3 kW**, chassis-mounted resistors **(SK BR2-..., IP20)** are also available. These must be mounted in the control cabinet, close to the frequency inverter. Approval: UL, cUL

2.3.1 Electrical data for braking resistors

Frequency inverter		Type	Part no.	Document
230 V	0.25 … 0.75 kW	**SK BRU5-1-240-050**	275 299 004	TI 275299004
	1.1 … 2.2 kW	**SK BRU5-2-075-200**	275 299 210	TI 275299210
400 V	0.25 … 0.75 kW	**SK BRU5-1-400-100**	275 299 101	TI 275299101
	1.1 … 2.2 kW	**SK BRU5-2-220-200**	275 299 205	TI 275299205
	3.0 … 5.5 kW	**SK BRU5-3-100-300**	275 299 309	TI 275299309
	7.5 … 11 kW	**SK BRU5-4-044-400**	275 299 512	TI 275299512

Table 5: Technical data bottom mounted braking resistor SK BRU5-...

Frequency inverter		Type	Part no.	Document
400 V	3.0 … 4.0 kW	**SK BR2-100/400-C** [1]	278 282 040	TI 278282040
	5.5 … 7.5 kW	**SK BR2-60/600-C**	278 282 060	TI 278282060
	11 … 15 kW	**SK BR2-30/1500-C**	278 282 150	TI 278282150
	18.5 … 22 kW	**SK BR2-22/2200-C**	278 282 220	TI 278282220
	30 … 37 kW	**SK BR2-12/4000-C**	278 282 400	TI 278282400
	45 … 55 kW	**SK BR2-8/6000-C**	278 282 600	TI 278282600
	75 … 110 kW	**SK BR2-6/7500-C**	278 282 750	TI 278282750
	132 … 160 kW	**SK BR2-3/7500-C**	278 282 753	TI 278282753
	132 … 160 kW	**SK BR2-3/17000-C**	278 282 754	TI 278282754

1) Type of assembly: vertical

Table 6: Technical data chassis braking resistor SK BR2-...

The chassis braking resistors (SK BR2-…) listed above are equipped with a temperature switch at the factory. Two different temperature switches with different triggering temperatures are optionally available for bottom-mounted braking resistors (SK BRU5-…).

In order to use the signal from the temperature switch, it must be connected to a free digital input of the frequency inverter and, for example, parameterised with the function “Voltage disable” or “Quick stop”.

NOTICE

Impermissible heating

If the bottom-mounted braking resistor is mounted below the frequency inverter, a temperature switch with a nominal switch-off temperature of 100°C (part no. 275991200) must be used. This is necessary to prevent impermissible heating of the frequency inverter.

- Failure to observe this may result in damage to the cooling system of the device (fan).

Bi-metal temperature switch							
For SK...	**Part no.**	**Protection class**	**Voltage**	**Current**	**Nominal switching temperature**	**Dimensions**	**Connection cable/terminals**
BRU5-...	275991100	IP40	250 V AC	2.5 A for cosφ=1 1.6 A for cosφ=0.6	180°C ± 5 K	Width +10 mm (one side)	2 x 0.8 mm², ˊAWG 18 L = 0.5 m
BRU5-...	275991200				100°C ± 5 K		
BR2-...	Integrated	IP00	250 V AC 125 V AC 30 V DC	10 A 15 A 5 A	180°C ± 5 K	Internal	Terminals 2 x 4 mm²

Table 7: Technical data of the braking resistor temperature switch

2.3.2 Temperature monitoring of the braking resistor

To prevent an overload of the braking resistor, the power fed into the resistor must be monitored. The most reliable method is thermal monitoring with a temperature switch that is mounted directly on the braking resistor.

2.3.2.1 Monitoring with a temperature switch

As standard, SK BR2-… braking resistors are equipped with a suitable temperature switch.

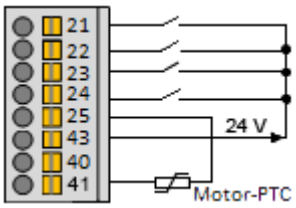
Typically, evaluation of the temperature switch is performed by an external control unit.

Alternatively, the temperature switch can be evaluated directly by the frequency inverter. To do this, it must be connected to a free digital input. This digital input must be parameterised with the function {10} *"Voltage disable"*.

Example, SK 5xxP

- Connect the temperature switch to digital input 4 (terminal 43 / 24)
- Set parameter **P420** to function {10} *"Voltage disable"*.

The switch opens if the maximum permissible temperature of the braking resistor is reached. The output of the frequency inverter is blocked. The motor runs down to a standstill.



2.3.2.2 Monitoring with current measurement and calculation

As an alternative to direct monitoring with a temperature switch, it is also possible to use indirect, arithmetical monitoring of the braking resistor load on the basis of measurement values.

This software-assisted indirect monitoring is activated by setting parameters **P556** *"Braking resistor"* and **P557** *"Brake resistor type"*. The current calculated resistor load can be read out in parameter **P737** *"Usage rate brakeres."* Overload of the braking resistor results in a shut-down of the frequency inverter with the error message **E3.1** *"Overcurrent Chopper"*.

Information

Safe monitoring

The indirect form of monitoring using measurement of electrical data and calculations is based on standardised ambient conditions. In addition, the calculated values are reset when the device is switched off. It is therefore not possible to detect the actual load on the braking resistor.

It is therefore possible that an overload may not be detected and the braking resistor or its environment may be damaged due to excessive temperatures.

Reliable temperature monitoring is only possible by using a temperature switch.

2.4 Chokes

Frequency inverters cause loads both on the mains side and the motor side (e.g. current harmonics, steep flanks, EMC interference), which may result in malfunctions in system operation and in the frequency inverter. Mains or link circuit chokes are primarily used for protection of the mains, motor chokes primarily reduce influences on the motor side.

2.4.1 Mains chokes

Two choke variants are available for mains protection:

- **Input chokes** are incorporated in the supply cable upstream of the inverter.
- **Link circuit chokes** are incorporated in the DC link circuit of the frequency inverter. These are smaller and lighter in weight in comparison with mains chokes.

Chokes reduce the recharging currents from the mains and the resulting harmonics. Chokes fulfil several functions:

- Reduction of the harmonics in the mains voltage upstream of the choke
- Reduction of the negative effects of mains voltage symmetries
- Increase of efficiency due to lower input current
- Increase of the service life of the link circuit capacitors

The use of chokes is recommended, for example:

- If the proportion of the installed inverter power exceeds 20% of the installed transformer power
- For very hard mains or capacitive compensation systems
- In case of large voltage fluctuations due to switching

From an inverter power of **45 kW**, the use of a **link circuit choke** is always **recommended**.

2.4.1.1 Link circuit choke SK DCL-

The link circuit choke is mounted in the immediate vicinity of the frequency inverter and connected directly to the DC link circuit of the device. All chokes have a protection class corresponding to IP00. The choke used must therefore be installed in a control cabinet.

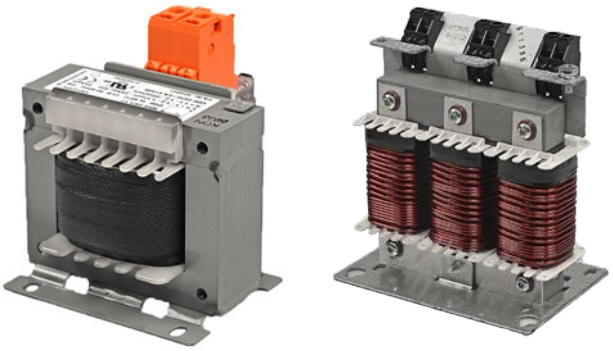
Nominal power of the frequency inverter	Filter type	Part no.	Data sheet
45 kW … 55 kW	SK DCL-950/120-C	276997120	TI 276997120
75 kW … 90 kW	SK DCL-950/200-C	276997200	TI 276997200
110 kW	SK DCL-950/260-C	276997260	TI 276997260
132 kW	SK DCL-950/320-C	276997320	TI 276997320
160 kW	SK DCL-950/380-C	276997380	TI 276997380

Table 8: Link circuit choke SK DCL-...

2.4.1.2 SK CI1 and SK CI5 mains chokes

Type SK CI1 and SK CI5 chokes are specified for a maximum supply voltage of 230 V or 480 V at 50/60 Hz.

All chokes have a protection class corresponding to IP00. The choke used must therefore be installed in a control cabinet.



Example of two mains chokes

Nominal power of the frequency inverter		Mains choke		
		Type	Part number	Data sheet
1~ 230 V	0.25 … 0.37 kW	SK CI5-230/006-C	276 993 005	TI 276993xxx
	0.55 … 0.75 kW	SK CI5-230/010-C	276 993 009	
	1.1 … 2.2 kW	SK CI5-230/025-C	276 993 024	
3~ 400 V	0.25 … 0.75 kW	SK CI5-500/004-C	276 993 004	
	1.1 … 2.2 kW	SK CI5-500/008-C	276 993 008	
	3.0 … 5.5 kW	SK CI5-500/016-C	276 993 016	
	7.5 … 11.0 kW	SK CI5-500/035-C	276 993 035	
	15.0 … 22.0 kW	SK CI5-500/063-C	276 993 063	
	30.0 … 37.0 kW	SK CI5-500/100-C	276 993 101	
3~ 400 V	45.0 kW	SK CI1-480/100-C	276 993 100	TI 276993xxx
	55.0 … 75.0 kW	SK CI1-480/160-C	276 993 160	
	90.0 kW	SK CI1-480/280-C	276 993 280	
	110.0 … 132.0 kW	SK CI1-480/350-C	276 993 350	

Table 9: Mains chokes

2.4.2 SK CO1/SK CO5 motor chokes

To reduce the motor cable's interference signals or to compensate for cable capacitance in long motor cables, an additional motor choke can be installed at the frequency inverter output.

During installation, ensure that the pulse frequency of the frequency inverter is set to 3 … 6 kHz (P504 = 3 … 6).

These chokes are specified for a maximum supply voltage of 480 V at 0 … 100 Hz.

Example of a motor choke

An output choke should be used for low powers up to 370 kW, for motor cable lengths over 50 m / 15 m (unshielded/shielded) and for higher powers from **100 m / 20 m** (unshielded/shielded). All chokes have a protection class corresponding to **IP00.** The choke used must therefore be installed in a control cabinet.

Nominal power of the frequency inverter		Motor choke		
		Type	Part number	Data sheet
1~ 230 V	0.25 … 0.37 kW	SK CO5-500/002-C	276 992 002	TI 276992xxx
	0.55 … 0.75 kW	SK CO5-500/006-C	276 992 006	
	1.1 … 2.2 kW	SK CO5-500/012-C	276 992 012	
3~ 400 V	0.25 … 0.75 kW	SK CO5-500/002-C	276 992 002	
	1.1 … 2.2 kW	SK CO5-500/006-C	276 992 006	
	3.0 … 5.5 kW	SK CO5-500/012-C	276 992 012	
	7.5 … 11 kW	SK CO5-500/024-C	276 992 024	
	15.0 … 22.0 kW	SK CO5-500/046-C	276 992 046	
	30.0 … 37.0 kW	SK CO5-500/075-C	276 992 075	
3~ 400 V	45.0 kW	SK CO1-460/90-C	276 996 090	TI 276992xxx
	55.0 … 75.0 kW	SK CO1-460/170-C	276 996 170	
	90.0 … 110.0 kW	SK CO1-460/240-C	276 996 240	
	132.0 … 160.0 kW	SK CO1-460/330-C	276 996 330	

Table 10: SK CO1/SK CO5 motor chokes

2.5 Electrical Connection

⚠ WARNING

Electric shock

Hazardous voltages may be present at the mains input and all power connection terminals (e.g. motor connection terminals, link circuit) even when the device is not in operation.

- Before starting work, check that all relevant components (e.g. voltage source, connection cables, connection terminals) are free of voltage using suitable measuring equipment.
- Use insulated tools (e.g. screwdrivers).
- Earth devices.

⚠ WARNING

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

Touching the contacts may lead to an electric shock.

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

NOTICE

Device failure due to increased input current

If 1-phase and 3-phase frequency inverters are operated on the same circuit, this can lead to increased input currents and corresponding faults on the 1-phase devices. You can prevent this effect through

- long mains supply cables (at least 10 m) or
- use of a mains choke before the 1-phase device.

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 9.1 "Maintenance information

".

2.5.1 Overview of connections

Depending on the size of the device, the connection terminals for the supply cables and the control cables are located in different positions. Depending on the configuration of the device, various terminals may not be present.

View from top | View from below | Front view

Note for X17/X19: The illustration shows the X17 Ethernet connection.

Terminal		Signal	Pin no.		Number of poles	SK 500P	SK 510P	SK 530P	SK 540P	SK 550P
			230 V	400 V						
X1	Mains	L1	L	L1	3[1)]	X	X	X	X	X
		L2 / N	N	L2						
		L3	–	L3						
X2	Motor	U	U		3	X	X	X	X	X
		V	V							
		W	W							
X3	Braking resistor	B+	B+		3	X	X	X	X	X
		B-	B-							
		DC-	DC-							
X4	PTC resistor	TF-	39		2	–	–	X	X	X
		TF+	38							
X5	Relay	K1.1	1		4	X	X	X	X	X
		K1.2	2							
		K2.1	3							
		K2.2	4							
X6	24 V	GND	40		1	–	–	X	X	X
		24 V	44							

Terminal		Signal	Pin no.	Number of poles	SK 500P	SK 510P	SK 530P	SK 540P	SK 550P
			230 V / 400 V						
X10	Analogue inputs	10 V	11	5	X	X	X	X	X
		0 V	12						
		AI1	14						
		AI2	16						
		AO	17						
X11	Digital inputs	DI1	21	8	X	X	X	X	X
		DI2	22						
		DI3	23						
		DI4	24						
		DI5	25						
		24 V	43						
		GND	40						
		5 V	41						
X12	Digital inputs and outputs	DI6	26	5	–	–	X	X	X
		DO1	34						
		DO2	35						
		24 V	43						
		GND	40						
X13	TTL incremental encoder	24 V	43	6	–	–	X	X	X
		GND	40						
		A+	51						
		A-	52						
		B+	53						
		B-	54						
X14	RJ12 diagnostic connection	–	–	6	X	X	X	X	X
X15	CAN	SHD	90	4	X	X	X	X	X
		GND	40						
		CAN-	76						
		CAN+	75						
X16	USB	–	–	4	–	–	X	X	X
X17	Industrial Ethernet 	–	–	2 x 8	–	–	–	–	X
X18	microSD	–	–		–	–	X	X	X
X19[2)]	STO, single channel 	24VOut	43		–	X	–	X	–
		GND	40						
		VISD_24V	94						
		VIS_0V	93						
		VIS_24V	91						
CAN	CANopen system bus termination	DIP switch		1	X	X	X	X	X
USS	RS485 termination	DIP switch		1	X	X	X	X	X

1) Size 2 devices for 230 V have 2 poles

2) Connection X19 is at the position of X17

2.5.2 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.

   This interference suppression is particularly important if the circuit breakers are controlled by the relay in the frequency inverter.
6. Shielded or armoured cables should be used for the load connections (motor cable). The shielding or armouring must be earthed at both ends. If possible, earthing should be made directly to the electrically conducting mounting plate of the control cabinet or the screening angle of the EMC Kit.

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.

2.5.3 Electrical connection of power unit

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

- Mains cable connection X1 (L1, L2/N, L3) and PE to connection contact
- Motor cable connection X2 (U, V, W) and PE to connection contact
- Braking resistor connection X3 (B+, B-)
- Link circuit connection (B+, DC-) Size 7 and higher (-DC/+DC)
- Link circuit choke connection (-DC, CP, PE)

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 (Chap. 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. Power cable connection: To terminals ***L1-L2/N-L3*** and ***PE***, depending on the device type (up to size 6 ***PE*** to the marked connection contact on the base plate)
4. Motor connection: To terminals ***U-V-W*** and ***PE*** (up to size 6 PE to the marked connection contact on the base plate)

Note: The PE connection contact is indicated by this symbol: 

5. The shield of a shielded motor cable must also be connected to a large area of the metal shielding bracket of the EMC Kit, however, at least to the electrically conducting mounting surface of the control cabinet.
6. For size 7 and higher, use the tubular cable lugs included in the scope of delivery. Use heat shrink to insulate them after crimping.

Note: The use of ring cable lugs is recommended for connecting to PE.

Information

Connection cable

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

When using ***ferrules***, the maximum connectable cross-section may be reduced.

All power terminals up to size 2 are plug-in versions.

To connect the power unit, the following ***tools*** must be used:

FI	Cable Ø [mm²]		AWG	Tightening torque		Tool
Size	Rigid	Flexible		[Nm]	[lb-in]	
1	0.2 ... 2.5	0.2 … 2.5	24 … 12	0.5 … 0.6	4.42 … 5.31	SL 0.6x3.5
2	0.2 ... 2.5	0.2 … 2.5	24 … 12	0.5 … 0.6	4.42 … 5.31	SL 0.6x3.5
2 (only 2.2 kW)	0.2 … 4.0	0.2 … 4.0	24 … 10	0.5 … 0.6	4.42 … 5.31	SL 0.6x3.5
3	0.2 … 6.0	0.2 … 4.0	24 … 10	0.5 … 0.6	4.42 … 5.31	SL 0.8x4.0
4	0.5 … 16.0	0.5 … 16.0	20 … 6	1.2	10.62	SL 0.8x4.0
5	0.5 … 35.0	0.5 … 35.0	20 … 2	3.8 … 4.5	33.6 … 39.8	SL 1.0x6.5
6	0.5 … 50.0	0.5 … 35.0	20 … 1	2.5 … 4.0	22.12 … 35.4	SL/PZ2; SL/PH2
7	50.0	50.0	1/0	15.0	135.0	SW13
8	95.0	95.0	3/0	15.0	135.0	SW13
9	120.0	120.0	4/0	15.0	135.0	SW13
10	150.0	150.0	5/0	15.0	135.0	SW13

SL = screwdriver
SW = socket wrench

Table 11: Connection data mains side X1

FI	Cable Ø [mm²]		AWG	Tightening torque		Tool
Size	Rigid	Flexible		[Nm]	[lb-in]	
1	0.2 … 2.5	0.2 … 2.5	24 … 12	0.5 … 0.6	4.42 … 5.31	SL 0.6x3.5
2	0.2 … 2.5	0.2 … 2.5	24 … 12	0.5 … 0.6	4.42 … 5.31	SL 0.6x3.5
3	0.2 … 6.0	0.2 … 4.0	24 … 10	0.5 … 0.6	4.42 … 5.31	SL 0.8x4.0
4	0.2 … 6.0	0.2 … 4.0	24 … 10	0.5 … 0.6	4.42 … 5.31	SL 0.8x4.0
5	0.5 … 16.0	0.5 … 16.0	20 … 6	1.2	10.62	SL 0.8x4.0
6	0.5 … 50.0	0.5 … 35.0	20 … 1	2.5 … 4.0	22.12 … 35.4	SL/PZ2; SL/PH2
7	50.0	50.0	1/0	15.0	135.0	SW13
8	95.0	95.0	3/0	15.0	135.0	SW13
9	120.0	120.0	4/0	15.0	135.0	SW13
10	150.0	150.0	5/0	15.0	135.0	SW13

SL = screwdriver
SW = socket wrench

Table 12: Connection data motor side X2, X3

2.5.3.1 Electromechanical brake

NOTICE

Power supply for an electromechanical brake

Connection of an electromechanical brake to the motor terminals may cause destruction of the brake or the frequency inverter.

- Only provide the power supply for an electromechanical brake (or its brake rectifier) via the mains or mains voltage.

An electromechanical brake (holding brake) can be controlled via one of the two relays (K1 / K2) on terminal X5. In particular, take special note of parameters P107, P114 and P434.

2.5.3.2 Mains connection

NOTICE

Damage to the FI by mains distortion

Strong mains distortions (harmonics) can lead to increased input currents and damage the rectifier in the frequency inverter.

- To prevent this, the use of mains chokes is recommended (see chapter 2.4.1 "Mains chokes").

The terminals PE, L1, L2/N and L3 are intended for mains connection. No special safety measures are required on the mains input side of the frequency inverter. It is advisable to use the normal mains fuses (see technical data) and a main switch or circuit breaker.

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

Adaptation to IT networks

⚠ 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

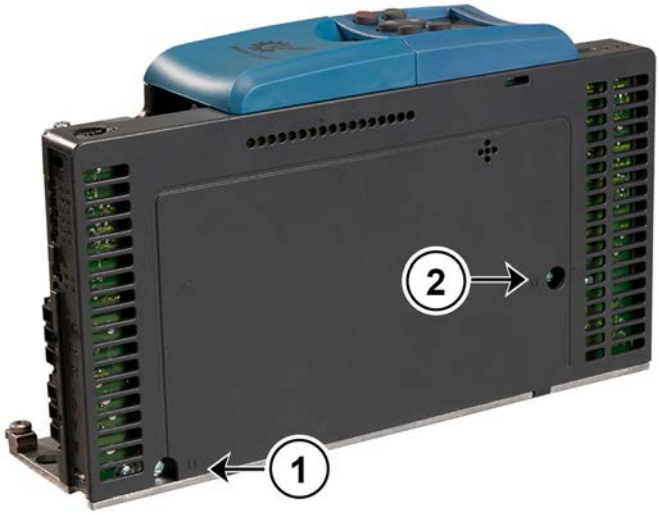
Operation in IT networks – mains fault

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.
- In standby mode, the error message “Overvoltage Ud” may occur despite connection of the braking resistor. This indicates an earth fault. The use of the braking resistor to dissipate the charging prevents the device from being destroyed or damaged.

As delivered, the device is configured for operation in TN or TT networks. For operation in IT networks, simple adaptations must be made. However, these impair the suppression of radio interference.

Adaptation for sizes 1 to 5



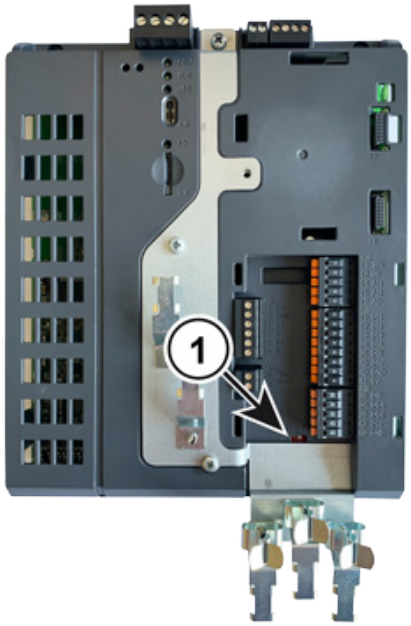
1) Motor output 2) Mains input

The adaptation to IT networks is carried out via two screw connections. To enable IT network operation, the two screws must be removed from the housing using a Phillips screwdriver (PZ1).

Adaptation of size 6 and higher

The adaptation to IT networks is carried out via the DIP switch “EMC filter” (1). On delivery, this switch is in the “ON” position.

For operation in IT networks, the switch must be set to the “OFF” position. This increases the leakage current while impairing the EMC.



Adaptation to HRG networks

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).

Use with differing supply networks or network types

The frequency inverter may only be connect to and operated in supply networks which are explicitly stated in this section (Chap. 2.5.3.2 "Mains connection")). Operation in differing network types may be possible, but must be ***explicitly checked and approved by the manufacturer in advance***.

2.5.3.3 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 100 m** if it is a standard cable type (observe EMC). If a shielded motor cable is used or if the cable is installed in a metallic and well-grounded duct, the total length should not exceed **20 m** (connect cable shield to PE at both ends).

For inverter powers up to 370 W, the length of the motor cable must not exceed 50 m / 15 m (unshielded / shielded).

For longer cable lengths an additional motor choke (accessory) must be used.

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.

2.5.3.4 Braking resistor

Terminals B+/B- are intended for the connection of a suitable braking resistor. A short, shielded connection should be selected.

Details on the braking resistor can be found in Chapter 2.3 "Braking resistor (BR)".

2.5.3.5 DC coupling

NOTICE

Link circuit overload

Link circuit coupling faults can have negative effects on the charging circuits in the inverters or the service life of the link circuits, up to their complete destruction.

- It is essential to observe the criteria summarised below for establishing the frequency inverter link circuit coupling.
- For DC coupling of single-phase devices, it is essential to ensure that the same external conductor is used for coupling.

In drive technology, DC coupling is advisable if motors simultaneously act as drivers and generators in the system. In this case, the energy from the drive which is acting as a generator can be fed back to the drive which is acting as a motor. The advantages are lower energy consumption and the sparing use of braking resistors. *In principle, devices with the same power should be connected together for DC coupling wherever possible. Furthermore, only devices which are ready for operation (whose link circuits are charged) may be coupled.*

Connection

Sizes 1 … 6	+B, -DC
Size 7 and higher	+DC, -DC

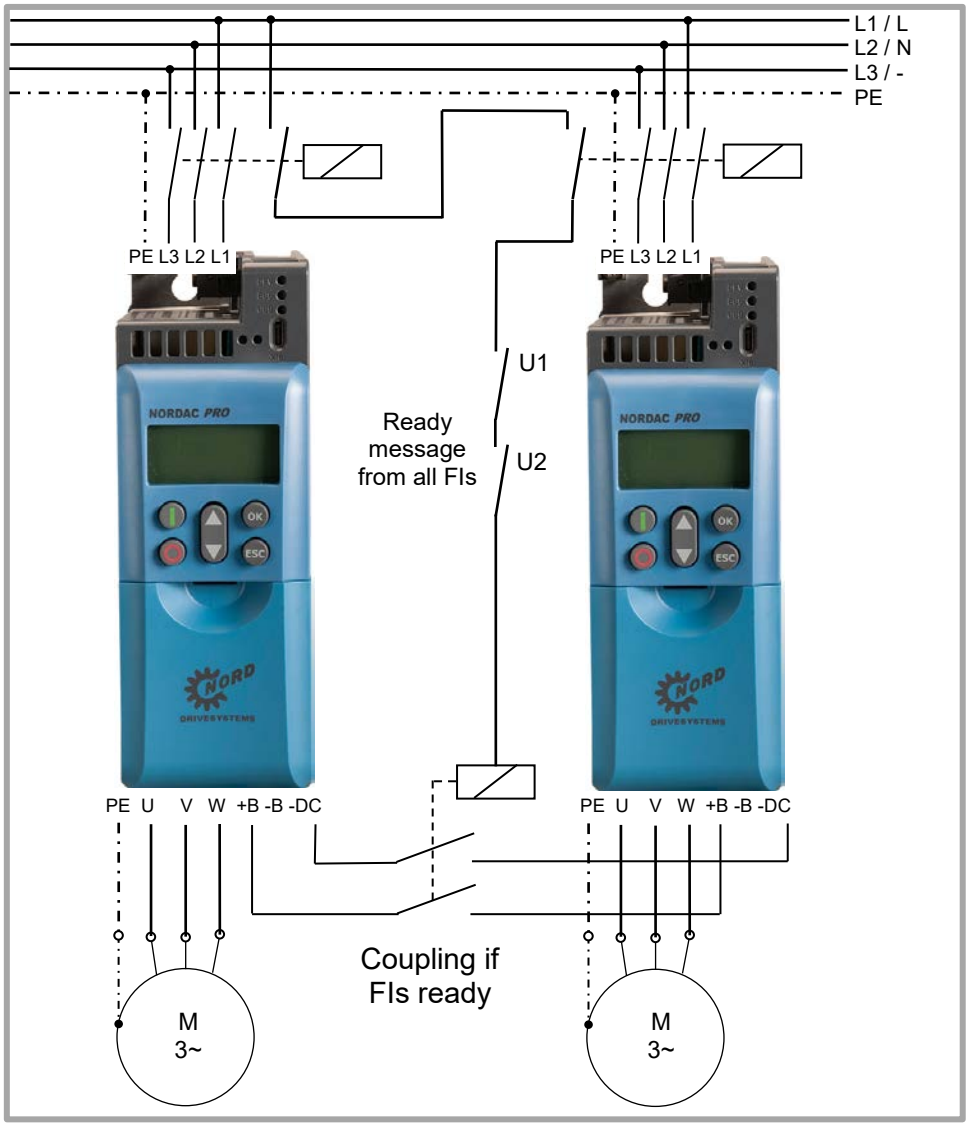


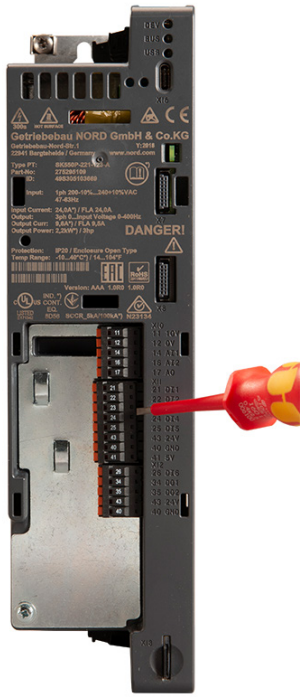
Figure 4: Illustration of a DC coupling

1 The link circuits of the individual frequency inverters must be protected with suitable fuses.
2 **NOTICE!** Ensure that the coupling is only made after readiness is reported. Otherwise, there is a risk that all frequency inverters will be charged by a single device.
3 Ensure that the coupling is disconnected as soon as one of the devices is no longer ready for operation.
4 For high availability, a braking resistor must be used. If different sizes of frequency inverters are used, the braking resistor must be connected to the larger of the two frequency inverters.
5 If devices with the same rating (identical type) are coupled, and the same mains impedances are in effect (identical lengths of cable to the mains rail), the frequency inverters may be operated without mains chokes. Otherwise, a mains choke must be installed in the mains cable of each frequency inverter.

2.5.4 Electrical connection of the control unit

The control connections are fitted differently depending on the version. All control terminals can be simply plugged in and exchanged. To prevent connection errors, the connections are coded and protected against incorrect connection.

To simplify wiring, a slot (third hand) to hold the connections is located next to the terminals. Both hands can then be used for wiring.



Simple assembly and removal

Fixing of the connections (third hand)

Connection data:

Terminal bar		X5	X19	X10, X11, X12	X13, X15, X4, X6
Rigid cable Ø	[mm²]	0.2 ... 2.5	0.2 … 2.5	0.2 … 1.5	0.14 … 1.5
Flexible cable Ø	[mm²]	0.2 ... 2.5	0.2 … 2.5	0.2 … 1.5	0.14 … 1.5
Cross section of the flexible conductor with ferrule without plastic sleeve	[mm²]	0.2 … 2.5	0.25 … 2.5	0.25 … 1.5	0.25 … 1.5
Cross section of the flexible conductor with ferrule with plastic sleeve	[mm²]	0.25 … 2.5	0.25 … 2.5	0.14 … 0.75	0.25 … 0.5
AWG standard		24 … 12	26 … 12	24 … 16	28 … 16
Tightening torque	[Nm]	0.5 … 0.6	Push-in spring connection	Push-in spring connection	0.22 … 0.25
	[lb-in]				

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

Information

Voltage/current

5 V / 24 V can be obtained from several terminals if required. This also includes e.g. digital outputs or a control module connected via RJ12.

The total output current must not exceed 150 mA (5 V) / 250 mA (24 V).

Information

Response time of digital inputs

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

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

A parallel channel exists for digital inputs DIN2 and DIN3, which relays the signal pulses between 250 Hz and 150 kHz directly to the processor, and therefore makes it possible for an encoder to be evaluated.

Information

Cable laying

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

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

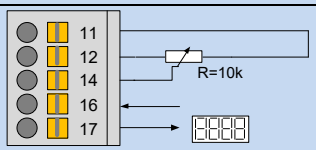
Alternatively: Use a hybrid cable with shielding of the control lines.

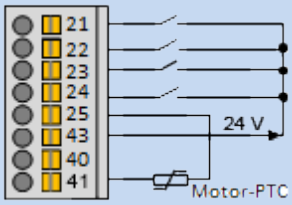
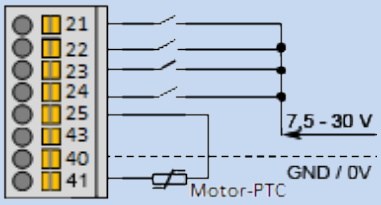
Information

Restricted parameter access

The external 24 V supply only supplies the bus communication circuit. Access to display parameters such as the actual position, device status or information parameters is not possible.

Meaning, Functions		Description / Technical data		
Terminal			Parameter	
No.	Designation	Meaning	No.	Function of factory setting
PTC input X4 (SK 530P and higher)		Monitoring of motor temperature using PTC		
		A shielded cable must be used if the device is installed near the motor. Switching shaft according to EN 60947-8 On: > 3.6 kΩ Off: < 1.65 kΩ Measurement voltage ≤ 6.6 V on R < 4 kΩ	The input is always active. In order to make the device operational, a temperature sensor must be connected or both contacts must be connected with jumpers. The function can be disabled via parameter **P425**.	
38	TF+	PTC resistor input	-	-
39	TF-	PTC resistor input	-	-
Relay X5		Relay closing contact 230 V AC, 24 V DC, < 60 V DC in circuits with safe isolation, ≤ 2 A **Note:** If two relays are to be used at the same time, the voltage reference must be identical: 24 V DC or 230 V AC. For 230 V AC, always use the same mains cable for both relays.		
1 **2**	K1.1 K1.2	Relay 1	P434 [-01]	External brake (applied on “Enable…“)
3 **4**	K2.1 K2.2	Relay 2	P434 [-02]	Fault (closes when “Inverter ready / no error“)
Control voltage connection X6 (SK 530P and higher)		External power supply to the device for bus communication or offline parameterisation.		
		24 V … 30 V, min. 1000 mA, depending on the load on inputs and outputs and use of options **Note:** Without the mains supply, there is only restricted visibility of the device status, position values and information parameters.		
44	24 V	Voltage input, connection optional. If a power supply is not connected, this is provided by an internal mains unit (no access to Ethernet parameters).	-	-
40	GND / 0V	Reference potential GND	-	-

Analogue inputs/outputs X10		Control of the device via external control unit, potentiometer or similar			
		Analogue input: For control of the FI output frequency. Analogue output: For external display or further processing in a following machine. Switching between current and voltage actual values is carried out automatically. The possible digital functions are described in parameter P420.			
11	10 V	10 V reference voltage, 10 V, 5 mA, not short-circuit protected		-	-
12	0 V	Reference potential for analogue signals, 0 V analogue		-	-
14	AI1	Analogue input 1	**U =** 0 ... 10 V, Ri = 20-40 kΩ, **I =** 0/4 ... 20 mA, Ri = 165 Ω, reference potential GND. For the use of digital functions 7.5 ... 30 V. Definition of V/C setpoints via **P405**	P400 [-01]	Set point frequency
16	AI2	Analogue input 2		P400 [-02]	No function
17	AO	Analogue output	**U =** 0 ... 10 V Max. load current: 5 mA **I =** 0 ... 20 mA, Ri = 165 Ω, reference potential GND, max. load current for digital signals: 20 mA	P418 [-01]	No function

Digital inputs X11		Actuation of device using an external controller, switch or similar. Each digital input has a response time of ≤ 5ms. Control with internal 24 V:  Control with external 7,5 … 30 V: 				
21	DI1	Digital input 1	7.5 ... 30 V, Ri = 6.1 kΩ, not suitable for PTC evaluation. HTL encoders can only be connected to DIN3 and DIN4. HTL encoder cable max. 10 m, max. limit frequency 150 kHz	P420 [-01]	ON right
22	DI2	Digital input 2		P420 [-02]	ON left
23	DI3	Digital input 3		P420 [-03]	Parameter set bit 0
24	DI4	Digital input 4		P420 [-04]	Fixed frequency 1, P429
25	DI5	Digital input 5, 2.5 ... 30 V, Ri = 2.2 kΩ. Not suitable for evaluation of a protective switching device. Suitable for thermistor evaluation with 5 V.		P420 [-05]	No function
43	24 V	24V supply voltage **output**. Power supply provided by the FI for controlling digital inputs or a 10 … 30 V encoder, 24 V ± 20 %, max. 200 mA (Output)		–	–
40	GND	Reference potential for digital signals, 0 V digital		–	–
41	5 V	5V voltage supply **output**; voltage supply for motor PTC, 5 V ± 20 %, max. 250 mA (Output), short-circuit protected		–	–

Digital inputs and outputs X12 (SK 530P or higher)		Signalling of operating statuses of the FI		
		24 V DC With inductive loads: Provide protection via free-wheeling diode!	Maximum load 20 mA	
26	DI6	Digital input 6	P420 [-06]	No function
34	DO1	Digital output 1	P434 [-03]	No function
35	DO2	Digital output 2	P434 [-04]	No function
43	24 V	Output voltage, VO/24 V	–	–
40	GND	Reference potential for digital signals, 0 V digital	–	–

Encoder (TTL) X13 (SK 530P or higher)		Speed feedback with TTL incremental encoder			
43	24 V	Output voltage, VO/24 V		-	-
40	GND	Reference potential for digital signals, 0 V		-	-
51	A+	Track A	TTL, RS422 16 … 8192 pulses per rotation, limit frequency: max. 250 kHz	P300	-
52	A-	Track A inverse			
53	B+	Track B			
54	B-	Track B inverse			

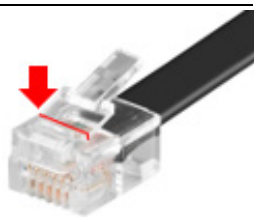
Communication interface X14		Connection of the FI to various communication tools		
		24 VDC ± 20 %	RS485 (for connecting a parametrisation box) 9600 … 115000 Baud Terminating resistance (1 kΩ) fixed RS232 (for connection to a PC, NORDCON, NORDCON *APP*) 9600 … 115000 Baud	
1	RS485 A+	Data cable RS485	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		

Information

Use RJ12 plugs without latching tab

Only use RJ12 plugs without latching tab for connection to the diagnostic interface (RJ12 socket). Otherwise, the plug may get jammed in the RJ12 socket.

If necessary, remove the latching tab according to the figure and make sure that no burr remains.



CANopen X15		Interface to CANopen bus system		
		The CANopen interface supports the DS-301 communication profile and the DS-402 drive profile of the CiA. The frequency inverter can be included as a standard slave in a CANopen bus system via this interface. This interface is also used to set up the NORD system bus that can be used to incorporate CANopen encoders or further frequency inverters, for example. Further details on the connection of the CANopen encoder can be found in the Manual 🕮 BU 0610. Baud rate … 500 kbaud; terminating resistor R = 120 Ω; DIP switch 2; recommended: implement strain relief.		
90	SHD	Shielding	P503 P509	
40 1)	GND	Reference potential for CANopen		
76	CAN-	CAN_L		
75	CAN+	CAN_H		

1) The potential of this terminal differs from that of other 40-series terminals of the frequency inverter.

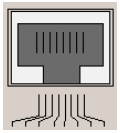
Information

Functional description of NORD system bus

A detailed description on the function and use of the NORD system bus (CANopen) can be found in the application guide 🕮 AG 0104.

Options for X15

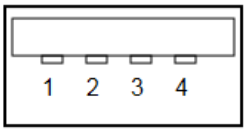
Two additional options are available for the CANopen connection: These allow the CANopen signals to be looped through.

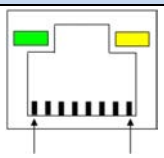
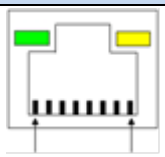
<table>
<tr><th>Option</th><th>Designation
Part number</th><th>Contact assignment</th><th>Connection data</th><th>Installation example</th></tr>
<tr><td>1</td><td> 
SK TIE5-CAO-WIRE-2x4P
275292201</td><td>
<table>
<tr><td>90</td><td>SHD</td></tr>
<tr><td>40</td><td>GND [1]</td></tr>
<tr><td>76</td><td>CAN-</td></tr>
<tr><td>75</td><td>CAN+</td></tr>
</table>
(Same as standard terminal [2])
</td><td>Push-in spring connection
<table>
<tr><td>Cable</td><td colspan="2">Details</td></tr>
<tr><td>Rigid/flexible</td><td>mm²</td><td>0.2 … 1.5</td></tr>
<tr><td>Flexible [3]</td><td>mm²</td><td>0.25 … 1.5</td></tr>
<tr><td>Flexible [4]</td><td>mm²</td><td>0.25 … 0.75</td></tr>
<tr><td>AWG</td><td></td><td>24 … 16</td></tr>
</table>
</td><td>  </td></tr>
<tr><td>2</td><td> 
SK TIE5-CAO-2X-RJ45
275292202</td><td> 
1 | 2 | 3 | 4 | 5 | 6 | 7 | 8
<table>
<tr><td>1</td><td>CAN+</td></tr>
<tr><td>2</td><td>CAN-</td></tr>
<tr><td>3</td><td>GND [1]</td></tr>
<tr><td>4-8</td><td>n.c.</td></tr>
</table>
</td><td>RJ45 connection</td><td>  </td></tr>
</table>

1) The potential of this terminal differs from that of other 40-series terminals of the frequency inverter.
2) 2 x 4 contact rows with identical assignment on both rows.
3) With ferrules without plastic collar
4) With ferrules with plastic collar

Assembly note

1. Remove the original standard terminal (single-row, 4-pole) by unplugging it from the slot (X15).
2. Plug the optional terminal straight and completely into the vacated slot. The terminal is coded and cannot be fitted the wrong way around.

USB Communication interface X16 (SK 530P or higher)		Connection of the FI to a PC (alternatively to the RJ12 interface) for communication with the NORDCON software **Note:** A 24 V supply (X6) is necessary for access to the Ethernet parameters.		
		USB 2.0 Type C (SK 530P or higher)		
1	+5 V	Supply voltage	P502… P513 [-02]	
2	Data -	Data cable		
3	Data +	Data cable		
4	GND	Bus signal reference potential		

Ethernet-on-Board X17 (SK 550P or higher)		**RJ45 socket details**				
1	TX+	Transmission Data +				
2	TX-	Transmission Data -				
3	RX+	Receive Data +				
6	RX-	Receive Data -	Pin 8	Pin 1	Pin 8	Pin 1
			Port 1		Port 2	

microSD-card X18	Interface for microSD card
	Option for saving and transferring data (see also P550). **Note**: Only industrial grade microSD cards should be used with the interface (see chapter 1.3 "Scope of delivery").

USS/CAN DIP switches S1/S2		
USS	Termination resistor for RS485 interface (RJ12); ON = switched in [Default = "OFF"] For RS232 communication DIP1 to "OFF"	DIP switch ON – OFF 
CAN	Termination resistor for CAN/CANopen interface (RJ12); ON = switched in [Default = "OFF"]	

Encoder connection

The incremental encoder connection is an input for a type with two tracks and TTL-compatible signals for EIA RS 422-compliant drivers. The maximum current consumption of the incremental encoder must not exceed 150 mA.

The pulse number per rotation can be between 16 and 8192 increments. This is set with the normal scaling via parameter **P301** "Incremental encoder pulse number" in the menu group "Control parameters". For cable lengths > 20 m and motor speeds above 1500 rpm the encoder should not have more than 2048 pulses/revolution.

For longer cable lengths the cable cross-section must be selected large enough so that the voltage drop in the cable is not too great. This particularly affects the supply cable, in which the cross-section can be increased by connecting several conductors in parallel.

Information

Phase sequence

The counting direction of the incremental encoder must correspond to the direction of rotation of the motor. The directions of rotation are identical if a positive speed is displayed in parameter **P735** when the output frequency is positive.

If the directions of rotation are not identical, a pulse number with a different sign can be set in parameter **P301**.

Alternatively, the motor phase sequence can be changed in parameter **P583**. A change of the direction of rotation is then only possible by software adjustment.

2.6 Incremental encoder

Depending on the resolution (pulse number), incremental encoders generate a defined number of pulses per rotation of the encoder shaft (track A). This enables the frequency inverter to determine the exact speed of the encoder or motor shaft.

When using the push-pull signals (track A inverse), conducted EMC interferences can be effectively filtered out. The signals become more resistant to faults and are suitable for connection over longer distances (longer encoder cables).

By using a second track (B / B inverse) shifted by 90° (¼ period), the direction of rotation can also be determined.

The supply voltage for the encoder is 10 … 30 V. An external source or the internal voltage can be used as the voltage source.

TTL encoder

Special terminals are available for connection of an encoder with TTL signals. Parameterisation of the corresponding functions is made with the parameters from the “Speed control” group (**P300** et seq.).

The use of an encoder without push-pull tracks (*track A inverse* and *track B inverse*) is permissible but only recommended for short cables lengths. Encoders with push-pull tracks must be used for more operational reliability in particular for cable lengths > 10 m.

HTL encoder

HTL encoders are not suitable for motor control of a NORD synchronous motor with the NORDAC *PRO* frequency inverter. The digital inputs DI 3 and DI 4 are used to connect an encoder with an HTL signal. Parameterisation of the corresponding functions is performed with parameters **P420 [-03/-04]**. The encoder’s cable length must be limited to 10 m, as the push-pull signals cannot be evaluated.

The following signal converters are optionally available:

Designation	Purpose	Part no.	Documentation
Connection kit HTL encoder WK 4/2/4*680 OHM	HTL to TTL signal converter	278910340	TI 278910340
Adapter module Level adapter HTL – RS422	Signal converter HTL or TTL to complementary signals with RS422 level [1)]	278910360	TI 278910360

1) The signal converter must be mounted in the immediate vicinity of the encoder (within one control cabinet). This minimises the risk of incorrect encoder signals due to induced interferences.

Function	Cable colours for incremental encoders	Signal type TTL		Signal type HTL	
10-30 V supply	Brown / green	**X13: 43**	(24 V)	**X11: 43**	(24 V)
0 V supply	White / green	**X13: 40**	GND	**X11: 40**	GND
Track A	Brown	**X13: 51**	A+	**X11: 23**	DI3
Track A inverse	Green	**X13: 52**	A-	-	-
Track B	Grey	**X13: 53**	B+	**X11: 24**	DI4
Track B inverse	Pink	**X13: 54**	B-	-	-
Track 0	Red	**X11: 25**	DI5 [1)]	**X11: 25**	DI5 [1)]
Track 0 inverse	Black	**-**	-	-	-
Cable shield	Connect to a large area of the frequency inverter housing or shielding bracket				

1) Recommended, DI can be freely selected

Table 13: Colour and contact assignments for NORD TTL / HTL incremental encoders

Information

Encoder signal faults

Wires that are not required (e.g. Track A inverse / B inverse) must be insulated. Otherwise, if these wires come into contact with each other or the cable shield, short-circuits may occur, which can cause encoder signal problems or destruction of the encoder.

Information

Incremental encoder data sheet

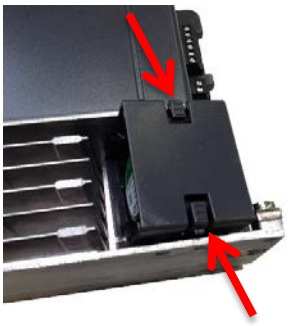
If the equipment deviates from the standard equipment for motors (encoder type 5820.0H40, 10 … 30 V encoder, TTL/RS422 or encoder type 5820.0H30, 10 … 30 V encoder, HTL), please note the accompanying data sheet or consult your supplier.

2.7 Fan

2.7.1 Removing the fan

Remove the fan by pressing the two fixing points out of the frequency inverter (1).

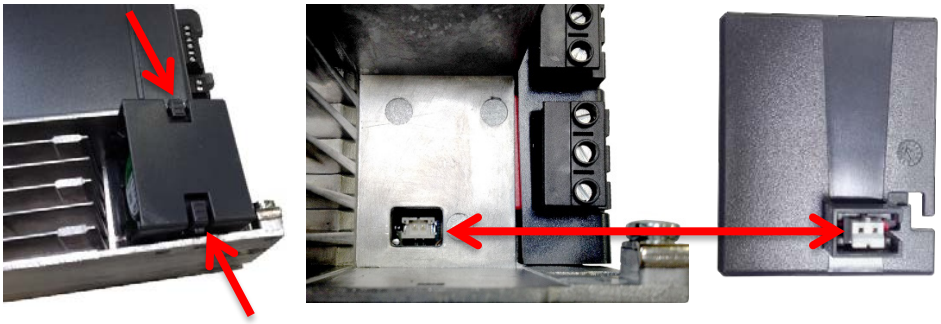
1.



2.7.2 Installing the fan

Fit the fan by pressing the two fixing points into the frequency inverter (1). Take care that the plug connector on the fan matches the socket of the frequency inverter.

1. 2.



Information

Installation/removal of the fan only permissible up to size 5!

The independent installation or removal of a fan is only permissible up to and including size 5. For fan modifications of sizes 6–10, contact the service department.

3 Options

3.1 Overview of option modules

The functions of the frequency inverter can be extended with a SK TU5-… parameterisation unit, a SK CU5-… (SK 530P/SK 550P, not SK 540P) customer unit and other optional modules. The options can be plugged in. Either a blind cover or a parameterisation unit can be attached to a customer unit.

SK TU5-…

SK CU5-…

Detailed information about the options listed below can be found in the relevant documentation.

Parameterisation units

Module	Designation	Description	Data	Part no.	Info
SK TU5-CTR	ControlBox	Commissioning, parameterisation and control of the frequency inverter	LCD screen (illuminated), 5-digit, 7-segment display, display for: • Dimensional unit • Utilisation level • Status • Operating values, control keypad	275297000	BU 0040
SK TU5-PAR	ParameterBox	Commissioning, parameterisation and control of the frequency inverter (firmware: ⩾ V1.4 R0)	LCD screen (illuminated), plain text display in 14 languages, memory for five device data sets, control keypad	275297100	BU 0040

Customer units

Module	Interface	IOs	Part no.	Info
SK CU5-MLT	Encoder interface: TTL, SIN/COS, Hiperface, Endat, Biss, SS1 Functional safety: STO, SS1	4 IO (usable as DI or DO)	275298200	TI 275298200
SK CU5-STO	Functional safety: STO, SS1	1 safe DI	275298000	TI 275298000
		Functional safety: 2-channel connection BU 0630		

Other option modules

Module	Interface	Data	Part no.	Info
SK EBGR-1	Electronic brake rectifier	Extension for direct control of an electromechanical brake, IP20, snap-on rail mounting	19140990	TI 19140990
SK EBIOE-2	IO extension [1]	Extension with 4 DI, 2 AI, 2 DO and 1 AO, IP20, snap-on rail mounting. Firmware version V1.3R1 required.	275900210	TI 275900210

1) Usable with SK 530P and higher

3.2 Connection of multiple devices to one parametrisation tool

In principle, it is possible to control several frequency inverters via the ***ParameterBox***(SK PAR-3X or SK PAR-5H) or the ***NORDCON software***. In the following example, communication is made via the parameterisation tool, by tunnelling the protocols of the individual devices (max. 8) via the common CAN system bus. 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 FI**							
No.	**Designation**	**FI1**	**FI2**	**FI 3**	**FI 4**	**FI 5**	**FI 6**	**FI 7**	**FI 8**
P503	Leading func. output	4 (Systembus active)							
P512	USS address	0	0	0	0	0	0	0	0
P513 [-3]	Telegram time-out (s)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
P514	CAN bus baud rate	5 (250 kbaud)							
P515	CAN bus address	32	34	36	38	40	42	44	46

3. Connect the parameterisation tool as usual via RS485 (terminal: X14; type: RJ12) to the ***first*** frequency inverter.

Conditions / restrictions:

a. The parameterisation tools must also correspond to the current software version:

NORDCON	≥ 02.09.xx.xx
ParameterBox	≥ 4.6 R2
NORDAC *PRO* SK 530P and higher	Hardware: BAA, firmware: V1.3 Rx

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 Factory settings

All frequency inverters supplied by Getriebebau NORD are pre-parameterised with the default setting for standard applications with 4-pole IE3 three-phase standard motors (same power and voltage). When using motors with a different power or number of poles, the data from the motor’s name plate must be entered into the parameters **P201 ... P207** under the menu item >Motor data<.

Information

Pre-setting data via parameter P200

All data from IE3 / IE4 and IE5+ motors 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 parameters **P201 ... P209** and can be compared with the data on the motor name plate.

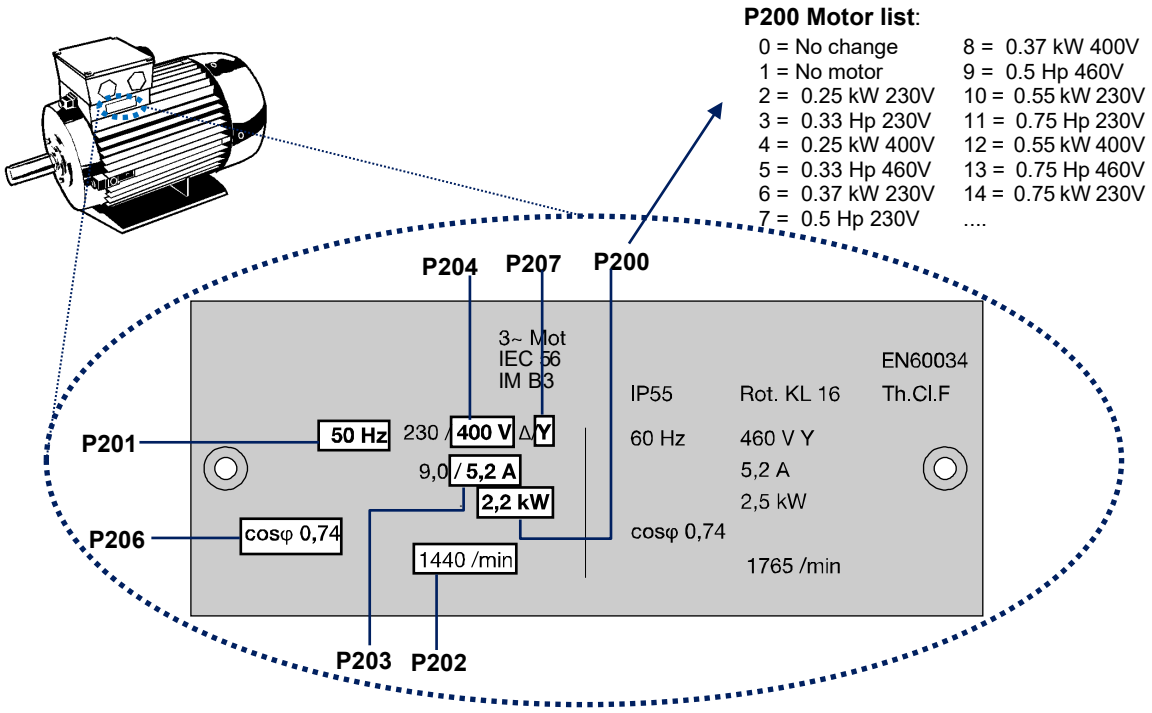


Figure 5: Motor name plate

RECOMMENDATION: 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.

To automatically determine the stator resistance, **P220 = 1** must be set and confirmed by pressing “ENTER”. The value calculated for the line resistance (depending on **P207**) will be saved in parameter **P208**.

The NORDCON software provides the motor data for all common NORD motors. Using the “Import motor parameter” function (see also the NORDCON software manual BU 0000), the required data set can be selected and imported into the device.

4.2 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”.

4.2.1 Explanation of the operating modes (P300)

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

- 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.

- CFC open-loop injection mode (**P300 = 3**) – for PMSM only
  This operating mode is comparable with the CFC open-loop (**P300 = 2**) operating mode, but is additionally linked to a slip error monitoring for operation without encoder. With this form of slip error monitoring, the actual speed is not determined by the encoder but calculated. If the setpoint speed deviates from the calculated actual speed, error **E013.1** is triggered.
  The slip error monitoring cannot be switched off, but the pre-defined limit values for the permissible speed deviation and a delay time can be adjusted via the parameters **P327 [-01]** and **P328 [-01]**.

4.2.2 Overview of controller parameter settings

The following illustration provides an overview of all parameters which are important, depending on the selected operating mode. In principle, the following applies: The more precise the setting, the more accurate the control and the higher the possible values for the dynamics and precision of drive operation. A detailed description of the individual parameters can be found in 🕮 Section "Parameter".

"Ø" = Parameter has no meaning	"-" = Leave the parameter in the factory setting
"√" = Change to the parameter is relevant	

Group	Parameter	Operating mode					
		VFC open-loop		CFC open-loop		CFC closed-loop	
		ASM	PMSM	ASM	PMSM	ASM	PMSM
Motor data	P201 … P209	√	√	√	√	√	√
	P210	√ 1)	√	√	√	√	√
	P211, P212	- 2)	-	-	-	-	-
	P215, P216	- 1)	-	-	-	-	-
	P217	√	√	√	√	Ø	Ø
	P220	√	√	√	√	√	√
	P240	-	√	-	√	-	√
	P241	-	√	-	√	-	√
	P243	-	√	-	√	-	√
	P244	-	√	-	√	-	√
	P246	-	-	√ 3)	√ 3)	√	√
	P245, 247	-	√	Ø	Ø	Ø	Ø
Controller data	P300	√	√	√	√	√	√
	P301	Ø	Ø	Ø	Ø	√	√
	P310, P311, P314, P317 … P320	Ø	Ø	√	√	√	√
	P312, P313, P315, P316	Ø	Ø	-	√	-	√
	P330 … P333	-	√	-	√	-	√
	P334	Ø	Ø	Ø	Ø	-	√

1) For the V/f characteristic curve: precise change to the parameter is important

2) For the V/f characteristic curve: typical setting "0"

3) Only effective above the switch-over point, because the CFC open-loop PMSM first starts with VFC (without the influence of **P246**) and CFC is only effective above the switch-over point

4.2.3 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.

Information

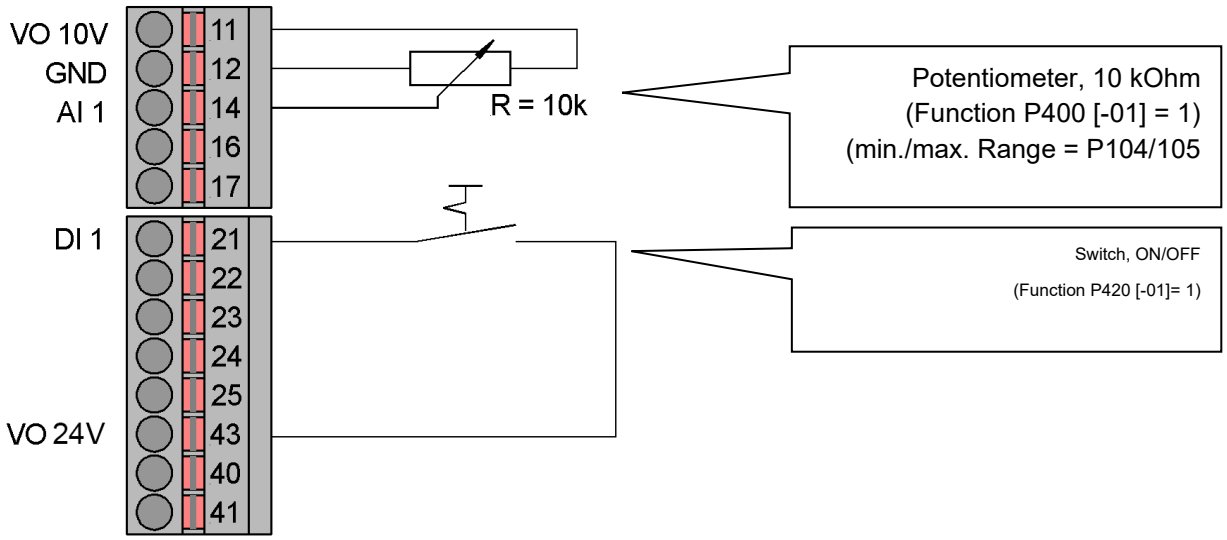
HTL encoder length limit

The length of the HTL encoder cable must not exceed a length of max. 10 m.

4.3 Minimum configuration of control connections

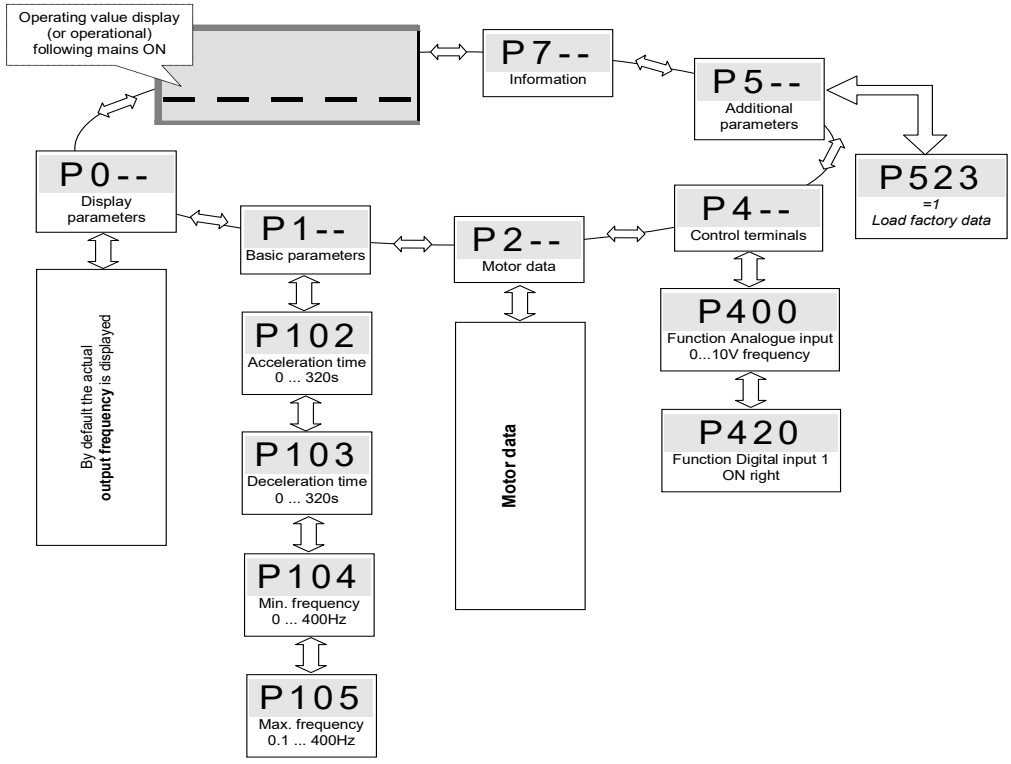
If the frequency inverter is to be controlled via the digital and analogue inputs, this can be implemented immediately in the condition as delivered. Settings are not necessary for the moment.

Minimum circuitry



Basic parameters

If the current setting of the frequency inverter is not known, loading the default setting is recommended → **P523 = 1**. The inverter is pre-programmed for standard applications in this configuration. If necessary the following parameters can be changed with the optional ControlBox SK TU5-CTR.



4.4 Temperature sensors

The current vector control of the frequency inverter can be further optimised by the use of a *temperature sensor*. By continuous measurement of the motor temperature, the highest control precision of the frequency inverter and the associated optimum speed precision of the motor is achieved at all times and with any load. As the temperature measurement starts immediately after (mains) switch-on of the frequency inverter, the frequency inverter provides immediate optimum control, even if the motor has a considerably increased temperature after an intermediate “Mains off/Mains on” of the frequency inverter.

Information

Determination of motor stator resistance

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

The motor overtemperature is also monitored and at 155 °C (switching threshold as with the PTC resistor) causes the drive to switch off with error message E002.

Information

Pay attention to polarity

Temperature sensors are wired semiconductors that must be operated in the conducting direction. For this, the anode must be connected to the "+" contact of the analogue input. The cathode must be connected to earth.

Failure to observe this can lead to false measurements. Motor winding protection is therefore no longer guaranteed.

Approved temperature sensors

The function of the approved temperature sensors is comparable. However, their characteristic curves differ. Correct matching of the characteristic curves to the frequency inverter is made by changing the following two parameters.

Sensor type	Shunt resistor [kΩ]	P402[xx][1] 0% adjustment [V]	P403[xx][1] 100% adjustment [V]
KTY84-130	2.7	1.54	2.64
1)	xx = parameter array, depending on the analogue input used		

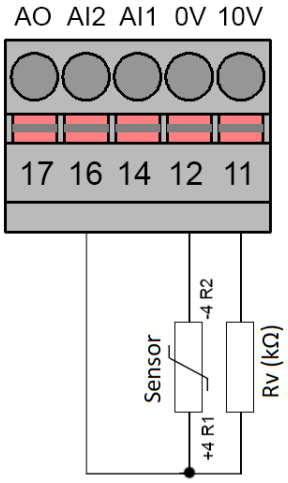
Table 14: Temperature sensors, adjustment

Connection of a temperature sensor is made according to the following examples.

Taking into account the relevant values for the 0% adjustment [P402] and 100% adjustment [P403], these examples can be used for all of the approved temperature sensors which are stated above.

Connection examples

A temperature sensor can be connected to either of the two analogue inputs of the relevant option. In the following examples, analogue input 2 is used.



Parameter settings (Analogue input 2)

The following parameters must be set for the function of the temperature sensor.

1. Analogue input 2 function, **P400 [-02] = 48** (motor temperature)
2. Analogue input 2 mode, **P401 [-02] = 1** (negative temperatures are also measured)
3. Comparison of analogue input 2: **P402 [-02]** (V) and **P403 [-02]** (V) for R_V (kΩ)
4. Motor temperature monitoring (display): **P739 [-03**]

4.5 Frequency addition and subtraction via control boxes

If the parameter **P549** (Pot Box Function) is set to {4}“*Frequency addition*” or {5}“*Frequency subtract.*”, a value can be added or subtracted using the arrow keys ▲ or ▼ of the ControlBox or the ParameterBox.

If the ENTER key is pressed, the value is saved in **P113**. The next time the device is started, the value will be added or subtracted immediately.

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.

A description of the relevant parameters for the frequency inverter can be found below. Access to the parameters is via a parameterisation tool (e.g. NORDCON software) or a control or parameterisation box (see chapter 3 "Options")and enables optimal adjustment of the frequency inverter to the drive application. Dependencies of the relevant parameters may result from the various configurations of the frequency inverters.

Information

Restricted visibility of parameters with external 24 V supply

Via terminal 44 the device can be externally supplied with 24 V (X6). This enables the values of most parameters to be read out and changed by the usual parameterisation methods. However, this does not apply for all parameters. The available display range is limited and essentially consists of the setting values for bus communication (Ethernet, CANopen, USS). The device status is not available if the mains supply is not connected (X1). Except for the communication sector, the device is therefore in a switched-off state. For complete diagnosis of the device, a mains supply (X1) is required (230 V for single phase devices, 400 V for 3-phase devices).

Information

Ethernet parameterisation

With power supply via USB (X169 the parameter for setting the Ethernet dialect cannot be changed, Unless 24 V is connected to terminal X6.

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

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

The individual parameters are combined into 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
DS402 parameters	(P0--)	Parameters for DS402 drive profile
Basic parameters	(P1--)	Basic device settings such as behaviour when switching on/off
Motor data	(P2--)	Electrical settings for the motor (motor current or starting voltage)
Control parameters	(P3--)	Setting for current and speed controls as well as encoder settings (incremental encoders)
		Settings for the integrated PLC (details 🕮 BU0550)
Control terminals	(P4--)	Assignment of functions for the inputs and outputs
Additional parameters	(P5--)	Primarily monitoring functions and other parameters
Positioning	(P6--)	Setting of the positioning function (details 🕮 BU0610)
Information	(P7--)	Display of operating values and status messages
Bus parameters	(P8--)	Parameters for Industrial Ethernet (details 🕮 BU0620)
		Parameters for IIoT

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.

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 6: 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.
!	Parameter name	For DS402 parameters **P046**, **P047**, **P048**, **P056**, **P057**, **P062**, **P063** and **P064** the precise designations can be obtained from the arrays.

5.1 Parameter overview

Operating displays

P000 Operating para. disp	**P001** Select of disp.value	**P002** Display factor
P003 Supervisor-Code	**P004** Password	**P005** Change password

DS402 parameters

P020 Target velocity	**P021** Velocity demand	**P022** Control effort
P023 Velocity amount	**P024** Velocity acceleration	**P025** Velocity deceleration
P026 Quick Stop	**P027** Percent demand	**P028** Control word
P029 Status word	**P030** Stop opt. code	**P031** Modes of operation
P032 Modes of operation display	**P033** Target torque	**P034** Actual digital inputs
P035 Digital outputs	**P046** Actual position / inc.	**P047** Follow time-out Pos. / Time
P048 Position window / timeout	**P049** Target position	**P050** Enc. polarity
P051 Max profile velocity	**P052** Profile velocity	**P053** Motion pro type
P054 Position notation	**P055** Position dimension	**P056** Gear ratio
P057 Feed constant / rotations	**P058** Homing method	**P059** Homing speeds
P060 Homing acceleration	**P061** Homing offset	**P062** Velocity actual
P063 Velocity time window	**P064** speeds threshold / time	**P065** Prof. acceleration
P066 Prof. deceleration	**P067** Quick Stop deceleration	**P068** Velocity notation
P069 Velocity speeds	**P070** Acceleration notation	**P071** Acceleration dimension
P072 Target velocity	**P073** Torque act value	**P074** Current act value
P075 DC link circuit voltage	**P076** Torque ramp	

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 frequency	**P202** Nominal speed
P203 Nominal current	**P204** Nominal voltage	**P205** Nominal power
P206 Cos phi	**P207** Star Delta con.	**P208** Stator resistance
P209 No Load Current	**P210** Static boost	**P211** Dynamic boost
P212 Slip compensation	**P213** ISD ctrl. loop gain	**P214** Torque precontrol
P215 Boost precontrol	**P216** Time boost prectrl.	**P217** Oscillation damping
P218 Modulation depth	**P219** Auto.magn.adjustment	**P220** Par.-identification
P221 Missing angleCFC-Inj	**P240** EMF voltage PMSM	**P241** Inductivity PMSM
P243 Reluct. angle IPMSM	**P244** Peak current PMSM	**P245** Osc damping PMSM VFC
P246 Mass Inertia	**P247** Switch freq VFC PMSM	

Control parameters

P300	Control method	**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	Switch time CFC-Inj	**P338**	Voltage CFC-Inj.	**P339**	ReinforcePLL CFC-Inj
P340	CurrentfilterCFC-Inj	**P341**	Dyn.I-Ctrl. CFC-Inj.	**P342**	Synchron Start PMSM
P350	PLC Functionality	**P351**	PLC set val. select.	**P353**	Bus status vial PLC
P355	PLC Integer setvalue	**P356**	PLC long setvalue	**P360**	PLC display value
P370	PLC status				

Control terminals

P400	Analog input func.	**P401**	Analog input mode	**P402**	Analog in. bal. 0%
P403	Analog.in. bal. 100%	**P404**	Analog input filter	**P405**	V/C Analog
P410	Min. freq. a-in 1/2	**P411**	Max. freq. a-in 1/2	**P412**	Nom.val process ctrl
P413	PID control P comp.	**P414**	PID control I comp.	**P415**	PID control D comp.
P416	Ramptime PI setpoint	**P417**	Offset analog output	**P418**	Analog output func.
P419	Analog output scal.	**P420**	Digit inputs	**P423**	Safety SS1 max. time
P424	Safe Dig.input	**P425**	Function PTC input	**P426**	Quick stop time
P427	Quick stop on Error	**P428**	Automatic starting	**P429**	Fixed frequency 1
P430	Fixed frequency 2	**P431**	Fixed frequency 3	**P432**	Fixed frequency 4
P433	Fixed frequency 5	**P434**	Digital out function	**P435**	Dig. out scaling
P436	Dig.out. hysteresis	**P460**	Watchdog time	**P464**	Fixed Frequency Mode
P465	Fixed freq. Array	**P466**	Min.freq. proc.ctrl.	**P475**	Delay on/off switch
P480	Funct. BusIO In Bits	**P481**	Funct-BusIO Out Bits	**P482**	Norm. BusIO Out Bits
P483	Hyst. BusIO Out Bits	**P499**	Safety CRC		

Additional parameters

P500	Language	**P501**	Inverter name	**P502**	Value Masterfunction
P503	Leading func. output	**P504**	Pulse frequency	**P505**	Absolute mini. freq.
P506	Automatic acknowled.	**P509**	Source control word	**P510**	Source Setpoints
P511	USS baud rate	**P512**	USS address	**P513**	Telegram time-out
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**	Fly. start resol.	**P522**	Fly. start offset
P523	Factory setting	**P525**	Load control max	**P526**	Load control min
P527	Load control freq.	**P528**	Load control delay	**P529**	Mode Load control
P533	Factor I²t Motor	**P534**	Torque disconn.limit	**P535**	I²t motor
P536	Current limit	**P537**	Pulse Disconnection	**P538**	Check input voltage
P539	Check output voltage	**P540**	Mode phase sequence	**P541**	Set digital out
P542	Set analog out	**P543**	Bus actual value	**P546**	Func. bus-setpoint
P549	Function Ctrlbox	**P550**	µSD jobs	**P551**	Drive profile
P552	CAN master circle	**P553**	PLC set values	**P554**	Chopper min.
P555	P-limit chopper	**P556**	Braking resistor	**P557**	Brake resistor type
P558	Flux delay	**P559**	DC Run-on time	**P560**	Mode of param.save
P583	Motor phase sequence				

Information

P700	Actual 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**	State of digital in.
P709	V/C Analogue input	**P710**	V/C Analogue output	**P711**	State of digital out
P712	Energy consumption	**P713**	Energy breake res.	**P714**	Operating time
P715	Running time	**P716**	Current frequency	**P717**	Current speed
P718	Current set freq.	**P719**	Actual current	**P720**	Act. 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	D.c. link voltage	**P737**	Usage rate brakeres.	**P738**	Usage rate motor
P739	Temperature	**P740**	PZD bus in	**P741**	PZD bus out
P742	Data base version	**P743**	Inverter ID	**P744**	Configuration
P745	Option Version	**P746**	Option Status	**P747**	Inverter Volt. Range
P748	Status CANopen	**P750**	Error statistics	**P751**	Counter statistics
P752	Last extended error	**P765**	Act. pulse frequency	**P780**	Device id
P799	Op.-time last error				

5.1.1 Operating display

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**
0	Actual frequency	[Hz]	Currently supplied output frequency
1	Speed	[rpm]	Calculated speed
2	Set point frequency	[Hz]	Output frequency corresponding to the present setpoint. It does not need to match the current output frequency.
3	Current	[A]	Currently measured output current
4	Torque current	[A]	Torque-generating output current
5	Voltage	[V AC]	Present AC voltage at the device output
6	D.c. link voltage	[V DC]	The "*DC link voltage*" is the internal FI DC voltage. Amongst other things, this depends on the level of the mains voltage.
7	Cos Phi	[-]	Calculated value of current power factor
8	Apparent power	[kVA]	Calculated value of current apparent power
9	Real Power	[kW]	Calculated value of current effective power
10	Torque	[%]	Calculated value of current torque
11	Field	[%]	Calculated value of current rotating field in the motor
12	On-time	[h]	Time for which mains voltage has been supplied to the device
13	Run-time	[h]	"*Enabled operating hours*" is the time for which the device has been enabled.
14	Analog input 1	[%]	Current value present at analogue input 1 of the device
15	Analog input 2	[%]	Current value present at analogue input 2 of the device
16 … 18	Reserved		Reserved for POSICON
19	Temp. of heat sink	[°C]	Current temperature of heat sink
20	Usage rate motor	[%]	Average motor load based on known motor data **P201** … **P209**
21	Usage rate brakeres.	[%]	"*Usage rate braking resistor*" is the average load on the braking resistor based on the known resistance data **P556** … **P557**
22	Inside inverter temp	[°C]	Current ambient temperature of the device
23	Motor temperature		Measured via temperature sensor (KTY-84, PT100, PT1000)
24 … 29	Reserve		---
30	Cur. set value MP-S	[Hz]	"*Current motor potentiometer function setpoint with storage*": **P420** … = 71/72. With this function, the setpoint can be read out or pre-set (without the drive running).
31 … 39	Reserve		---
40	PLC-Ctrlbox Value		Visualisation mode for PLC communication
41 … 49	Reserve		---
50 … 57	Reserved		Reserved for POSICON
60	R Stator Ident.		Stator resistance determined by measurement (**P220 = 1**)
61	R Rotor Ident.		Rotor resistance determined by measurement (**P220 = 2**)
62	L Scat. Stator Ident		Leakage inductance determined by measurement (**P220 = 2**)
63	L Stator Ident		Inductance determined by measurement (**P220 = 2**)
64	Clock input 1		
65	Reserved		Reserved

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 2 ... 9999 the settings are as for the 0 setting.
Setting values	**Value** / **Meaning**

0	Supervisor mode Off	The supervisor parameters are not visible.
1	Supervisor mode On	All parameters are visible.
2	Supervisor mode Off	Only the menu group 0 (without supervisor parameter) is visible.

P004	Password
Setting range	-32768 … 32767
Factory setting	{ 0 }
Description	Entry of the password from **P005** to unlock all standard parameters. Safety parameters are excluded from this.
Note	The value entered here is lost when the control board/frequency inverter is switched off. Password protection is active again.

P005	Change Password	S
Setting range	-32768 … 32767	
Factory setting	{ 0 }	
Description	Specification of a password to protect the setting values of standard parameters from unauthorised changes. Password protection can be temporarily suspended via **P004**. Safety parameters are excluded from this.	
Note	No password is set with **P005 = 0**.	

5.1.2 DS402 parameter

Information

For parameters **P046**, **P047**, **P048**, **P056**, **P057**, **P062**, **P063** and **P064** the precise designations can be obtained from the arrays. These parameters are indicated with an exclamation mark (!) in the top line.

Information

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

P020	**6042 Target velocity**	**S**
Setting range	-24000... 24000 rpm	
Factory setting	{ 0 }	
PDO mapping	RxPDO	
Data type	INTEGER 16Bit	
Description	DS402 object 6042h: Target speed in “Velocity” operating mode.	

P021	**6043 Velocity demand**	**S**
Display range	-32768...32767 rpm	
Factory setting	{ 0 }	
PDO mapping	TxPDO	
Data type	INTEGER 16Bit	
Description	DS402 object 6043h: Actual target speed after the ramp function in “Velocity” operating mode.	

Information

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

P022	**6044 Control effort**	**S**
Display range	-32768...32767 rpm	
Factory settings	{ 0 }	
PDO mapping	TxPDO	
Data type	INTEGER 16Bit	
Description	DS402 object 6044h: Present actual speed in “Velocity” mode.	

P023	**6046 Velocity amount**			**S**
Setting range	[-01] =	0... 24000 rpm	[-02] =	1... 24000 rpm
Arrays	[-01] =	Minimum speed	[-02] =	Maximum speed
Factory setting	[-01] =	{ 0 }	[-02] =	{ 1500 }
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32Bit	[-02] =	UNSIGNED 32Bit
Description	DS402 object 6046h: Minimum or maximum speed in “Velocity” mode.			

P024	6048 Velocity accele				S
Setting range	[-01] =	1... 2400000 rpm	[-02] =	0... 32767 sec	
Arrays	[-01] =	Delta-N acceleration	[-02] =	Delta-T acceleration	
Factory setting	[-01] =	{ 1500 }	[-02] =	{ 2 }	
PDO mapping	[-01] =	No	[-02] =	No	
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 16 Bit	
Description	DS402 object 6048h: Acceleration ramp in “Velocity” mode.				

P025	6049 Velocity decele				S
Setting range	[-01] =	1... 2400000 rpm	[-02] =	0... 32767 sec	
Arrays	[-01] =	Delta-N braking	[-02] =	Delta-T braking	
Factory setting	[-01] =	{ 1500 }	[-02] =	{ 2 }	
PDO mapping	[-01] =	No	[-02] =	No	
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 16 Bit	
Description	DS402 object 6049h: Braking ramp in “Velocity” operating mode.				

P026	604A Velocity qStop				S
Setting range	[-01] =	1... 2400000 rpm	[-02] =	0... 32767 sec	
Arrays	[-01] =	Delta-N Quick stop	[-02] =	Delta-T Quick stop	
Factory setting	[-01] =	{ 1500 }	[-02] =	{ 1 }	
PDO mapping	[-01] =	No	[-02] =	No	
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 16 Bit	
Description	DS402 object 604Ah: Braking ramp when quick stop is triggered in “Velocity” operating mode				

P027	6053 Percent demand	S
Display range	-32768... 32767 (-200%... 200%)	
Factory setting	{ 0 }	
PDO mapping	TxPDO	
Data type	INTEGER 16Bit	
Description	DS402 object 6053h: Actual target speed in percentage of the setpoint value after the ramp function in “Velocity” mode.	

P028	6040 Controlwort	S
Setting range	0000h … FFFFh	
Factory setting	{ 0000h }	
PDO mapping	RxPDO	
Data type	INTEGER 16 Bit	
Description	DS402 object 6040h: Control word for control of the frequency inverter in the DS402 drive profile.	

Information

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

P029	6041 Statuswort	S
Display range	0000h … FFFFh	
Factory setting	{ 0000h }	
PDO mapping	TxPDO	
Data type	INTEGER 16 Bit	
Description	DS402 object 6041h: The status word indicates the current status of the frequency inverter in the DS402 drive profile.	

P030	605D Stop opt. code	S
Setting range	0 … 2	
Factory setting	{ 2 }	
PDO mapping	No	
Data type	INTEGER 16 Bit	
Description	DS402 object 605Dh: Setting of the behaviour if Bit 8 “Stop” is set in the control word.	

Setting values

Value	Function	Description
0	Disable voltage	The frequency inverter output voltage is switched off; the motor runs down freely.
1	Brake ramp P025	The frequency inverter reduces the frequency according to the braking ramp from **P025**.
2	Quick stop P026	The frequency inverter reduces the frequency according to the quick stop ramp from **P026**.

P031	6060 Modes of operat	S
Setting range	-1 … 6	
Factory setting	{ 2 }	
PDO mapping	RxPDO	
Data type	INTEGER 8 Bit	
Description	DS402 object 6060h: Setting of the operating mode in the DS402 drive profile.	

Setting values

Value	Function	Description
-1	Nord mode	NORD standard mode
0	Reserve	---
1	Profile position	Position control
2	Velocity mode	Speed control with minimum and maximum speeds
3	Profile velocity	Speed control without minimum and maximum speeds
4	Profile torque	Torque control
5	Reserve	---
6	Homing mode	Homing

Information

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

P032	6061 Modes of op.Dis		S
Display range	-1 … 6		
Factory setting	{ 3 }		
PDO mapping	TxPDO		
Data type	INTEGER 8 Bit		
Description	DS402 object 6061h: Display of the actual operating mode in the DS402 drive profile.		
Setting values	**Value**	**Function**	**Description**
	-1	Nord mode	NORD standard mode
	0	Reserve	---
	1	Profile position	Position control
	2	Velocity mode	Speed control with minimum and maximum speeds
	3	Profile velocity	Speed control without minimum and maximum speeds
	4	Profile torque	Torque control
	5	Reserve	---
	6	Homing mode	Homing

P033	6071 Target tourque	S
Setting range	-400.0 … 400.0 %	
Factory setting	{ 100.0 }	
PDO mapping	RxPDO	
Data type	INTEGER 16 Bit	
Description	DS402 object 6071h: Target torque for “Profile Torque” operating mode.	

Information

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

P034	60FD Digital inputs		S
Display range	0000h … FFFFh		
Factory setting	{ 0000h }		
PDO mapping	TxPDO		
Data type	INTEGER 32 Bit		
Description	DS402 object 60FDh: Displays the current status of the digital inputs.		
Setting values	**Value**	**Function**	**Description**
	Bit 0	Negative limit switch	Negative limit switch
	Bit 1	Positive limit switch	Positive limit switch
	Bit 2	Home switch	Home switch
	Bit 3	Reserve	
	…		
	Bit 15		
	Bit 16	Bus / 2.IOE Dig In1	
	Bit 17	Digital input 2	
	Bit 18	Digital input 3	
	Bit 19	Digital input 4	
	Bit 20	Digital input 5	
	Bit 21	Digital input 6	
	Bit 22	Digital input 7	
	Bit 23	Digital input 8	
	Bit 24	Digital input 9	
	Bit 25	Digital input 10	
	Bit 26	Digital input 11	
	Bit 27	Digital input 12	
	Bit 28	Digital fct Analog 1	
	Bit 29	Digital fct Analog 2	

Information

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

P035	60FE Digital outputs		S
Setting range	0000h … FFFFh		
Factory setting	{ 0000h }		
PDO mapping	RxPDO		
Data type	INTEGER 32 Bit		
Description	DS402 object 60FEh: The digital outputs of the frequency inverter can be set with this object.		
Setting values	**Value**	**Function**	**Description**
	Bit 0	Set brake	Brake control
	Bit 1	Reserve	
	…		
	Bit 15		

Bit 16	Relay 1
Bit 17	Relay 2
Bit 18	Digital output 1
Bit 19	Digital output 2
Bit 20	Digital output 3
Bit 21	Digital output 4
Bit 22	Digital output 5
Bit 23	Digital output 6
Bit 24	Analog output 1 – digital function

Information

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

P046	**6063 & 6064 Akt. Position**			**! S**
Display range	[-01] =	-2147483648 … 2147483647 inc	[-02] =	-2147483.648 … 2147483.647 rev
Arrays	[-01] =	6063 Akt. Pos Inc.	[-02] =	6064 Akt. Position
Factory setting	[-01] =	{ 0 }	[-02] =	{ 0000 }
PDO mapping	[-01] =	TxPDO	[-02] =	TxPDO
Data type	[-01] =	INTEGER 32 Bit	[-02] =	INTEGER 32 Bit
Description	[-01] =	DS402 object 6063h: Displays the current position as an incremental value	[-02] =	DS402 object 6064h: Displays the current position in rotations

P047	6065 & 6066 Follow error			! S
Arrays	[-01] =	6065 Follow err wind	[-02] =	6066 Follow timeout
Setting range	[-01] =	0 … 2 147 483.647 rev	[-02] =	0 ... 32767 ms
Factory setting	[-01] =	{ 0000 }	[-02] =	{ 200 }
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 16 Bit
Description	[-01] =	DS402 object 6065h: Maximum permissible deviation of the current position from the setpoint position.	[-02] =	DS402 object 6066h: Permissible time for a slip error.

P048	6067 & 6068 Position window			! S
Arrays	[-01] =	6067 Position window	[-02] =	6068 Pos wind timeou
Setting range	[-01] =	0 … 2 147 483.647 rev	[-02] =	0 ... 32767 ms
Factory setting	[-01] =	{ 0,100 }	[-02] =	{ 200 }
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 16 Bit
Description	[-01] =	DS402 object 6067h: Permissible deviation of the current position relative to the target position in which the target is considered to have been reached.	[-02] =	DS402 object 6068h: Dwell time in the target window so that the target position is considered to have been reached.

P049	607A Target position	S
Setting range	-2 147 483.648 … 2 147 483.647 rev	
Factory setting	{ 0000 }	
PDO mapping	RxPDO	
Data type	INTEGER 32 Bit	
Description	DS402 object 607Ah: Setpoint position in “Profile position” operating mode	

P050	607E Polarity	S
Setting range	0000h … FFFFh	
Factory setting	{ 0000h }	
PDO mapping	No	
Data type	UNSIGNED 8 Bit	
Description	DS402 object 607Eh: Sets the encoder polarity	

Setting values

Value	Function	Description
Bit 0 … Bit 5	Reserve	
Bit 6	Inverse velocity polarity	0 = Direction reversal disabled, 1 = Direction reversal enabled
Bit 7	Inverse position polarity	

P051	607F Max pro velocit	S
Setting range	0 ... 24000 rpm	
Factory setting	{ 1500 }	
PDO mapping	No	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 607Fh: Maximum profile velocity in “Profile position” and “Profile velocity” operating modes	

P052	6081 Profile velocit	S
Setting range	0 ... 24000 rev	
Factory setting	{ 0 }	
PDO mapping	RxPDO	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6081h: Setpoint speed in “Profile position” and “Profile velocity” operating modes	

P053	6086 Motion pro type	S
Setting range	0 … 1	
Factory setting	{ 0 }	
PDO mapping	No	
Data type	INTEGER 16 Bit	
Description	DS402 object 6086h: Type of acceleration or deceleration ramps in “Profile Position” and “Profile Velocity” operating modes.	

Setting values

Value	Function	Description
0	Linear ramp	
1	Sin^2 ramp	

P055	608A Pos dimension			S
Setting range	0 … 1			
Factory setting	{ 0 }			
PDO mapping	No			
Data type	UNSIGNED 8 Bit			
Description	DS402 object 608Ah: Setting of the unit.			
Setting values	**Value**	**Function**	**Description**	
	0	rev [rotations]		
	1	m [Metre		

P056	6091 Gear ratio			! S
Arrays	[-01] =	6091_1 Gear ratio	[-02] =	6091_2 Gear ratio
Setting range	[-01] =	1 ... 2 147 483 647	[-02] =	1 ... 2 147 483 647
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 32 Bit
Factory setting	[-01] =	{ 1 }	[-02] =	{ 1 }
Description	DS402 object 6091h: Sets the ratio and reduction ratio			

P057	6092 Feed constant			! S
Arrays	[-01] =	6092_1 feed constant	[-02] =	6092_2 feed constant
Setting range	[-01] =	1 … 2 147 483 647 m	[-02] =	1 … 2 147 483 647 rev
Factory setting	[-01] =	{ 1 }	[-02] =	{ 10 }
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 32 Bit
Description	DS402 object 6092h: Sets the feed constants.			
Note	The values are only taken into account in scaling if in **P055** “*DS402 Pos dimension*” (608A), the setting value “*m*” is selected.			

P058	6098 Homing method		S
Setting range	0 … 35		
Factory setting	{ 0 }		
PDO mapping	No		
Data type	INTEGER 8 Bit		
Description	DS402 object 6098h: Setting of the required reference run method.		
Setting values	**Value**	**Function**	**Description**
	0	No reference run	No reference run
	1	Reference run to negative limit switch taking the index pulse into account.	
	2	Reference run to positive limit switch taking the index pulse into account.	
	3	Reference run to the left falling switching flank of the reference switch, taking the index pulse into account	
	4	Reference run to the left rising switching flank of the reference switch, taking the index pulse into account	
	5	Reference run to the right falling switching flank of the reference switch, taking the index pulse into account	
	6	Reference run to the right rising switching flank of the reference switch, taking the index pulse into account	
	7	Reference run to the left falling flank of the reference switch with consideration of the index pulse and limitation of movement by the positive limit switch	
	8	Reference run to the left rising flank of the reference switch with consideration of the index pulse and limitation of movement by the positive limit switch	
	9	Reference run to the right rising flank of the reference switch with consideration of the index pulse and limitation of movement by the positive limit switch	
	10	Reference run to the right falling flank of the reference switch with consideration of the index pulse and limitation of movement by the positive limit switch	
	11	Reference run to the right falling flank of the reference switch with consideration of the index pulse and limitation of movement by the positive limit switch	
	12	Reference run to the right rising flank of the reference switch with consideration of the index pulse and limitation of movement by the negative limit switch	
	13	Reference run to the left rising flank of the reference switch with consideration of the index pulse and limitation of movement by the negative limit switch	
	14	Reference run to the left falling flank of the reference switch with consideration of the index pulse and limitation of movement by the negative limit switch	
	15	Reserved	
	16		
	17	Reference run to negative limit switch without taking the index pulse into account.	
	18	Reference run to positive limit switch without taking the index pulse into account.	
	19	Reference run to the left falling switching flank of the reference switch without taking the index pulse into account	
	20	Reference run to the left rising switching flank of the reference switch without taking the index pulse into account	
	21	Reference run to the right falling switching flank of the reference switch without taking the index pulse into account	
	22	Reference run to the right rising switching flank of the reference switch without taking the index pulse into account	
	23	Reference run to the left falling flank of the reference switch without consideration of the index pulse and with limitation of movement by the positive limit switch	
	24	Reference run to the left rising flank of the reference switch without consideration of the index pulse and with limitation of movement by the positive limit switch	
	25	Reference run to the right rising flank of the reference switch without consideration of the index pulse and with limitation of movement by the positive limit switch	
	26	Reference run to the right falling flank of the reference switch without consideration of the index pulse and with limitation of movement by the positive limit switch	
	27	Reference run to the right falling flank of the reference switch without consideration of the index pulse and with limitation of movement by the positive limit switch	
	28	Reference run to the right rising flank of the reference switch without consideration of the index pulse and with limitation of movement by the negative limit switch	
	29	Reference run to the left rising flank of the reference switch without consideration of the index pulse and with limitation of movement by the negative limit switch	
	30	Reference run to the right falling flank of the reference switch without consideration of the index pulse and with limitation of movement by the negative limit switch	
	31	Reserved	
	…		
	34		
	35	The actual position of the drive is set directly as the zero point.	

P059	6099 Homing speeds			S
Arrays	[-01] =	6099 Search switch	[-02] =	6099 Search zero
Setting range	[-01] =	0 … 24000 rpm	[-02] =	0 … 24000 rpm
PDO mapping	[-01] =	No	[-02] =	No
Data type	[-01] =	UNSIGNED 32 Bit	[-02] =	UNSIGNED 32 Bit
Factory setting	[-01] =	{ 30 }	[-02] =	{ 30 }
Description	[-01] =	DS402 object 6099h: Setpoint speed for homing to the reference switch	[-02] =	DS402 object 6099h: Setpoint speed for homing to the encoder's zero track

P060	609A Homing accelera	S
Setting range	0 … 2 147 483 647 rpm s^{-1}	
Factory setting	{ 750 }	
PDO mapping	No	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 609Ah: Acceleration and brake delay in "Homing" operating mode	

P061	607C Homing offset	S
Setting range	-2 147 483.648 … 2 147 483.647 rev	
Factory setting	{ 0000 }	
PDO mapping	No	
Data type	INTEGER 32 Bit	
Description	DS402 object 607Ch: States the difference between the zero position of the application and the reference point of the machine.	

Information

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

P062	606B & 606C & 6069 Velocity actual			!	S
Display range	-2 147 483 648 … 2 147 483 647 rpm		-2 147 483 648 … 2 147 483 647 inc		
Arrays	[-01] =	606B Velocity demand	[-03] =	6069 Act. Increm.Enc	
	[-02] =	606C Velocity actual			
Factory setting	All { 0 }				
PDO mapping	[-01] =	No			
	[-02] =	TxPDO			
	[-03] =	No			
Data type	All	INTEGER 32 Bit			
Description	[-01] =	DS402 object 606Bh: Actual velocity in "Profile velocity" operating mode			
	[-02] =	DS402 object 606Ch: Actual velocity after the ramp function in "Profile velocity" operating mode			
	[-03] =	DS402 object 6069h: Actual encoder velocity in "Profile velocity" operating mode			

P063	606D & 606E Velocity window			!	S
Setting range	[-01] =	0 … 24000 rpm	[-02] =	0 … 32767 ms	
Arrays	[-01] =	606D Velocity window	[-02] =	606E Veloc wind time	
Factory setting	[-01] =	{ 100 }	[-02] =	{ 200 }	
PDO mapping	[-01] =	No	[-02] =	No	
Data type	[-01] =	UNSIGNED 16 Bit	[-02] =	UNSIGNED 16 Bit	
Description	[-01] =	DS402 object 606Dh: Permissible deviation of the actual speed relative to the target speed in which the speed is considered to have been reached. Applies in “Profile velocity” operating mode.			
	[-02] =	DS402 object 6068h: Dwell time in the target window so that the target speed is considered to have been reached. Applies in “Profile velocity” operating mode.			
Description	Set target window for velocity and time				

P064	606F & 6070 606F Velocity thresh			!	S
Arrays	[-01] =	606F Velocity thresh	[-02] =	6070 Veloc thre time	
Setting range	[-01] =	0 … 24000 rpm	[-02] =	0 … 32767 ms	
Factory setting	[-01] =	{ 100 }	[-02] =	{ 200 }	
PDO mapping	[-01] =	No	[-02] =	No	
Data type	[-01] =	UNSIGNED 16 Bit	[-02] =	UNSIGNED 16 Bit	
Description	[-01] =	DS402 object 606Fh: Permissible deviation of the actual speed relative to zero speed. If the drive undershoots this threshold value beyond the dwell time, Bit 12 of the status word is set. Applies in “Profile velocity” operating mode.			
	[-02] =	DS402 object 6070h: Dwell time below the threshold value until Bit 12 “Drive stopped” is set. Applies in “Profile velocity” operating mode.			

P065	6083 Prof accelerat	S
Setting range	0 ... 2 147 483 647 rpm s^{-1}	
Factory setting	{ 750 }	
PDO mapping	RxPDO	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6083h: Acceleration in “Profile position” and “Profile velocity” operating modes	

P066	6084 Prof decelerat	S
Setting range	0 ... 2 147 483 647 rpm s^{-1}	
Factory setting	{ 750 }	
PDO mapping	RyPDO	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6084h: Deceleration in “Profile position” and “Profile velocity” operating modes	

P067	6085 qStop decelerat	S
Setting range	0 ... 2 147 483 647 rpm s^{-1}	
Factory setting	{ 15000 }	
PDO mapping	RxPDO	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6085h: Quick stop deceleration in “Profile position” and “Profile velocity” operating modes	

P072	60FF Target Velocity	S
Setting range	-24000 ... 24000 rpm	
Factory setting	{ 0 }	
PDO mapping	RxPDO	
Data type	INTEGER 32 Bit	
Description	DS402 object 60FFh: Target velocity in “Profile velocity” operating mode	

P073	6077 Torque act val	S
Display range	-400.0 ... 400.0%	
Factory setting	{ 0.0 }	
PDO mapping	TyPDO	
Data type	INTEGER 16 Bit	
Description	DS402 object 6077h: Actual torque as percentage of nominal torque in “Profile torque” operating mode	

P074	6078 Current act val	S
Display range	-300.0 ... 300.0%	
Factory setting	{ 0.0 }	
PDO mapping	TxPDO	
Data type	INTEGER 16 Bit	
Description	DS402 object 6078h: Actual current as percentage of the nominal current in “Profile torque” operating mode	

P075	6079 DC link cir vol	S
Display range	0.000 ... 1200.000 V	
Factory setting	{ 0000 }	
PDO mapping	No	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6079h: Current DC link voltage	

P076	6087 Torque ramp	S
Setting range	0.0 ... 1 000 000.0 % s^{-1}	
Factory setting	{ 10000.0 }	
PDO mapping	No	
Data type	UNSIGNED 32 Bit	
Description	DS402 object 6087h: Sets the torque ramp	

5.1.3 Basic parameter

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

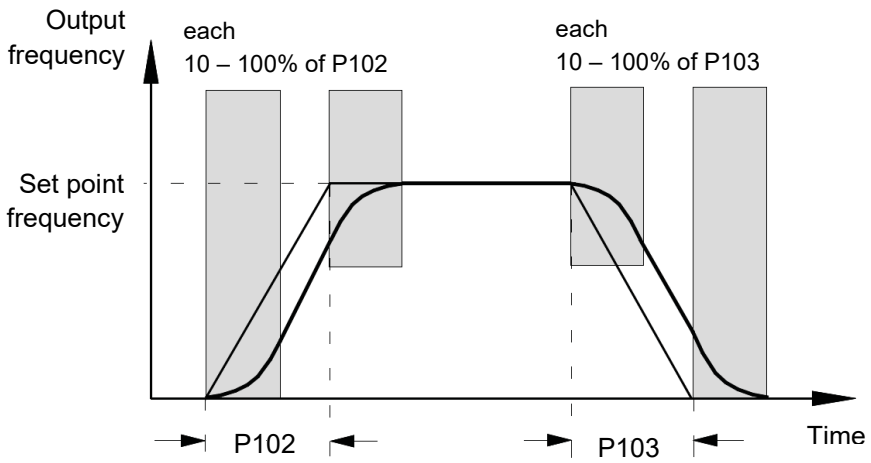
Value		Meaning
0	Do not copy	No copy process triggered.
1	Copy actual to P1	Copies the active parameter set to parameter set 1
2	Copy actual to P2	Copies the active parameter set to parameter set 2
3	Copy actual to P3	Copies the active parameter set to parameter set 3
4	Copy actual to P4	Copies the active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

P102	Acceleration time	P
Setting range	0.00 … 320.00 s	
Factory setting	{ 2.00 } { 5.00 } ≥ 45 kW	
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 } { 5.00 } ≥ 45 kW	
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**.	

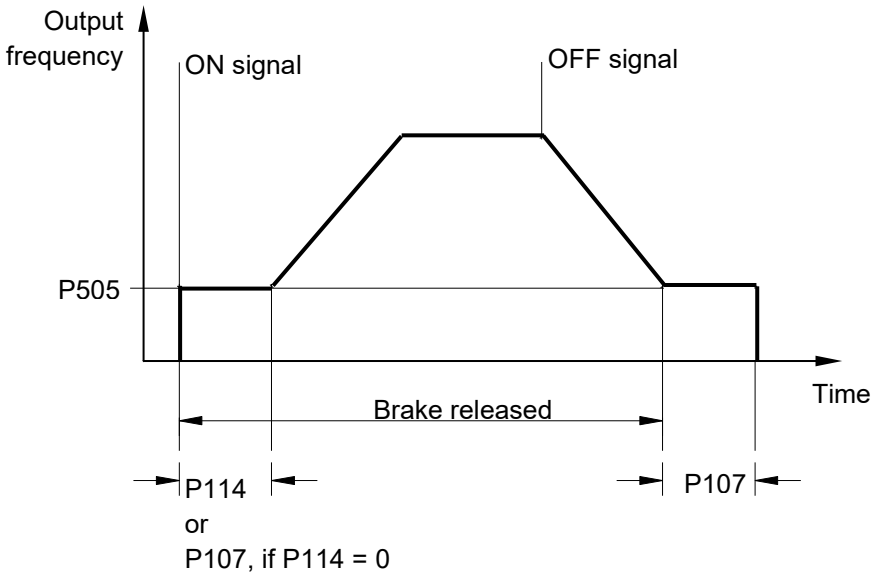
Recommended parameterisation for the application:
Lifting gear with brake without speed feedback

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 "Reduced overcurrent due to output frequency ", 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	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. 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. balance 100%, **P403**) then corresponds to the setting value in **P112**. The limit value 20% of torque current cannot be undershot by a smaller analogue setpoint (**P400 = 2**). In contrast, with the “CFC closed-loop” (**P300 = 1**) control method, a limit value of 0% is possible.		
Note	A torque limit is not permissible for lifting gear applications!		
	With **P300 = 3**, an internal torque limit is active, which cannot be switched off. • IE4 motors – 200% (lower speed range (injection mode)) – 250 % (upper speed range) • IE5 motors – 150% (lower speed range (injection mode)) – 250 % (upper speed range)		
Setting values	**Value** / **Meaning**		
	401 / OFF / The torque current is not limited.		

P113	Jog frequency	S	P
Setting range	-400.0 … 400.0 Hz		
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 triggered via one of the digital inputs. The jog frequency 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. The current output frequency is applied to parameter **P113** and is available when it is enabled again.		
Note	Activation of the jog frequency via one of the digital inputs causes the remote control to be switched off in case of bus operation. In addition, any setpoint frequencies which are present are not taken into account. Exception: Analogue setpoints which are processed via the functions *“Frequency addition”* or *“Freq. subtraction”*.		

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] = Reserve		
Factory setting	All { 1 }			
Scope of application	**SK 530P, SK 540P, SK 550P**			
Description	Monitoring of communication at system bus level (in case of fault: Error message **E010.9**)			
Note	If fault messages, which are detected by the optional module (e.g. faults at field bus level) are not to result in a switch-off of the drive electronics, 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.

5.1.4 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 IE3 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**.	
	IE1/IE2motors If IE1/IE2 motors are used after selecting a IE3 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 230 V 90SP
3	0.33 PS 230 V 71SP	11	0.75 PS 230 V 80SP	19	1.5 PS 230 V 90SP
4	0.25 kW 400 V 71SP	12	0.55 kW 400V 80SP	20	1.1 kW 400 V 90SP
5	0.33 PS 460 V 71SP	13	0.75 PS 460 V 80SP	21	1.5 PS 460 V 90SP
6	0.37 kW 230V 71LP	14	0.75 kW 230V 80LP	22	1.5 kW 230 V 90LP
7	0.5 PS 230 V 71LP	15	1.0 PS 230 V 80LP	23	2.0 PS 230 V 90LP
8	0.37 kW 400V 71LP	16	0.75 kW 400V 80LP	24	1.5 kW 400 V 90LP
9	0.5 PS 460 V 71LP	17	1.0 PS 460 V 80LP	25	2.0 PS 460 V 90LP
26	2.2 kW 230V 100MP	36	5.5 kW 230 V 132SP	46	15.0 kW 400V 160LP
27	3.0 PS 230 V 100LP	37	7.5 PS 230 V 132SP	47	20.0 PS 460 V 160LP
28	2.2 kW 400V 100MP	38	5.5 kW 400 V 132SP	48	18.5 kW 400V 180MP
29	3.0 PS 460 V100LP	39	7.5 PS 460 V 132SP	49	25.0 PS 460 V 180MP
30	3.0 kW 230V 100AP	40	7.5 kW 230 V 132MP	50	22.0 kW 400V 180LP
31	3.0 kW 400 V 100 AP	41	10.0 PS 230 V 132MP	51	30.0 PS 460 V 180LP
32	4.0 kW 230V 112MP	42	7.5 kW 400 V 132MP	52	30.0 kW 400 V 225RP
33	5.0 PS 230 V 112MP	43	10.0 PS 460 V 132MP	53	40.0 PS 460 V 225RP
34	4.0 kW 400V 112MP	44	11.0 kW 400V 160MP	54	37.0 kW 400 V 225SP
35	5.0 PS 460 V 112MP	45	15.0 PS 460 V 160MP	55	50.0PS 460V
56	45.0 kW 400 V 225MP	66	132.0 kW 400V 315MP	76	15.0 kW 230V 160LP
57	60.0 PS 460 V 225SP	67	180.0 PS 460 V 315MP	77	20.0 PS 230 V 160LP
58	55.0 kW 400 V 250WP	68	160.0 kW 400V 315RP	78	18.5 kW 230V 180MP
59	75.0 PS 460 V 250WP	69	220.0 PS 460 V 315RP	79	25.0 PS 230 V 180MP
60	75.0 kW 400 V 280SP	70	200.0kW 400V	80	22.0 kW 230V 180LP
61	100.0 PS 460 V 280SP	71	270.0PS 460V	81	30.0 PS 230 V 180LP
62	90.0 kW 400 V 280MP	72	250.0kW 400V	82	30.0 kW 230V 225RP
63	120.0 PS 460 V 280MP	73	340.0PS 460V	83	40.0 PS 230 V 225RP
64	110.0 kW 400V 315SP	74	11.0 kW 230V 160MP	84	37.0 kW 230V 225SP
65	150.0 PS 460 V 315SP	75	15.0 PS 230 V 160MP	85	50.0PS 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	4.0PS 230V	103	2.20 kW 230 V 100T2/4	113	4.00 kW 400 V 100T2/4
94	4.0PS 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
119	0.70 kW 400 V 71x2/8	126	2.20 kW 400 V 90F3/8	141	1.50 kW 230 V 90N2/8
120	1.05 kW 400 V 71x3/8	127	3.00 kW 400 V 90F4/8	142	1.50 kW 230 V 90F2/8
121	1.10 kW 400 V 90N1/8	130	4.00 kW 400 V 90F5/8	143	2.20 kW 230 V 90N3/8
122	1.50 kW 400 V 71F4/8	135	0.35 kW 230 V 71N1/8		
123	1.50 kW 400 V 90N2/8	137	0.70 kW 230 V 71N2/8		
124	1.50 kW 400 V 90F2/8	138	1.05 kW 230 V 71N3/8		
125	2.20 kW 400 V 90N3/8	139	1.10 kW 230 V 90N1/8		

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	100 ... 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:** Settings in this parameter do not have any effect.		
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.		

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		

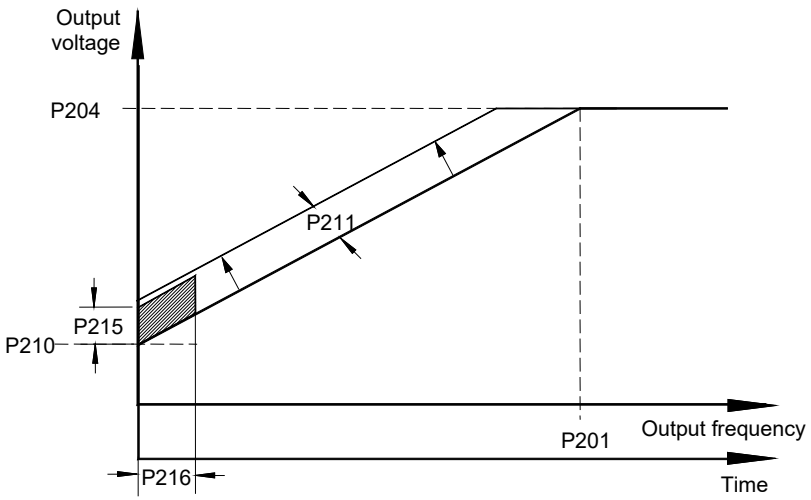
Note	This function is not active in control mode "CFC closed-loop" (Servo Mode) **P300= 1**,

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

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 5.5 kW (230 V ≤ 2.2 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 5.5 kW (230 V ≤ 2.2 kW). **ASM**: All motor parameters (**P202**, **P203**, **P206**, **P208**, **P209**) are determined. **PMSM**: The stator resistance **P208** and the inductance **P241** are determined

P221	Shift angle CFC inj.	S	P
Setting range	-90 … 90°		
Factory setting	{ 0 }		
Description	*"Shift angle CFC injection"*. Compensation of the load-dependent phase shift angle of the rotor position of a PMSM.		
Note	The parameter is only relevant for sensorless control with injection signal (**P300 = 3**). When using NORD motors, the value is automatically set by selecting the motor via the motor list (**P200**).		

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		

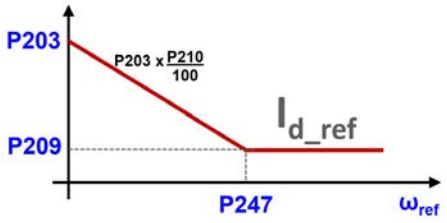
P241	Inductivity PMSM		S	P
Setting range	0.1 … 200.0 mH			
Arrays	[-01] = Ld	[-02] = Lq		
	[-03] = unsaturated Ld	[-04] = unsaturated Lq		
	[-05] = saturated Ld	[-06] = saturated Lq		
Factory setting	The default setting depends on the nominal power of the FI.			
Description	The stator inductivity of 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 ... 500 000.0 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**. 		

5.1.5 Control parameters

P300	Control method		P
Setting range	0 … 3		
Factory setting	{ 0 }		
Description	Definition of the control method for the motor		
Note	Commissioning information: (📖 (Chap. 4.2 "Selecting the operating mode for motor control")).		
Setting values	**Value**	**Meaning**	
	0	VFC open-loop	Field-oriented control without encoder feedback
	1	CFC closed-loop	Speed control with encoder feedback
	2	CFC open-loop	Observer-based speed control without encoder feedback (In the lower speed range: field-oriented control (VFC open-loop))
	3	CFC open-loop-inje	For PMSM only: Observer-based speed control without encoder feedback (In the lower speed range: injection-based operation)

P301	Incremental encoder		
Setting range	0 … 27		
Arrays	[-01] = TTL	[-02] = HTL	[-03] = Sin/Cos
Factory setting	{ 6 }	{ 3 }	{ 3 }
Description	"*Encoder resolution*". Input of the pulse count per rotation of the connected 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 = 1**, 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	16 pulses	23	-16 pulses
	19	32 pulses	24	-32 pulses
	20	64 pulses	25	-64 pulses
	21	128 pulses	26	-128 pulses
	22	256 pulses	27	-256 pulses
	28	1024 SLCA [1]	29	-1024 SLCA [1]

1 The settings { 28 } and { 29 } 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 … 5				
Arrays	[-01] = TTL	[-02] = HTL	[-03] = Sin/Cos	[-04] = Universal (UART)	
Factory setting (SK 500P/510P)	{ 0 }	{ 1 }	{ 0 }	{ 0 }	
Factory setting (SK 530P/540P/550P)	{ 1 }	{ 0 }	{ 0 }	{ 0 }	
Description	The actual speed value supplied by an incremental encoder can be used for various functions in the FI.				

Setting values

Value	Meaning	
0	Off	
1	CFC closed-loop	"*Servo mode speed measurement*": The motor speed list value is used for speed control with encoder feedback. The ISD control cannot be switched off in this function.
2	Actual PID frequency	The speed list 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 use an incremental encoder which is not mounted directly onto the motor for speed control. **P413** … **P416** govern the control.
3	Frequency addition	The determined speed is added to the actual setpoint value.
4	Freq. subtraction	The determined speed is subtracted from the actual setpoint.
5	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			
Arrays	[-01] = TTL	[-02] = HTL	[-03] = Sin/Cos	[-04] = Universal (UART)
Factory setting	All { 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. $P326 = \frac{\text{Motor speed}}{\text{Encoder speed}}$			
Note	Not for **P325**, setting "CFC closed-loop" (servo mode speed measurement).			

P327	Speed slip error			P
Setting range	0 … 3000 rpm			
Arrays	[-01] = Permissible deviation during operation • FI enabled		[-02] = Permissible deviation during standstill (to monitor a holding brake) • FU ready to switch-on	
Factory setting	All { 0 }			
Description	"*Slip error speed control*". The limit value for a permissible 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**, • Limit value has been exceeded during standstill: Error **E013.4**. Slip error monitoring functions with all control methods (**P300**).			
Note	With sensorless control using **P300 = 3**, and in closed-loop mode of a PMSM (**P300 = 1**), if no limit values have been parameterised in **P327** and **P328**, a mandatory limit is activated (see *Default values mandatory limit*).			
	Default values mandatory limit • Slip error limit (**P327 [-01]**): • Speed slip delay (**P328 [-01]**):		500 rpm 0.5 s	
Setting values	0 = Off			

Relevant settings

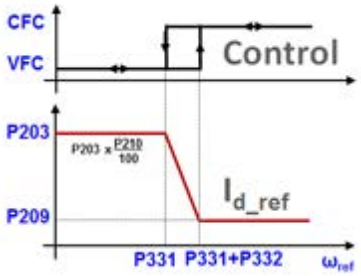
Encoder type	Electrical connection		Parameter
TTL encoder	Encoder interface (X13 terminals)		**P325 = 1** [1]
HTL encoder	DIN3 (X11:23 terminal)	…	**P420 [-03] = 43**
	DIN4 (X11:24 terminal)	…	**P420 [-04] = 44**

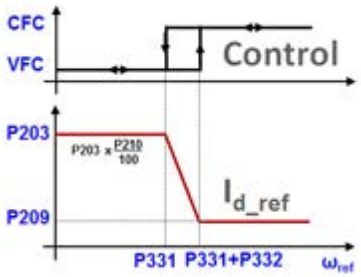
1 Only for SK 500P and SK 510P

P328	Speed slip delay				P
Setting range	0.0 … 10.0 s				
Arrays	[-01] =	Delay time during operation • FI enabled	[-02] =	Delay time during standstill (to monitor a holding brake) • FU ready to switch-on	
Factory setting	All { 0.0 }				
Description	"*Slip error delay*". If the permissible slip error defined in **P327** is exceeded, the error message is temporarily suppressed.				
Note	With sensorless control using **P300 = 3**, and in closed-loop mode of a PMSM (**P300 = 1**), if no limit values have been parameterised in **P327** and **P328**, a mandatory limit is activated (see *Default values mandatory limit*).				
	Default values mandatory limit • Slip error limit (**P327 [-01]**): • Speed slip delay (**P328 [-01]**)			500 rpm 0.5 s	
Setting values	0 = Off				

P330	Ident startrotor pos	S	P
Setting range	0 … 7		
Factory setting	{ 0 }		
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**.
	2	**Value of abs. univ. enc.,** *"Value of absolute encoder of the universal encoder interface"*: With this method, the starting position of the rotor is determined from the absolute position of a universal encoder (Hyperface, EnDat with Sin/Cos track, BISS with Sin/Cos track or SSI with Sin/Cos track). The universal encoder type is set in parameter **P604**. For this position information to be unique, it must be known (or determined) how this rotor position relates to the absolute position of the universal encoder. This is performed with the offset parameter **P334**. Motors should either be delivered with a rotor starting position "zero" or the rotor starting position must be marked on the motor. If this value is not available, the offset value can also be determined with the functions **P330 = 0** and **P330 = 1**. After the first start, the determined offset value is stated in the parameter **P334**. This value is volatile, i.e. it is only stored in the RAM. In order to save it in the EEPROM, it must be briefly changed and then set back to the determined value. After this, fine tuning can be carried out with the motor 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 U_d (**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 "Zero" cannot be completely achieved, as the synchronous motor has a slight load at high speeds due to the fan wheel. The universal encoder should be located on the motor shaft. **Note:** If the UART encoder is used for speed control, rotor position coupling via **P330 = 2** is not possible. Fault **E019.1** is triggered.
	3	**Value CANopen enc.,** *"Value from CANopen encoder"*: Same as **P330 = 2**, but a CANopen absolute encoder is used for the determination of the starting position of the rotor.
	4	**Voltage. zero track,** *"Voltage encoder zero track"*: 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	**Test signal z. track**: 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	**Voltage Track Z cycl**, *"Voltage control with track Z, cyclically":* Same as **P330 = 4**, but the starting position of the rotor is determined with each enable.
	7	**Testsig track-Z cycl,** *"Test signal method with track Z, cyclically"*: Same as **P330 = 5**, 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 from which a field-oriented control without encoder feedback (VFC open-loop) is switched to an observer-based speed control without encoder feedback (ASM and PMSM) For **P300 = 3**: Definition of the frequency from which an injection-based speed control without encoder feedback is switched to an observer-based speed control without encoder feedback (PMSM only) 		
Note	• The parameter is only relevant for: **P300 = 2 ... 3**. • 100% corresponds to the nominal frequency from **P201** • With **P300 = 3**, the switchover frequency is internally limited to 50% of the nominal frequency from **P201**		
	• The switchover frequency cannot be higher than 100 Hz The frequency inverter eventually limits the setting internally. (Only valid for **P300 = 3**)		

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 ... 3		
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**).
3	Each enable	Identification of the PMSM rotor position is performed on each enable. Determination of the estimated motor starting temperature is performed when the drive is enabled for the first time.

P337	Switchover time CFC inj	S	P
Setting range	0.3 ... 100.0 ms		
Factory setting	{ 25.0 }		
Description	“*Switchover CFC injection*”: **P337** defines how long the transition from injection-based speed control to observer-based speed control will take. The transition range starts with a frequency from **P331** + **P332**. By increasing the switchover time (**P337**), potential vibrations can be reduced during the transition between both control methods. Increased settings, however, are to the disadvantage of dynamics.		
Note	The parameter is only relevant for the “CFC open-loop-inje” control method (**P300 = 3**) and only during starting and not during braking.		

P338	Voltage CFC-Inj	S	P
Setting range	1 ... 1000%		
Factory setting	{ 100 }		
Description	"*Voltage CFC injection*": Adjustment of injection voltage. The higher the selected voltage, the greater the precision. In addition, the noise development increases during the identification process.		
Note	• The factory setting (100%) for the voltage required for the drive is automatically calculated and results from the motor data and the frequency inverter used • Parameter **P338** only has an influence if: – **P300 = 3** or – **P300 = 1** and **P330** = Selection of a test signal method (e.g. **P330 = 1**)		

P339	PLL CFC inj. gain	S	P
Setting range	5 ... 2000%		
Factory setting	{ 100 }		
Description	"*PLL CFC injection gain*": Adjustment of the gain of the rotor position tracking speed for the injection-based speed control (**P300 = 3**). A high gain results in a higher angular precision. The sensitivity to faults however, increases.		

P340	Current filter CFC inj	S	P
Setting range	1.0 ... 100.0% ms^{-1}		
Factory setting	{ 6.0 }		
Description	"*Current filter CFC injection*" Adjustment of the filter for the injection signal of the injection-based speed control (**P300 = 3**) With highly dynamic systems, the adjustment of the filter may be required.		
Note	When using the injection-based control (**P300 = 3**), an incorrectly set filter may result in a deterioration of the speed precision.		

P341	Dyn.I ctrl. CFC inj	S	P
Setting range	0.1 ... 100.0 ms		
Factory setting	{ 4.0 }		
Description	"*Current control dynamics CFC injection*": Adjustment of the current control dynamics when using the injection-based control (**P300 = 3**) in injection mode (lower speed range). A reduction of the time constant results in an increased control dynamics in injection mode.		
Note	For the upper speed range, the adjustment of the control dynamics takes place via parameters **P312**, **P313**, **P315** and **P316**. Adjusting the current control dynamics for the injection mode (**P341**) to that of the upper speed range achieves a good transition behaviour between the control methods.		

P342	Synchron Start PMSM	S	P
Setting range	0 … 5		
Factory setting	{ 0 }		
Description	*“Synchronised startup time for PMSM”:* Delay of motor start after the enable signal. The delay time corresponds to the duration of the identification cycle according to **P330** of the test signalling method and the identification of the starting position of the rotor with **P300 = 3**, multiplied by the setting parameterised in **P342**.		
Note	The parameter is only functional when using a PMSM.		
	With rotor position detection, the parameter is functional via a test signal method (**P330**) and **P300 = 3**.		
	A delayed motor start can be required, if several drives use the "CFC open-loop-inje" control (**P300 = 3**) or the rotor position identification by means of test signal methods in closed loop (**P300 = 1**), and will start being synchronised with each other. This ensures that the drives only jointly start after the successful rotor position detection of all drives.		
	If a synchronisation is not possible in the number of cycles set in **P342**, the frequency inverter switches to fault state (**E019.2**).		
Setting values	**Value**	**Meaning**	
	0 Off	No delay. The start takes place immediately after the rotor position identification.	
	1 After 1 cycle	The start takes place after one typical cycle for the rotor position identification.	
	2 After 2 cycles	The start takes place after two typical cycles for the rotor position identification.	
	… …	…	
	5 After 5 cycles	The start takes place after five typical cycles for the rotor position identification.	

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 FI is via IOs.
	1 On — The PLC is active, control of the FI is 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**

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**

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.

Information

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

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!

Information

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

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.

5.1.6 Control terminals

Information

The input functions {48} and {58} do not function with the following parameter **P400** without connection of a mains voltage (X1).

P400	**Analog input func.**		**P**
Setting range	0 … 58		
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 IO extension	
	[-04] = Ext. Analogue in 2	*"External analogue input 2":* Analogue input 2 of the first IO extension	
	[-05] = Ext.AI 1 2.IOE	*"External analogue input 1 of the 2nd IOE":* Analogue input 1 of the second I/O extension	
	[-06] = Ext.AI 2 2.IOE	*"External analogue input 2 of the 2nd IOE":* Analogue input 2 of the second I/O extension	
	[-07] = Reserve	---	
	[-08] = Reserve	---	
	[-09] = Clock input 1	Evaluation of pseudo-analogue pulse signals on DI3 (**P420 [-03]**) if it has been set to **P420 [-03] = 81** / **P420 [-03] = 82**.	
Scope of application	**[-01], [-02], [-09]** **SK 500P and higher**		
	[-03] … [-08] **SK 530P and higher**		
Factory setting	[-01] = { 1 }	All others { 0 }	
Description	"*Analogue input function*". Assignment of analogue functions to internal analogue inputs or the analogue inputs of optional modules.		
Note	The analogue inputs of the frequency inverter (analogue inputs 1 and 2) can alternatively be parameterised to digital functions. When using the analogue inputs for digital functions, the required digital functions must be set via parameter **P420 [-13]** or **[-14]**. Additionally, the analogue function of the relevant analogue inputs must be deactivated (**P400 [-01] = 0** or **P400 [-02] = 0**) to avoid any misinterpretation of signals.		

Setting values

Value		**Description**
0	Off	The analogue input has no function. After the FI has been enabled via the control terminals, it supplies the set minimum frequency **P104**.
1	Set point frequency	The specified analogue range (matching of analogue input) varies the output frequency between the set minimum and maximum frequencies **P104 / P105**.
2	Torque current limit	Based on the set torque current limit **P112**, this can be changed by means of an analogue value. The 100% setpoint corresponds to the set torque current limit **P112**.
3	PID 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** ... **P415**:
4	Frequency addition [2]	The supplied frequency value is added to the setpoint.
5	Frequency subtract. [2]	The supplied frequency value is subtracted from the setpoint.

6	Current limit	Based on the set current limit **P536**, this can be changed via the analogue input.
7	Maximum frequency	The maximum frequency of the FI is varied. 100% corresponds to the setting in parameter **P411**. 0% corresponds to the setting in parameter **P410**. The values for the min./max. output frequency **P104/P105** cannot be undershot/exceeded.
8	PID ltd.current.freq [1]	Same as **P400 = 3**, but the output frequency cannot drop below the programmed “Minimum frequency” value in parameter **P104** (no phase sequence reversal).
9	PID suprvsd.cur.freq [1]	Same as **P400 = 3**, but the FI switches off the output frequency when the minimum frequency **P104** is reached.
10	Servo-Mode Torque	In the *“CFC closed-loop“* control method (**P300 = 1**), the motor torque can be set/limited with this function. Here, the speed controller is switched off and a torque control is activated. In this case, the analogue input is the setpoint source. In the open-loop method (**P300 ≠ 1**), this function can be used with reduced control precision.
11	Pre-tension Torque	This function enables a value for the anticipated torque requirement to be entered in the controller (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring.
12	Reserve	---
13	Multiplication	The setpoint is multiplied by the supplied analogue value. The analogue value adjusted to 100% then corresponds to a multiplication factor of 1.
14	Cur.val process ctrl [1]	Activates the process controller. Analogue input 1 is connected to the actual value encoder (compensator, pressurised can, flow volume meter, etc.). The mode (0 … 10 V or 0/4 … 20 mA) is set in **P401**.
15	Nom.val process ctrl [1]	Same as **P400 = 14**, but the setpoint is specified (e.g. by a potentiometer). The actual value must be specified using another input.
16	Add. process control [1]	Adds an adjustable additional setpoint after the process controller.
17	Reserve	---
18	Curve control	The slave communicates its actual speed to the master. From its own speed, the speed of the slave and the specified speed, the master calculates the current setpoint speed. Therefore, neither of the two drives travels faster than the specified speed in the curve.
19	Reserve	---
20	Set Analog Out	Value from **P542**
21	Reserve	---
…		
45		
46	Setval.torque p.reg.	Setpoint Torque Process controller
47	Reserved	Reserved for POSICON
48	Motor temperature	Motor temperature measurement with temperature sensor (e.g. KTY-84), see Section (Chap. 4.4)for details.
49	Ramp time	Acceleration and deceleration
53	d-corr. F Process	“Diameter correction, PID process controller frequency”
54	d-corr. Torque	“Diameter correction, torque”
55	d-corr. F+Torque	“Diameter correction, PID process controller frequency and torque”
56	Acceleration time	Adjustment of the time for the acceleration process. 0% is the shortest time possible, 100% ≙ **P102**
57	Deceleration time	Adjustment of the time for the deceleration process. 0% is the shortest time possible, 100% ≙ **P103**
58	Reserved	Reserved for POSICON

1 Process controller details: **P400** and "Process controller".

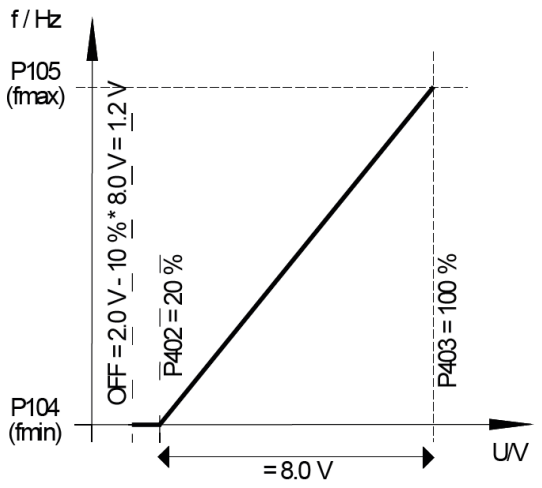
2 The limits of these values are set by parameter **P410** *“Min. freq. a-in 1/2”* and parameter **P411** *“Max. freq. a-in 1/2”*.

Note: Overview of scaling (Chap. 8.10).

P401	**Analog input mode**		**S**
Setting range	0 … 5		
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 IO extension	
	[-04] = Ext. Analogue in 2	*"External analogue input 2":* Analogue input 2 of the first IO extension	
	[-05] = Ext.AI 1 2.IOE	*"External analogue input 1 of the 2nd IOE":* Analogue input 1 of the second I/O extension	
	[-06] = Ext.AI 2 2.IOE	*"External analogue input 2 of the 2nd IOE":* Analogue input 2 of the second I/O extension	
	[-07] = Reserve	---	
	[-08] = Reserve	---	
	[-09] = Clock input 1		
Scope of application	**[-01], [-02], [-09]** **SK 500P and higher**		
	[-03] … [-08] **SK 530P and higher**		
Factory setting	All { 0 }		
Description	"*Analog 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 - 100% limited	An analogue setpoint smaller than the programmed 0% adjustment (**P402**) does not result in undershooting of the programmed minimum frequency **P104**, i.e. it does not result in a phase sequence reversal.
1	0 - 100%	If a setpoint smaller than the programmed 0% adjustment (**P402**) is present, this can cause a change in the direction of rotation. This allows a phase sequence reversal using a simple voltage source and potentiometer. For example, internal setpoint with change in the 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**; a brake controlled by the FI is not applied.

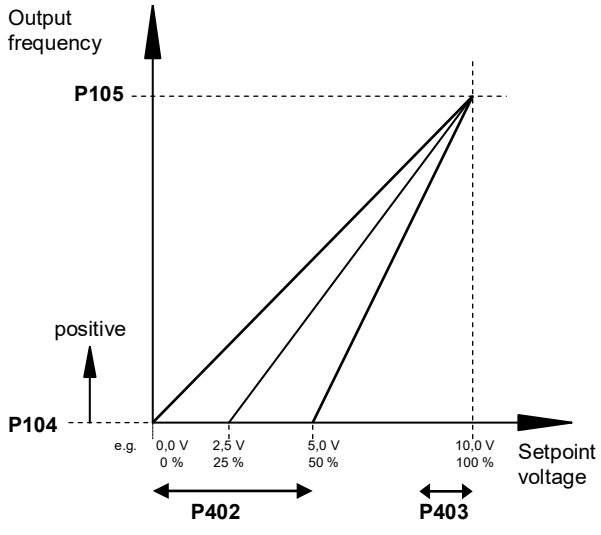
2	0 - 100% monitored	If the minimum adjusted setpoint **P402** is undershot by 10% of the difference from **P403** and **P402**, the FI output switches off. Once the setpoint is greater than **P402** - (10% × (**P403** - **P402**)), it will deliver an output signal. **Note**: A function for the relevant input must be assigned in **P400**.
		
		For example, setpoint 4 … 20 mA: **P402**: "Adjust: 0%" = Setting 20%; **P403**: "Adjust: 100%" = Setting 100%; 10% of the difference between **P403** and **P402** is 0.8 V; i.e. 2 V … 10 V (4 ... 20 mA) = normal operating range, 0.8 V ... 2 V = minimum frequency setpoint, less than 0.8 V (2.4 mA) causes the output to switch off.
3	-100% - 100%	If a setpoint smaller than the programmed "Adjust: 0%" (**P402**) is present, this may cause a change in the direction of rotation. This allows a phase sequence reversal using a simple voltage source and potentiometer. For example, internal setpoint with change in the 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**; a brake controlled by the FI is not applied. **NOTE**: The *"-100 - 100%"* function is a description of the method of function and not a reference to a physical bipolar signal (see example above).
4	0 - 100% with err. 1	"*0 - 100% with error switch-off 1*". If the value of the 0% adjustment value in **P402** is undershot, error message **E012.8** "*AI minimum undershot*" is activated. If the value of the 100% adjustment value in **P403** is exceeded, error message **E012.9** "*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 - 100% with err. 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**.

P402	**Analog in. bal. 0%**		**S**
Setting range	-500.0 ... 500.0%		
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 IO extension	
	[-04] = Ext. Analogue in 2	*"External analogue input 2":* Analogue input 2 of the first IO extension	
	[-05] = Ext.AI 1 2.IOE	*"External analogue input 1 of the 2nd IOE":* Analogue input 1 of the second I/O extension	
	[-06] = Ext.AI 2 2.IOE	*"External analogue input 2 of the 2nd IOE":* Analogue input 2 of the second I/O extension	
	[-07] = Reserve		
	[-08] = Reserve		
	[-09] = Clock input 1		
Scope of application	**[-01], [-02], [-09]**	**SK 500P and higher**	
	[-03] … [-08]	**SK 530P and higher**	
Factory setting	All { 0.0 }		
Description	"*Analogue input balance: 0%*". This parameter sets the value that should correspond with the minimum value of the selected function for the analogue input. Typical setpoints and corresponding settings: 0 … 10 V — 0.0% 2 … 10 V — 20.0% (for **P401 = 2**) 0 … 20 mA — 0.0 % (internal resistance approx. 250Ω) 4 … 20 mA — 20.0 % (internal resistance approx. 250Ω)		

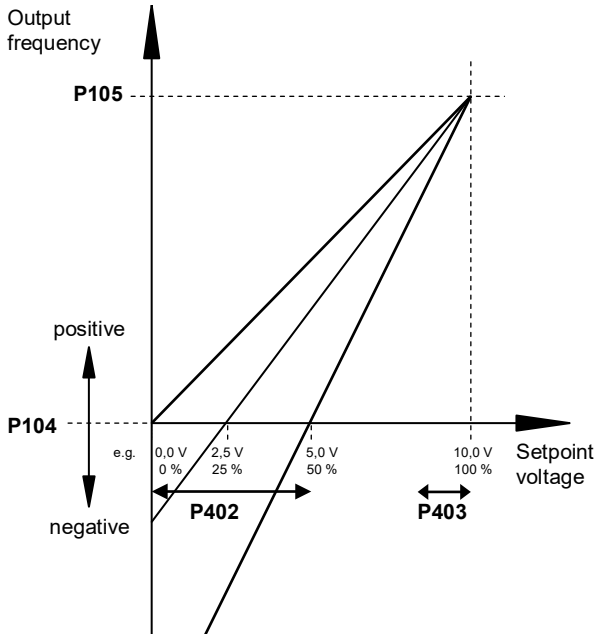
P403	Analog.in. bal. 100%		S
Setting range	-500.0 ... 500.0%		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter	
	[-03] = Ext. Analogue in 1	*"External analogue input 1":* Analogue input 1 of the first IO extension	
	[-04] = Ext. Analogue in 2	*"External analogue input 2":* Analogue input 2 of the first IO extension	
	[-05] = Ext.AI 1 2.IOE	*"External analogue input 1 of the 2nd IOE":* Analogue input 1 of the second I/O extension	
	[-06] = Ext.AI 2 2.IOE	*"External analogue input 2 of the 2nd IOE":* Analogue input 2 of the second I/O extension	
	[-07] = Reserve		
	[-08] = Reserve		
	[-09] = Clock input 1		
Scope of application	**[-01], [-02], [-09]** **SK 500P and higher**		
	[-03] … [-08] **SK 530P and higher**		
Factory setting	All { 100.0 }		
Description	"*Analogue input balance: 100%*". This parameter sets the value that should correspond with the maximum value of the selected function for the analogue input. Typical setpoints and corresponding settings: 0 … 10 V 100.0% 2 … 10 V 100.0% (for **P401 = 2**) 0 … 20 mA 100.0 % (internal resistance approx. 250Ω) 4 … 20 mA 100.0 % (internal resistance approx. 250Ω)		

P400 ... P403

P401 = 0 → 0 – 100 % limited



P401 = 1 → 0 – 100 %



P404	Analog input filter		S
Setting range	1 ... 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	
	[-03] = Reserve		
	[-04] = Reserve		
	[-05] = Clock input 1		
Factory setting	All { 100 }		
Description	Adjustable digital low-pass filter for the analogue signal. Interference peaks are hidden, the response time is extended.		

P405	V/C Analog		S
Setting range	0 … 1		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter	
	[-03] = Reserve		
Factory setting	{ 0 }		
Description	Selection of the type of analogue signal.		
Setting values	**Value** / **Function**	**Description**	
	0 / Voltage	A voltage signal is present at the analogue input.	
	1 / Current	A current signal is present at the analogue input.	

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	-100 ... 100 %			
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), (Chap. 8.2 "Process controller").			

P413	PID control P comp.		S	P
Setting range	0.0 ... 400.0 %			
Factory setting	{ 10.0 }			
Description	This parameter is only effective if the function *„"PID actual frequency"* is selected. The P-component of the PID 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	PID 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 *"PID current freq."* is selected. In case of a control deviation, the I component of the PID controller determines the frequency change depending on time.			

P415	PID control D comp.	S	P
Setting range	0 ... 400.0% ms^{-1}		
Factory setting	{ 1.0 }		
Description	This parameter is only effective when the function *"PID current freq."* is selected. In case of a control deviation, the D component of the PID controller determines the frequency change depending on time. If one of the analogue inputs is set to the function *"Cur.val process ctrl"*, this parameter determines the controller limitation (%) after the PI controller. For further details see (Chap. 8.2 "Process controller")		

P416	Ramptime PI setpoint	S	P
Setting range	0.00 ... 99.99 sec		
Factory setting	{ 2.00 }		
Description	"*Ramptime PI setpoint*". This parameter is only effective when the function *"PID actual frequency"* is selected. Ramp for PI setpoint		

P417	Offset analog output		S	P
Setting range	-100 ... 100%			
Arrays	[-01] = Analog output 1	Analogue output 1 of the frequency inverter		
	[-02] = Reserve			
	[-03] = IOE-1	*"External analogue output 1 of the 1st IOE".* Analogue output 1 of the first IO extension		
	[-04] = IOE-2	*"External analogue output 1 of the 2nd IOE":* Analogue output 1 of the second IO extension		
Scope of application	**[-01] SK 500P and higher**			
	[-03], [-04] SK 530P and higher			
Factory setting	All { 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, the difference between the switch-on point and the switch-off point (hysteresis) can be set in this parameter.			

Information

If the following parameter **P418** is to be used in the function of an analogue output, all functions are inactive or the value 0 V is output unless the mains voltage (X1) is applied. However, if **P418** is to be used as a digital output, then **P418 = 61** must be selected. The digital functions can then be selected via **P434**.

P418	**Analog output func.**		**P**
Setting range	0 ... 61		
Arrays	[-01] = Analog output 1	Analogue output 1 of the frequency inverter	
	[-02] = Reserve		
	[-03] = IOE-1	*"External analogue output of the 1st IOE".* Analogue output of the first IO extension	
	[-04] = IOE-2	*"External analogue output of the 2nd IOE".* Analogue output of the second IO extension	
Scope of application	**[-01] SK 500P and higher**		
	[-02] … [-04] SK 530P and higher		
Factory setting	All { 0 }		
Description	"*Analogue output function*".: An analogue signal can be taken from the control terminals. Various functions are available, where the following basically applies: The analogue value (0 V or 0 mA analogue signal) corresponds to an amount of 0% of the selected function. The analogue value (10 V or 20 mA) corresponds to an amount of 100% of the selected function with the scaling factor **P419**, for example: $\Rightarrow 10\ \text{V} = \frac{\text{Nominal motor value} \bullet \text{P419}}{100\%}$		

Setting values	**Value**	**Description**
0	No function	No output signal at terminals.
1	Actual frequency [1]	The analogue voltage is proportional to the device output frequency. (**100% = P201**)
2	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**)
3	Current [1]	The effective value of the output current supplied by the device.
4	Torque current [1]	Displays the motor load torque calculated by the device (**100% = P112**).
5	Voltage [1]	The output voltage supplied by the device. (**100% = P204**)
6	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% scaling, corresponds to 450 V DC (230 V mains) or 850 V DC (480 V mains)!
7	Value of P542	The analogue output can be set independently of the actual operating status of the device using parameter **P542**. With bus control, for example an analogue value from the control can be directly tunnelled to the analogue output of the device.
8	Apparent power [1]	The motor's current apparent power calculated by the device. (**100% = P203*P204** or **= P203*P204*√3**)
9	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 ±	The analogue voltage is proportional to the output frequency of the device, 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 from 5 V to 0 V.
13	Speed ± [1]	The synchronous 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]	The current torque calculated by the device, whereby the zero point has been shifted to 5 V. For motor torques, values from 5 V to 10 V are output, and for generator torques, values from 5 V to 0 V.
15	Reserve	---
…		
28		
29	Reserved	Reserved for 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 acceleration or deceleration ramp **P102**, **P103**.
31	Output via Bus PZD	The analogue output is controlled via a bus system. The process data is transferred directly (**P546 = 20**).
32	Reserve	---
33	Freq.of setp.source	"*Frequency from setpoint source*"
34	Reserved	Reserved for POSICON
…		
40		
41	Reserve	---
…		
59		
60	Value of PLC	The analogue output is set by the integrated PLC, independently of the current operating status of the FI.
61	Dig. fct. P434	*"Digital function P434"*. If this function is set, array [-09] is activated in **P434** and digital functions like in **P434** can be selected there. When using IO extensions, the respective arrays [-11], [12] are activated in **P434**.

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%			
Arrays	[-01] = Analog output 1	Analogue output 1 of the frequency inverter		
	[-02] = Reserve			
	[-03] = IOE-1	*"External analogue output of the 1st IOE"*. Analogue output of the first IO extension		
	[-04] = IOE-2	*"External analogue output of the 2nd IOE"*. Analogue output of the second IO extension		
Scope of application	**[-01] SK 500P and higher**			
	[-02] … [-04] SK 530P and higher			
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 scaling value of the appropriate selection. Therefore, if this parameter is increased 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. Digital functions **P418** For the functions *"Current limit"* , *"Torque current limit"* and *"Frequency limit"*, the switching threshold can be set via this parameter. The 100% value refers to the corresponding nominal motor value (see **P435**). With a negative value, the output function is output negated (0/1 → 1/0).			

Information

With the following parameter **P420** no input functions operate unless a mains voltage (X1) is connected, except for fault acknowledgement via the functions **P420 = 1** *"Enable right"*, **P420 = 2** *"Enable left"* and **P420 = 12** *"Fault acknowledgement"*.

P420	**Digit inputs**				
Setting range	0 … 82				
Arrays	[-01] = Digital input 1	Digital input 1 of the frequency inverter			
	[-02] = Digital input 2	Digital input 2 of the frequency inverter			
	[-03] = Digital input 3	Digital input 3 of the frequency inverter			
	[-04] = Digital input 4	Digital input 4 of the frequency inverter			
	[-05] = Digital input 5	Digital input 5 of the frequency inverter			
	[-06] = Digital input 6	Digital input 6 of the frequency inverter			
	[-07] = Digital input 7	Digital input 1 of the SK CU5			
	[-08] = Digital input 8	Digital input 2 of the SK CU5			
	[-09] = Digital input 9	Digital input 3 of the SK CU5			
	[-10] = Digital input 10	Digital input 4 of the SK CU5			
	[-11] = Reserve	---			
	[-12] = Reserve	---			
	[-13] = Digital fct Analog 1	Analogue input 1 of the frequency inverter (digital function)			
	[-14] = Digital fct Analog 2	Analogue input 2 of the frequency inverter (digital function)			
Scope of application	**[-01] … [-05] SK 500P and higher**				
	[-06] … [-12] SK 530P and higher				
	[-13] … [-14] SK 500P and higher				
Factory setting	[-01] = { 1 }	[-02] = { 2 }	[-03] = { 8 }	[-04] = { 4 }	All others { 0 }
Description	"*Digital input functions*". Up to 14 inputs are available, which can be freely programmed with digital functions.				
Note	Analogue inputs 1 and 2 of the device do not comply with EN61131-2 (Type 1 digital inputs)				
	Digital inputs 7 … 10 can also be alternatively used as digital outputs 3 … 6 (see **P434**). For these inputs/outputs, it is recommended to parameterise either an input or an output function.				
Setting values	**Value | Description | Signal**				

0	No function	Input switched off.	---
1	Enable right	The device delivers an output signal with the rotating field “right”, if a positive setpoint is applied. 0 → 1 edge (**P428 = 0**)	High
2	Enable left	The device delivers an output signal with the rotating field “left”, if a positive setpoint is applied. 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 (bridge between digital input 1 and the control voltage output). 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.			
3	Phase seq. reversal	Leads to phase sequence reversal (combined with “Enable right” and “Enable left”).	High
4 [1]	Fixed frequency 1	The frequency from **P429** is added to the current setpoint.	High
5 [1]	Fixed frequency 2	The frequency from **P430** is added to the current setpoint.	High
6 [1]	Fixed frequency 3	The frequency from **P431** is added to the current setpoint.	High
7 [1]	Fixed frequency 4	The frequency from **P432** 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.			
8	Param. set switching	First bit of the parameter set switching, selection of the active parameter set 1 … 4 (**P100**).	High
9	Maintain the freq.	During the acceleration or deceleration phase, a “low” level will cause the current output frequency to be “maintained”. A “high” level allows the ramp to continue.	Low
10 [2]	Voltage disable	The 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]	Temperatur sensor	Analogue evaluation of the signal applied. Switching threshold approx. 2.5 V, switch-off delay = 2 s, warning after 1 s. From the SK 530P / SK 540P / SK 550P onwards, there is a separate connection at terminals 38 and 39, which is intended for the PTC resistor connection. If there is no PTC resistor on the motor, the function of the PTC resistor input can be switched off in parameter **P425**.	Level
14 [2, 3]	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	Same as **P420 = 9**, but the frequency is not maintained below the minimum frequency **P104** and above the maximum frequency **P105**.	Low
17	ParaSetSwitching 2	Second bit of the parameter set switching, selection of the active parameter set 1 … 4 (**P100**).	High
18	Watchdog [2]	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 result in shutdown when the minimum frequency **P104** > absolute minimum frequency **P505**.	High
20	Setpoint 2 on / off		
21 [1]	Fixed frequency 5	The frequency from **P433** is added to the current setpoint.	High
22	Reserved	Reserved for POSICON.	---
…			
25			
26	Reserve	---	---
…			
29			
30	Inhibit PID	Switches the PID controller/process controller function on or off (High = PID ON)	Low
31 [2, 4]	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, 4]	Inhibit turn left		Low

33	Reserve	---	---
…			
40			
41	Track-Z TTL-enc. 5	Evaluation of the zero track of a TTL encoder. Only connection to digital input 5 (DI5)	
42	Track-Z HTL-encoder	Evaluation of the zero track of an HTL encoder.	
43	Track-A HTL-enc. 3/4	Evaluation of a 24 V HTL encoder for speed measurement (connection of track A and B only possible to digital inputs 3 and 4 (DI3, DI4). For reliable evaluation, the transferable frequencies should be between 50 Hz and 150 kHz.	Pulses
44	Track-B HTL-enc. 3/4		Pulses
45	3-W-Ctrl.Start-Right (normally open switch for enable right)	"*3-Wire-Control*". This control function provides an alternative to "Enable right"/"Enable left" (**P420 = 1**/**P420 = 2**), which requires permanently applied levels. Here, only one 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 **P420 = 65**) inverts the present phase sequence. This function is reset with a "Stop signal" or by activating a switch for the functions (**P420 = 45**, **P420 = 46**, **P420 = 49**).	0→1 edge
46	3-W-Ctrl.Start-Left (normally open switch for enable left)		0→1 edge
49	3-Wire-Ctrl.Stop (normally closed switch for 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 32 fixed frequencies. **P465 [-01] ... [-31]**	High
51	Bit1 fixedfreq.Array		High
52	Bit2 fixedfreq.Array		High
53	Bit3 fixedfreq.Array		High
54	Bit4 fixedfreq.Array		High
55	Reserved	Reserved for POSICON.	---
…			
64			
65	3-Wire-Direction (normally open switch for phase sequence reversal)	See function (**P420 = 45**, **P420 = 46**, **P420 = 49**)	0→1 edge
66	Reserve	---	---
…			
70			
71	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, for example analogue or fixed frequencies, can be added or subtracted. Adjustment of the frequency setpoint is performed with the ramps from **P102** and **P103**.	High
72	Motorpot.F- and Save		High
73 [2, 4]	Inhibit right+quick	Same as **P420 = 31**, but coupled to the "Quick stop" function.	Low
74 [2, 4]	Inhibit left + quick	Same as **P420 = 32**, but coupled to the "Quick stop" function.	Low
75	Reserve	---	---
76	Reserve	---	---
77	Reserved	Reserved for POSICON.	---
78	Reserved	Reserved for POSICON.	---

79	Start identification	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 “Ready to switch-on” status • The rotor position is not known (see **P434 = 28**, **P481 = 28**) • **P336 = 2** is selected	0→1 edge
80	PLC stop	The program execution of the internal PLC is stopped for as long as the signal is present.	High
81	Freq.Measure input.3	The frequency measured via the analogue input (**P400 [-09]**) is used as the setpoint (2 kHz to 22 kHz) **Note:** Only functions with DI3.	Pulses
82	Duty measure. inp 3	The duty cycle (20% … 80% at 2 kHz) measured via the analogue input (**P400 [-09]**) is used as the setpoint. **Note:** Only functions with DI3.	Pulses

1 If neither of the digital inputs is programmed for “Enable right” or “Enable left”, control of a fixed frequency or jog frequency enables the frequency inverter. The rotating field direction depends on the sign of the setpoint.

2 Also effective for bus control (e.g. RS232, RS485, CANbus, CANopen, …)

3 Function cannot be selected via BusIO In Bits

4 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 }		
Scope of application	**SK 530P and higher**		
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 (**E002.0**).		
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 ... 3	
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	Off	Automatic quick stop in case of fault is deactivated
1	On mains failure [1]	Automatic quick stop in case of mains failure
2	On errors	Automatic quick stop in case of error
3	Error or mains fail. [1]	Automatic quick stop in case of error or mains failure

1 Quick stop in case of mains failure is excluded for DC supply (**P538 = 4**).

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!**	

P429	Fixed frequency 1	P
Setting range	-400.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	Following actuation via a digital input and enabling of the device (right or left), the fixed frequency is used as a setpoint. A negative setting value will cause a phase sequence reversal (based on the *Enable rotation direction* **P420**). If several fixed frequencies are actuated simultaneously, the individual values are added with the correct sign. This also applies to combinations with the jog frequency **P113**, analogue setpoint (if **P400 = 1**) or minimum frequency **P104**. If none of the digital inputs are programmed for enable (right or left), the simple fixed frequency signal results in an enable. A positive fixed frequency corresponds to a right enable, a negative to a left enable.	
Note	The frequency limits **P104 = f_{min}** or **P105 = f_{max}** cannot be overshot or undershot.	

P430	Fixed frequency 2	P
Setting range	-400.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	For a description of the function of the parameter, see **P429** “Fixed frequency 1”.	

P431	Fixed frequency 3	P
Setting range	-400.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	For a description of the function of the parameter, see **P429** “Fixed frequency 1”.	

P432	Fixed frequency 4	P
Setting range	-400.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	For a description of the function of the parameter, see **P429** “Fixed frequency 1”.	

P433	Fixed frequency 5	P
Setting range	-400.0 … 400.0 Hz	
Factory setting	{ 0.0 }	
Description	For a description of the function of the parameter, see **P429** “Fixed frequency 1”.	

Information

For the following parameter **P434**, all functions are disabled or 0 V is output unless the mains voltage (X1) is applied. This does not include the following functions: {7}, {8}, {12}, {30} … {37}, {38} and {50} … {59}.

P434	Digital out function		P
Setting range	0 … 59		
Arrays	[-01] = Binary out 1 /MFR1	Relay 1 of the frequency inverter	
	[-02] = Binary out 2 /MFR2	Relay 2 of the frequency inverter	
	[-03] = Digital output 1	Digital output 1 of the frequency inverter	
	[-04] = Digital output 2	Digital output 2 of the frequency inverter	
	[-05] = Digital output 3	Digital output 1 of the SK CU5	
	[-06] = Digital output 4	Digital output 2 of the SK CU5	
	[-07] = Digital output 5	Digital output 3 of the SK CU5	
	[-08] = Digital output 6	Digital output 4 of the SK CU5	
	[-09] = Digital fct Analog 1	Analogue output 1 of the frequency inverter (digital function)	
	[-10] = Reserve	---	
	[-11] = Digital fct Analog 3	Analogue output 3 of the 1st IO extension (digital function)	
	[-12] = Digital fct Analog 4	Analogue output 4 of the 2nd IO extension (digital function)	
Scope of application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-08] SK 530P and higher		
	[-09] … [-10] SK 500P and higher		
	[-11] … [-12] SK 530P and higher		
Factory setting	[-01] = { 1 }	[-02] = { 7 }	All others { 0 }
Description	"*Digital output function*". Up to 10 digital outputs (2 of which as relays) are available, which can be freely programmed with digital functions. These can be seen in the following table.		
Note	With settings 3 to 5 and 11, the two relays (K1, K2) work with 10% hysteresis, i.e. the relay contact closes (setting 11: opens) on reaching the limit value and opens (setting 11: closes) if a 10% lower value is undershot. This behaviour can be inverted with a negative value in **P435**.		
	Alternatively, digital outputs 3 … 6 can also be used as digital inputs 7 … 10 (see **P420**). For these inputs/outputs, it is recommended to parameterise either an input or an output function. However, if an input function and an output function are parameterised, a High signal from the output function will result in activation of the input function. This IO connection is hence used as a kind of "marker".		

Setting values

Value		Description	Signal
0	No function	Input switched off.	Low
1	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. A mechanical brake can be directly switched with AC. (Note the technical specification of the relay contact!)	High
2	Inverter is working	The closed relay contact indicates voltage at the inverter output (U – V – W) (as well as DC run-on **P559**).	High
3	Current limit	Based on the nominal motor current setting in **P203**. This value can be adjusted via scaling **P435**.	High

4	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
5	Frequency limit	Based on the nominal motor frequency setting in **P201**. This value can be adjusted via scaling **P435**.	High
6	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, contact opens.	High
7	Fault	General fault message, fault is active or not yet acknowledged. Fault: Contact opens, ready for operation: Contact closes.	Low
8	Warning	General warning. A limit value was reached, which could result in a later switch-off of the device.	Low
9	Overcurrent warning	At least 130% of the nominal device current was supplied for 30 s.	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
14	Effect. power limit	Ratio of the output mechanical power to the nominal power of the motor.	-
15	Freq+current limit	tbd	-
16	Quick stop active	A quick stop (**P427**) was triggered.	High
17	Quick stop+STO act.	A quick stop (**P427**) is triggered, if STO "*Voltage disable*" or "*Quick stop*" is enabled.	High
18	Inverter ready	The device is ready for operation. After being enabled, it delivers an output signal.	High
19	Gen. torque limit	Same as **P434 = 13**, but a limit value can be set via **P435**.	High
20	Reserved	Reserved for POSICON.	-
…			-
27			-
28	Rotorpos PMSM ok	The PMSM rotor position is known.	High
29	Motor stopped	Speed less than **P505**	High
30	BusIO In Bit 0	Control by Bus In Bit 0 (**P546** …)	High
31	BusIO In Bit 1	Control by Bus In Bit 1 (**P546** …)	High
32	BusIO In Bit 2	Control by Bus In Bit 2 (**P546** …)	High
33	BusIO In Bit 3	Control by Bus In Bit 3 (**P546** …)	High
34	BusIO In Bit 4	Control by Bus In Bit 4 (**P546** …)	High
35	BusIO In Bit 5	Control by Bus In Bit 5 (**P546** …)	High
36	BusIO In Bit 6	Control by Bus In Bit 6 (**P546** …)	High
37	BusIO In Bit 7	Control by Bus In Bit 7 (**P546** …)	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
41	Comparison val. AIN1	Comparison of AI1 with the value, which can be set in the adjustment **P435**.	-
42	Comparison val. AIN2	Comparison of AI2 with the value, which can be set in the adjustment **P435**.	-
43	STO o. OUT2/3 inact.	Neither safe stop, voltage disable nor quick stop is active.	High
50	State digital In 1	A signal is present at digital input 1.	High
51	State digital In 2	A signal is present at digital input 2.	High
52	State digital In 3	A signal is present at digital input 3.	High
53	State digital In 4	A signal is present at digital input 4.	High
54	State digital In 5	A signal is present at digital input 5.	High
55 [1]	State digital In 6	A signal is present at digital input 6.	High

56 [1]	State digital In 7	A signal is present at digital input 7.	High
57 [1]	State digital In 8	A signal is present at digital input 8.	High
58 [1]	State digital In 9	A signal is present at digital input 9.	High
59 [1]	State digital In 10	A signal is present at digital input 10.	High
Note: For relay contacts (High = “Contact closed”, Low = “Contact open”)			

1 ≥ SK 530P

P435	**Dig. out scaling**		**P**
Setting range	-400 … 400%		
Arrays	[-01] = Binary out 1 /MFR1	Relay 1 of the frequency inverter	
	[-02] = Binary out 2 /MFR2	Relay 2 of the frequency inverter	
	[-03] = Digital output 1	Digital output 1 of the frequency inverter	
	[-04] = Digital output 2	Digital output 2 of the frequency inverter	
	[-05] = Digital output 3	Digital output 3 of the SK CU5	
	[-06] = Digital output 4	Digital output 4 of the SK CU5	
	[-07] = Digital output 5	Digital output 5 of the SK CU5	
	[-08] = Digital output 6	Digital output 6 of the SK CU5	
	[-09] = Digital fct Analog 1	Analogue output 1 of the frequency inverter (digital function)	
	[-10] = Reserve	---	
Scope of application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-08] SK 530P and higher		
	[-09] … [-10] SK 500P and higher		
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%			
Arrays	[-01] = Binary out 1 /MFR1	Relay 1 of the frequency inverter		
	[-02] = Binary out 2 /MFR2	Relay 2 of the frequency inverter		
	[-03] = Digital output 1	Digital output 1 of the frequency inverter		
	[-04] = Digital output 2	Digital output 2 of the frequency inverter		
	[-05] = Digital output 3	Digital output 3 of the SK CU5		
	[-06] = Digital output 4	Digital output 4 of the SK CU5		
	[-07] = Digital output 5	Digital output 5 of the SK CU5		
	[-08] = Digital output 6	Digital output 6 of the SK CU5		
	[-09] = Digital fct Analog 1	Analogue output 1 of the frequency inverter (digital function)		
	[-10] = Reserve	---		
Scope of application	**[-01] … [-02] SK 500P and higher**			
	[-03] … [-08] SK 530P and higher			
	[-09] … [-10] SK 500P and higher			
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**		
	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
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
	…
	[-31] = Fixed frequency array 31
Factory setting	All { 0.0 }
Description	In the array levels, up to 31 different fixed frequencies can be set, which in turn can be selected with the functions 50 ... 54 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 (Chap. 8.2 "Process controller").		

P475	Delay on/off switch		S
Setting range	-30.000 … 30.000 s		
Arrays	[-01] = Digital input 1	Digital input 1 of the frequency inverter	
	[-02] = Digital input 2	Digital input 2 of the frequency inverter	
	[-03] = Digital input 3	Digital input 3 of the frequency inverter	
	[-04] = Digital input 4	Digital input 4 of the frequency inverter	
	[-05] = Digital input 5	Digital input 5 of the frequency inverter	
	[-06] = Digital input 6	Digital input 6 of the frequency inverter	
	[-07] = Digital input 7	Digital input 7 of the SK CU5	
	[-08] = Digital input 8	Digital input 8 of the SK CU5	
	[-09] = Digital input 9	Digital input 9 of the SK CU5	
	[-10] = Digital input 10	Digital input 10 of the SK CU5	
	[-11] = Reserve	---	
	[-12] = Reserve	---	
	[-13] = Digital fct Analog 1	Analogue input 1 of the frequency inverter (digital function)	
	[-14] = Digital fct Analog 2	Analogue input 2 of the frequency inverter (digital function)	
Scope of application	**[-01] … [-05] SK 500P and higher**		
	[-06] … [-12] SK 530P and higher		
	[-13] … [-14] SK 500P and higher		
Factory setting	All { 0,000 }		
Description	"*Digital function switch-on/switch-off delay*". Adjustable switch-on/switch-off delay for digital inputs and digital functions of 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	

Information

With the following parameter **P480**, the BusIO In Bits are considered to be digital inputs as with **P420**. Therefore, the input functions {8}, {13}, {17}, {18}, {61} and {80} … {82} do not operate without the application of a mains voltage (X1).

P480	**Funct. BusIO In Bits**		**S**
Setting range	0 … 82		
Arrays	[-01] = Bus / 2.IOE Dig In1	In Bit 0 … 3 via bus or Digital input 1 … 4 of the 2nd IO extension	
	[-02] = Bus / 2.IOE Dig In2		
	[-03] = Bus / 2.IOE Dig In3		
	[-04] = Bus / 2.IOE Dig In4		
	[-05] = Bus / 1.IOE Dig In1	In Bit 4 … 7 via bus or Digital input 1 … 4 of the 1st IO extension	
	[-06] = Bus / 1.IOE Dig In2		
	[-07] = Bus / 1.IOE Dig In3		
	[-08] = Bus / 1.IOE Dig In4		
	[-09] = Marker 1	See “Use of markers” at the end of the description of parameter P481	
	[-10] = Marker 2		
	[-11] = Bit8 bus controlword	Assignment of a function for Bit 8 or 9 of the control word	
	[-12] = Bit9 bus controlword		
Factory setting	All { 0 }		
Description	“*BusIO In Bits function*”. The BusIO In Bits are considered to be digital inputs **P420**. They can be set to the same functions. In order to use this function, one of the bus setpoints **P546** must be set to “BusIO In Bits 0-7”. The required function must then be assigned to the relevant bit.		
Note	The possible functions for the Bus In Bits can be found in the table of functions for the digital inputs. Function 14 *“Remote control”* is not possible.		
	If **P551 = 3** is selected, the last eight bits of the control word can be freely assigned. Bits 8 … 11 of the control word can be defined via **P480 [-01] … [-04]**, and Bits 12 … 15 via **P480 [-05] … [-08]**.		

Information

With the following parameter **P481**, the BusIO Out Bits are considered to be digital outputs as with **P434**. Therefore none of the functions operate without the application of a mains voltage. An exception to this is if one of the following functions has been selected: {7}, {8}, {12}, {30} … {37}, {38} and {50} … {59}.

P481	**Funct-BusIO Out Bits**		**S**
Setting range	0 … 59		
Arrays	[-01] = Bus / Dig Out 1	Out Bit 0 … 3 via bus	
	[-02] = Bus / Dig Out 2		
	[-03] = Bus / Dig Out 3		
	[-04] = Bus / Dig Out 4		
	[-05] = Bus / 1.IOE Dig Out1	Out Bit 4 … 5 via bus or Digital output 1 … 2 of the 1st IO extension	
	[-06] = Bus / 1.IOE Dig Out2		
	[-07] = Bus / 2.IOE Dig Out1	Out Bit 6 … 7 via bus or Digital output 1 … 2 of the 2nd IO extension	
	[-08] = Bus / 2.IOE Dig Out2		
	[-09] = Marker 1	See “Use of markers” at the end of the description of parameter P481	
	[-10] = Marker 2		
	[-11] = Bus statusword Bit10	Assignment of a function for Bit 10 or 13 of the status word **Note:** Not available with **P551 = 3**.	
	[-12] = Bus statusword Bit13		
	[-13]… [-18]	Reserve	
Factory setting	All { 0 }		
Description	“*BusIO Out Bits function* “. Die BusIO Out Bits are considered to be digital outputs **P434**. They can be set to the same functions. In order to use this function, one of the bus actual values **P543** must be set to “BusIO Out Bits 0-7”. The required function must then be assigned to the relevant bit.		
Note	The possible functions for the Bus Out Bits can be found in the table of functions for the digital outputs or relays.		
	If **P551 = 3** is selected, the last eight bits of the status word can be freely assigned. Bits 8 … 11 of the status word can be defined via **P481 [-01] … [-04]**, Bits 12 … 13 via **P481 [-05] … [-06]** and Bits 14 … 15 via **P481 [-07] … [-08]** .		

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 [-09] “Marker 1” and [-10] “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 [-09] = 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 / Dig Out 1	Out Bit 0 … 3 via bus	
	[-02] = Bus / Dig Out 2		
	[-03] = Bus / Dig Out 3		
	[-04] = Bus / Dig Out 4		
	[-05] = Bus / 1.IOE Dig Out1	Out Bit 4 … 5 via bus or Digital output 1 … 2 of the 1st IO extension	
	[-06] = Bus / 1.IOE Dig Out2		
	[-07] = Bus / 2.IOE Dig Out1	Out Bit 6 … 7 via bus or Digital output 1 … 2 of the 2nd IO extension	
	[-08] = Bus / 2.IOE Dig Out2		
	[-09] = Marker 1	See “Use of markers” at the end of the description of parameter **P481**	
	[-10] = Marker 2		
	[-11] = Bus statusword Bit10	Bit 10 or 13 of status word	
	[-12] = Bus statusword Bit13		
	[-13] = Reserve		
	[-14] = Reserve		
	[-15] = Reserve		
	[-16] = Reserve		
	[-17] = Reserve		
	[-18] = Reserve		
Factory setting	All { 100 }		
Description	“*Scaling of BusIO Out Bits”.* Adjustment of the limit values of the Bus Out Bits. With a negative value, the output function is output negated. Reference to the following values: Current limit (P481 = 3) = x [%] × P203 “Nominal current” Torque current limit (P481 = 4) = x [%] × P203 × P206 (calculated nominal motor torque) Frequency limit (P481 = 5) = x [%] × P201 “Nominal frequency”		

P483	Hyst. BusIO Out Bits		S
Setting range	1 … 100%		
Arrays	[-01] = Bus / Dig Out 1	Out Bit 0 … 3 via bus	
	[-02] = Bus / Dig Out 2		
	[-03] = Bus / Dig Out 3		
	[-04] = Bus / Dig Out 4		
	[-05] = Bus / 1.IOE Dig Out1	Out Bit 4 … 5 via bus or Digital output 1 … 2 of the 1st IO extension	
	[-06] = Bus / 1.IOE Dig Out2		
	[-07] = Bus / 2.IOE Dig Out1	Out Bit 6 … 7 via bus or Digital output 1 … 2 of the 2nd IO extension	
	[-08] = Bus / 2.IOE Dig Out2		
	[-09] = Marker 1	See “Use of markers” at the end of the description of parameter **P481**	
	[-10] = Marker 2		
	[-11] = Bus statusword Bit10	Bit 10 or 13 of status word	
	[-12] = Bus statusword Bit13		
	[-13] = Reserve		
	[-14] = Reserve		
	[-15] = Reserve		
	[-16] = Reserve		
	[-17] = Reserve		
	[-18] = Reserve		
Factory setting	All { 10 }		
Description	“*BusIO Out Bit hysteresis”.* Difference between switch-on and switch-off point to prevent oscillation of the output signal.		

5.1.7 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 … 58				
Arrays	[-01] = Master value 1	[-02] = Master value 2	[-03] = Master value 3		
	[-04] = Master value 4	[-05] = Master value 5			
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**.				
Note	Details regarding the processing of set-/actual values (Chap. 8.10)				
Setting values	**Value | Meaning**				

0	Off	10	Reserved POSICON	21	**A**ct. Freq. w/o Slip Master value; *“Actual frequency without slip master value”*
1	Actual frequency	11			
2	Actual speed	12	BusIO Out Bits 0-7	22	Speed encoder
3	Current	13	Reserved POSICON	23	Act. freq. With slip *“Actual frequency with slip”*
4	Torque current	…		24	Lead.act.freq.+slip *“Master value Actual frequency with slip”*
5	State digital-IO	16		53	Actual value 1 PLC
6	Reserved POSICON	17	Value Analog In 1	…	…
7		18	Value Analog In 2	57	Actual value 5 PLC
8	Set point frequency	19	Freq. Master Value *“Setpoint frequency master value”*	58	Clock input 1
9	Error code	20	Set Freq. After Ramp *“Setpoint frequency after ramp master value“*		

P503	Leading func. output		S	
Setting range	0 ... 5			
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 control word and master values.	
	1	USS	Output of control word and master values to USS	
	2	CAN	Output of control words and master values to CAN (up to 250kBaud).	
	3	CANopen	Output of control words and master values to CANopen.	
	4	System bus active	No output of STW and master values, however all participants which are set to "System bus active" are visible via the ParameterBox or NORDCON.	
	5	CANopen + System bus active	Output of control word and master values on CAN open via the ParameterBox or NORDCON; all participants which are set on the System bus active are visible.	

P504	Pulse frequency	S
Setting range	4.0 ... 16.0 kHz / 16.1 ... 16.4 (≥ 45 kW: 3.0 ... 8.0 kHz)	
Factory setting	{ 6.0 (≥ 45 kW: 4.0) }	
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 (Chap. 8.4 "Reduced output power").		

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 ... 10
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 BusIO Bits.
1	Contr. terminal only [2]	Control is via the digital and analogue inputs or via BusIO Bits.
2	USS / Modbus [2]	The control word is expected via the RS 485 interface. The frequency inverter automatically detects whether this is a USS protocol or a Modbus protocol.
3	CAN [2]	The control word is expected via the CAN interface.
4	USB [2, 3]	The control word is expected via the USB interface.
5	Reserve	---
6	CANopen [2]	The control word is expected via the CANopen system bus interface.
7	Reserve	---
8	Ethernet [2, 4]	The control word is expected via the Ethernet-based interface, which was selected according to **P899** (see BU 0620).
9	CAN Broadcast [2]	The control word is expected via the CAN interface.
10	CANopen Broadcast [2]	The control word is expected via the CANopen system bus interface.

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.

3 **SK 530P** and higher.

4 **SK 550P** and higher.

P510	Source Setpoints	S
Setting range	0 … 10	
Arrays	Selection of setpoint source [-01] = Main setvalue [-02] = 2nd setpoint	
Factory setting	All { 0 }	
Description	Selection of the interface via which the frequency inverter receives its setpoints.	

Setting values

Value		Meaning
0	Auto (= **P509**)	The setpoint source corresponds to that of the control word (**P509**).
1	Contr. terminal only	Digital and analogue inputs control the frequency, including fixed frequencies.
2	USS / Modbus	The setpoint is expected via the RS 485 interface.
3	CAN	The setpoint is expected via the CAN interface.
4	USB [1]	The setpoint is expected via the USB interface.
5	Reserve	---
6	CANopen	The setpoint is expected via the CANopen system bus interface.
7	Reserve	---
8	Ethernet [2]	The setpoint is expected via the Ethernet-based interface, which was selected according to **P899**.
9	CAN Broadcast	The setpoint is expected via the CAN interface.
10	CANopen Broadcast	The setpoint is expected via the CANopen system bus interface.

1 **SK 530P** and higher

2 **SK 550P** and higher

P511	USS baud rate	S
Setting range	0 … 6	
Factory setting	{ 3 }	
Description	Setting of the transfer rate (transfer speed) via the RS 485 interface. The same baud rate must be set for all bus participants.	
Note	For communication via Modbus RTU, a transfer speed of maximum 38400 baud must be set.	

Setting values

Value	Meaning	Value	Meaning
0	4800 Baud	4	57600 Baud
1	9600 Baud	5	115200 Baud
2	19200 Baud	6	187500 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 ... 100.0 s		
Arrays	[-01] = USS / Modbus	[-02] = USB	
	[-03] = CAN / CANopen	[-04] = Ethernet	
Scope of application	**[-01] SK 500P and higher**	**[-02] SK 530P and higher**	
	[-03] SK 500P and higher	**[-04] SK 550P and higher**	
Factory setting	All { 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 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 process data channels for USS, CAN/CANopen and CANopen Broadcast are monitored independently of each other. The decision about which channel is monitored is made by the setting in parameter **P509** or **P510**. For example, this way it is possible to register the interruption of a CAN Broadcast communication, although the FI is still communicating with a master via CAN.		
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.

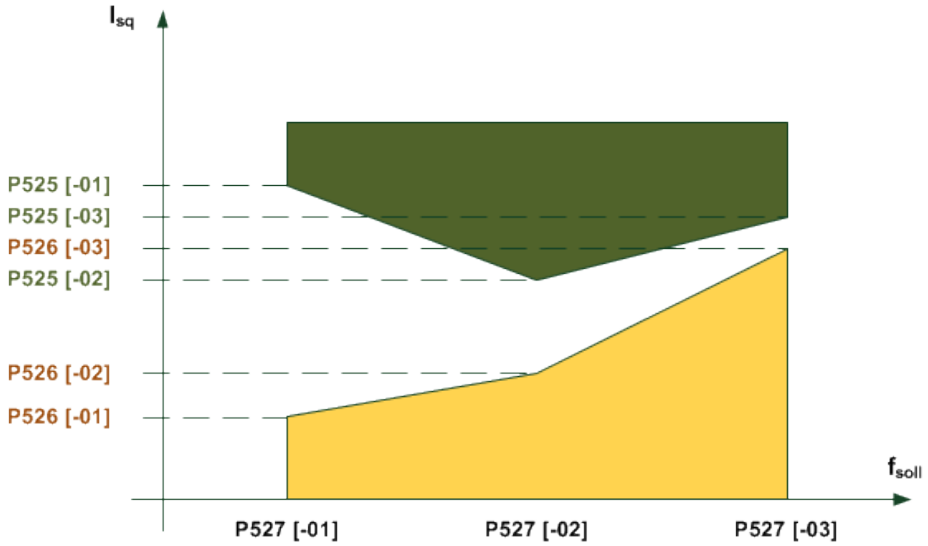
P521	Flying start Resolution	S	P
Setting range	0.02 … 2.50 Hz		
Factory setting	{ 0.05 }		
Description	"*Flying start resolution*“. The flying start circuit search increment size can be adjusted using this parameter. Values that are too large affect accuracy and cause the FI to cut out with an overcurrent 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 ... 4
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	With setting "*Load factory setting*", the safety-relevant parameters **P423**, **P424**, **P499** and the passwords in **P004** and **P497** are not reset. These must be reset manually.
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 are lost.
2	Fact.setng.w.out bus	*"Load factory setting without bus".* All FI parameters, however *not* the CAN-, CANopen-, USS-, and system bus parameters are reset to the factory setting (including Ethernet).
3	Fact. without motor data	*"Load factory setting without motor parameter".* All parameters of the frequency inverter, with the *exception* of the motor data, are reset to the factory setting.
4	Fact.set only Ethernet	*"Load factory settings, only Ethernet parameters".* Only the FI parameters for the Ethernet settings are reset to the factory setting

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.						

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.

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 output current is limited to the nominal current (I_N) of the frequency inverter (see technical data) taking into account the factor which is set in **P536**. When the limit value is reached, the FI reduces the actual output frequency.	
Note	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 (Chap. 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.

P538	Mains voltage Monitoring	S
Setting range	0 ... 4	
Factory setting	{ 3 }	
Description	"*Mains voltage monitoring*". For reliable operation of the frequency inverter the power supply must have a certain quality. If there is a brief interruption of a phase or the voltage supply falls below a particular limit value, the inverter will output an error. Under certain operating conditions, it may be necessary to suppress this error message. In this case, the input monitoring can be modified.	
Note	Operation with an impermissible mains voltage can destroy the frequency inverter!	
	With 1/3~230 V or 1~115 V devices, the phase error monitoring does not function!	
Setting values	**Value**	**Meaning**

0	Off	No monitoring of supply voltage.
1	Phase error	Only phase errors will produce an error message.
2	Mains voltage	Only low voltage will produce an error message.
3	Phase err. + mains voltage	*"Phase error and mains voltage"*. A phase error or undervoltage triggers an error message.
4	DC supply	The input voltage is fixed at 480 V for the direct supply of direct current. Phase error and low mains voltage monitoring are deactivated.

P539	Check output voltage	S	P
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	The output current at the U-V-W terminals is monitored and checked for plausibility. In case of error, the error message **E016** is output.		
Note	This function can be used as an additional protective function for lifting applications, but is not permissible on its own as protection for persons.		

Setting values

Value		Meaning
0	Off	Monitoring is not performed.
1	Motor Phases only	The output current is measured and checked for symmetry. If an asymmetry is present, the FI switches off and outputs error message **E016**.
2	Magnetisation only	At the moment the FI is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the FI switches off with the error message **E016**. A motor brake is not released in this phase.
3	Motor Phas.+Magnet.	Monitoring according to settings {1} and {2}.

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 digital out		S
Setting range	0000h … FFFFh		
Arrays	[-01] = Set relays (internal)	[-02] = Set bus / IOE out	
Factory setting	All { 0000h }		
Description	"*Set relays and digital outputs*". This function provides the option of controlling the relays and the digital outputs independently of the frequency inverter status. For this, the relevant output (e.g. relay 1: **P434 [-01]**) must be set to **P434 [-01] = 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 values

[-01] = Set relays (internal)		**[-02] = Set bus / IOE out**	
Bit 0	Binary out 1 /MFR1	Bit 0	Bus / Dig Out 1
Bit 1	Binary out 2 /MFR2	Bit 1	Bus / Dig Out 2
Bit 2	Binary out 3 /MFR3 [1]	Bit 2	Bus / Dig Out 3
Bit 3	Binary out 4 /MFR4 [1]	Bit 3	Bus / Dig Out 4
Bit 4	Binary out 5 /MFR5 [1]	Bit 4	Bus / 1.IOE Dig Out1
Bit 5	Binary out.6 / DOUT4 [1]	Bit 5	Bus / 1.IOE Dig Out2
Bit 6	Binary out.7 / DOUT5 [1]	Bit 6	Bus / 2.IOE Dig Out1
Bit 7	Binary out.8 / DOUT6 [1]	Bit 7	Bus / 2.IOE Dig Out2
Bit 8	Digital fct Analog 1		
Bit 9	Reserve		
Bit 10	Digitalfunc. analog3 [1]		
Bit 11	Digitalfunc. analog4 [1]		

1 SK 530P and higher

P542	Set analog out		S
Setting range	0 … 100%		
Arrays	[-01] = Analog output	Analogue output of the frequency inverter	
	[-02] = Reserve	---	
	[-03] = IOE-1	Analogue output of the 1st IO extension	
	[-04] = IOE-2	Analogue output of the 2nd IO extension	
Scope of application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-04] SK 530P and higher		
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 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!		

Information

The input functions {10}, {11}, {13} … {16}, {53} … {57} and {58} do not function with the following parameter **P543** without connection of a mains voltage (X1).

P543	**Bus actual value**			**S**	**P**
Setting range	0 … 58				
Arrays	[-01] = Bus actual value 1	[-02] = Bus actual value 2	[-03] = Bus actual value 3		
	[-04] = Bus actual value 4	[-05] = Bus actual value 5			
Factory setting	[-01] = { 1 }	[-02] = { 4 }	[-03] = { 9 }	[-04] = { 0 }	[-05] = { 0 }
Description	Selection of the return values for bus control				
Setting values	**Value | Meaning**				

0	Off	18	Value Analog In 2
1	Actual frequency	19	Freq. Master Value **(P503)**
2	Actual speed	20	Set Freq. After Ramp, *"Setpoint frequency after ramp master value"*
3	Current		
4	Torque current (**100% = P112**)	21	Act. Freq. w/o Slip, *"Actual frequency without slip master value"*
5	State digital-IO [1]		
6, 7	Reserved for POSICON	22	Speed encoder
8	Set point frequency	23	Act. freq. With slip, *"Actual frequency with slip"*
9	Error code	24	Lead.act.freq.+slip, *"Master value Actual frequency with slip"*
10, 11	Reserved for POSICON	53	Actual value 1 PLC
12	BusIO Out Bits 0-7	…	…
13	Reserved for POSICON	57	Actual value 5 PLC
…		58	Clock input 1
16			
17	Value Analog In 1		

1 Digital input assignments

Bit 0	DI 1 (FI)	Bit 8	AI 2 (FI)
Bit 1	DI 2 (FI)	Bit 9	DI 2 (CU5)
Bit 2	DI 3 (FI)	Bit 10	DI 3 (CU5)
Bit 3	DI 4 (FI)	Bit 11	DI 4 (CU5)
Bit 4	DI 5 (FI)	Bit 12	K1 (FI)
Bit 5	DI 6 (FI)	Bit 13	K2 (FI)
Bit 6	DI 1 (CU5)	Bit 14	DO 1 (FI)
Bit 7	AI 1 (FI)	Bit 15	DO 2 (FI)

Information

With the following parameter **P546**, the input functions {21} … {46}, {48} and {58} do not function without the application of a mains voltage (X1).

P546	Func. bus-setpoint			S	P
Setting range	0 … 58				
Arrays	[-01] = Bus-setpoint 1	[-02] = Bus-setpoint 2	[-03] = Bus-setpoint 3		
	[-04] = Bus-setpoint 4	[-05] = Bus-setpoint 5			
Factory setting	[-01] = { 1 }	All others { 0 }			
Description	Assignment of a function to a bus setpoint.				
Setting values	**Value | Meaning**				

0	Off	18	Curve control
1	Set point frequency	19	Set Relais (same as **P541**)
2	Torque current limit (**P112**)	20	Set Analog Out (same as **P542**)
3	PID current freq.	21	Reserved for POSICON
4	Frequency addition	…	
5	Frequency subtract.	24	
6	Current limit (**P536**)	46	Setval.torque p.reg., *"Set value torque process controller"*
7	Maximum frequency (**P105**)		
8	PID ltd.current.freq	47	Reserved for POSICON
9	PID suprvsd.cur.freq	48	Motor temperature
10	Servo-Mode Torque (**P300**)	49	Ramp time (acceleration / deceleration)
11	Pre-tension Torque (**P214**)	53	d-corr. F Process
13	Multiplication	54	d-corr. Torque
14	Cur.val process ctrl	55	d-corr. F+Torque
15	Nom.val process ctrl	56	Acceleration time
16	Add. process control	57	Deceleration time
17	Reserved for POSICON	58	Reserved for POSICON

P549	Function CtrlBox		S
Setting range	0 … 5		
Factory setting	{ 0 }		
Description	This parameter provides the option of adding a correction value to the current setpoint (fixed frequency, analogue value, bus) by means of the ControlBox keyboard. Explanations of the setting values can be found in the description of **P400**.		
Setting values	**Value**	**Meaning**	**Value**	**Meaning**
	0	Off	4	Frequency addition
	5	Freq. subtraction		

P550	µSD jobs
Setting range	0 … 11
Factory setting	{ 0 }
Scope of application	**SK 530P, SK 540P, SK 550P**
Description	If a microSD card is present in slot X18, entire parameter data sets (each consisting of the parameter sets 1 … 4) can be exchanged between the microSD card and the frequency inverter. **Note:** This does not include Ethernet-related parameters.
Note	Five memory slots are available on the microSD card. Therefore data sets from a total of 5 different frequency inverters can be archived on the card.
	NOTICE! Do not remove the microSD card during data transfer (loss of data! + Error **E026**)
	NOTICE! The existing data will be overwritten.
	NOTICE! The data to be copied are not checked for plausibility. When writing to the frequency inverter, take care that the correct data set for the FI is transferred, otherwise frequency inverter malfunctions may occur.

Setting values

Value		Meaning
0	No change	No copying
1	FI → µSD 1	The data set is copied from the frequency inverter to memory slot 1 of the microSD card.
2	FI → µSD 2	Same as **P550 = 1**, but to memory slot 2.
3	FI → µSD 3	Same as **P550 = 1**, but to memory slot 3.
4	FI → µSD 4	Same as **P550 = 1**, but to memory slot 4.
5	FI → µSD 5	Same as **P550 = 1**, but to memory slot 5.
6	µSD 1 → FI	The data set from memory slot 1 of the microSD card is copied to the frequency inverter.
7	µSD 2 → FI	Same as **P550 = 6**, but from memory slot 2.
8	µSD 3 → FI	Same as **P550 = 6**, but from memory slot 3.
9	µSD 4 → FI	Same as **P550 = 6**, but from memory slot 4.
10	µSD 5 → FI	Same as **P550 = 6**, but from memory slot 5.
11	Format µSD	Format µSD

P551	Drive profile		S	
Setting range	0 … 3			
Factory setting	{ 0 }			
Description	Activation of a process data profile.			
Setting values	**Value**	**Meaning**		
	0	USS	No specific drive profile	
	1	CANopen DS402	CANopen drive profile according to DS402	
	2	Reserve	---	
	3	Nord-custom	Drive profile with freely assignable bits **Note:** The free bits are set via parameters **P480 / P481**	

P551 = 3 Free bit assignment in the control and status word for Nord-custom

Control word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
P480 [-07]	**P480 [-06]**	**P480 [-05]**	**P480 [-04]**	**P480 [-03]**	**P480 [-02]**	**P480 [-01]**	**P480 [-00]**	FR	P2	P1	SPE	EO	QS	EV	SO

SO = Switched On
EV = Enable Voltage
QS = Quick Stop
EO = Enable Operation
SPE = Setpoint Enable
P1 / P2 = Parameter Set Switch
FR = Fault Reset
P480 [0 … 7] = NORD user bit

Status word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
P481 [-07]	**P481 [-06]**	**P481 [-05]**	**P481 [-04]**	**P481 [-03]**	**P481 [-02]**	**P481 [-01]**	**P481 [-00]**	WARN	P2	P1	TARG	FAULT	QS	OE	RTSO

RTSO = Ready To Switch-On
OE = Operation Enabled
QS = Quick Stop
FAULT = Error occurred
TARG = Target Reached
P1 / P2 = Current Parameter Set
WARN = Warning
P481 [0 … 7] = NORD user bit

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.		

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

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.

P553	PLC set values		
Setting range	0 … 57		
Arrays	[-01] = PLC setpoint 1	[-02] = PLC setpoint 2	[-03] = PLC setpoint 3
	[-04] = PLC setpoint 4	[-05] = PLC 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**		

0	Off	18	Curve control
1	Set point frequency	19	Set Relais (same as **P541**)
2	Torque current limit (**P112**)	20	Set Analog Out (same as **P542**)
3	PID current freq.	21	Reserved for POSICON
4	Frequency addition	…	
5	Frequency subtract.	24	
6	Current limit (**P536**)	46	Setval.torque p.reg., *"Set value torque process controller"*
7	Maximum frequency (**P105**)		
8	PID ltd.current.freq	47	Reserved for POSICON
9	PID suprvsd.cur.freq	48	Motor temperature
10	Servo-Mode Torque (**P300**)	49	Ramp time (acceleration / deceleration)
11	Pre-tension Torque (**P214**)	53	d-corr. F Process
13	Multiplication	54	d-corr. Torque
14	Cur.val process ctrl	55	d-corr. F+Torque
15	Nom.val process ctrl	56	Acceleration time
16	Add. process control	57	Deceleration time
17	Reserved for POSICON		

P554	Min. chopper Chop.	S
Setting range	65 … 102 %	
Factory setting	{ 65 }	
Description	"*Minimum chopper threshold*". Adjustment of the switching threshold of the brake chopper.	
Note	An increase in this setting leads to a faster overvoltage FI switch off.	
	For applications where pulsating energy is returned (crank drives) the braking resistor power dissipation can be minimised by increasing this setting.	
	In case of an FI error the brake chopper is generally disabled.	
Setting values	**Value** | **Meaning**	

65 ... 100	Brake chopper switching threshold.
101	In case of an FI error the brake chopper is always disabled. Monitoring is also active if the FI is not enabled. Chopper activation at 65%, e.g. in the event of an increase in the link circuit voltage due to a mains fault.
102	Chopper always switched on, except for active chopper overcurrent (error **E003.4**).

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

P556	Braking resistor	S
Setting range	1 ... 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**.	

P557	Brake resistor type	S
Setting range	0.00 ... 320.00 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 … 320.00	Setting the continuous power (nominal power) of the resistor

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)

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.

5.1.8 Positioning

Parameter group P6xx is used to adjust the POSICON positioning control. A detailed description of these parameters can be found in manual BU 0610.

5.1.9 Information

P700	Actual operating status	
Display range	0.0 … 99.9	
Arrays	[-01] = Actual error	Indicates the presently active (unacknowledged) fault.
	[-02] = Actual warning	Indicates a present warning message.
	[-03] = Reason for switch-on inhibit	Indicates the reason for active switch-on inhibit.
	[-04] = Extended actual error (DS402)	Displays the present active error according to DS402 terminology.
Description	Messages (coded) for the actual operating status of the frequency inverter such as faults, warnings or the cause of a switch-on inhibit (Chap. 6.2 "Messages").	
Note	Display of bus-level error messages is in decimal integer format. The displayed value must be divided by 10 in order to correspond with the correct format. Example: Display: 20 → Error number: 2.0	
	The error number range from 50.0 to 99.9 displays messages from any extension modules. The meaning of these numbers is explained in the relevant documentation for the extension module.	

P701	Last fault
Display range	0.0 … 999.9
Arrays	[-01] … [-10]
Description	"*Last fault 1 … 10*". This parameter stores the last 10 faults (Chap. 6.2 "Messages").

P702	Freq. last error	S
Display range	-400.0 … 400.0 Hz	
Arrays	[-01] … [-10]	
Description	"Frequency l*ast error 1 … 10*". This parameter stores the output frequency that was being delivered at the time the fault occurred. The values of the last 10 errors are stored.	

P703	Current. last error	S
Display range	0.0 ... 500.0 A	
Arrays	[-01] … [-10]	
Description	"*Current, last error 1 … 10*". This parameter stores the output current that was supplied when the error occurred. The values of the last 10 errors are stored.	

P704	Volt. last error	S
Display range	0 ... 500 V AC	
Arrays	[-01] … [-10]	
Description	“*Voltage, last error 1 … 10*”. This parameter stores the output voltage that was supplied when the error occurred. The values of the last 10 errors are stored.	

P705	Dc.lnk volt. last er.	S
Display range	0 ... 1000 V DC	
Arrays	[-01] … [-10]	
Description	"*Link circuit voltage last error 1 … 10*“. This parameter stores the link circuit voltage that was being delivered at the time the error occurred. The values of the last 10 errors are stored.	

P706	P set last error	S
Display range	0 ... 3	
Arrays	[-01] … [-10]	
Description	“*Parameter set last error 1 … 10*”. This parameter stores the parameter set code that was active when the error occurred. Data for the previous 10 faults are stored.	

P707	Software version			
Display range	0.0 ... 9999.9			
Arrays	[-01] =	IO Version	[-02] =	IO Revision
	[-03] =	IO Special version	[-04] =	RG Version
	[-05] =	RG Revision	[-06] =	RG Special version
	[-07] =	IO Loader Version	[-08] =	RG Loader Version
	[-09] =	FW update File version		
Description	“*Software version / Revision*”. This parameter shows the software and revision numbers in the FI. This can be significant when different FIs are assigned the same settings. Array [-03] provides information about any special versions of the hardware or software A zero stands for the standard version.			

P708	State of digital in.
Display range	0000h ... FFFFh
Arrays	[-01] = Signal state of the digital inputs of the frequency inverter
	[-02] = Signal state of the bus/digital inputs of the extension modules
Description	Display of the digital inputs' signal states
Display values	**Value | Meaning**

Array [-01]		
Bit 0	Digital input 1	Signal state of digital inputs 1 … 10
Bit 1	Digital input 2	
Bit 2	Digital input 3	
Bit 3	Digital input 4	
Bit 4	Digital input 5	
Bit 5	Digital input 6 [1]	
Bit 6	Digital input 7 [2]	
Bit 7	Digital input 8 [2]	
Bit 8	Digital input 9 [2]	
Bit 9	Digital input 10 [2]	
Bit 10	Safe Dig.input [3]	Signal state of the STO digital input
Bit 11	Reserve	---
Bit 12	Digital func. Ain1	Digital signal state of analogue input 1
Bit 13	Digital func. Ain2	Digital signal state of analogue input 2

1 SK 530P and higher

2 Only with SK CU5-MLT

3 For SK 510P, SK 540P, SK 530P with SK CU5-STO, SK 550P with SK CU5-STO

Array [-02]		
Bit 0	Bus / 1.IOE Dig In1	Signal state of the bus/1st IO extension digital input 1 … 4
…	…	
Bit 3	Bus / 1.IOE Dig In4	
Bit 4	Bus / 2.IOE Dig In1	Signal state of the bus/2nd IO extension digital input 1 … 4
…	…	
Bit 7	Bus / 2.IOE Dig In4	

P709	V/C Analogue input	
Display range	-100.0 ... 100.0%	
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 IO extension
	[-04] = Ext. Analogue in 2	*"External analogue input 2":* Analogue input 2 of the first IO extension
	[-05] = Ext.AI 1 2.IOE	*"External analogue input 1 of the 2nd IOE":* Analogue input 1 of the second I/O extension
	[-06] = Ext.AI 2 2.IOE	*"External analogue input 2 of the 2nd IOE":* Analogue input 2 of the second I/O extension
	[-07] = Reserve	---
	[-08] = Reserve	---
	[-09] = Clock input 1	tbd
	[-10] = Reserve	---
Scope of application	**[-01], [-02], [-09] SK 500P and higher**	
	[-03] … [-06] SK 530P and higher	
Description	"*Voltage/current analogue inputs*". Displays the measured analogue input value.	
Note	100% = 10.0 V or 20.0 mA	

P710	V/C Analogue output	
Display range	0 ... 100%	
Arrays	[-01] = Analog output	Analogue output of the frequency inverter
	[-02] = Reserve	---
	[-03] = IOE-1	*"External analogue output of the 1st IOE".* Analogue output of the first IO extension
	[-04] = IOE-2	*"External analogue output of the 2nd IOE".* Analogue output of the second IO extension
Description	"*Analogue output voltage*". Displays the output value of the analogue output.	
Note	100% = 10.0 V or 20.0 mA	

P711	State of digital out
Display range	0000h ... FFFFh
Description	Display of the digital outputs' signal state
Display values	**Value | Meaning**

Bit 0	Relay 1	Signal state of relay 1
Bit 1	Relay 2	Signal state of relay 2
Bit 2	Digital output 1 [1]	Signal state of digital output 1
Bit 3	Digital output 2 [1]	Signal state of digital output 2
Bit 4	Digital Output 3 [2]	Signal state of digital output 3 … 6
...	…	
Bit 7	Digital output 6 [2]	
Bit 8	Analog output 1	Digital signal state of analogue output 1
Bit 9	Reserve	Reserve
Bit 10	Digital out 1/1.IOE	Signal state of the 1st IO extension digital output 1
Bit 11	Digital out 2/1.IOE	Signal state of the 1st IO extension digital output 2
Bit 12	Digital out 1/2.IOE	Signal state of the 2nd IO extension digital output 1
Bit 13	Digital out 2/2.IOE	Signal state of the 2nd IO extension digital output 2

1 SK 530P and higher

2 SK 530P and higher, with SK CU5-MLT

Information

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

P712	Energy consumption
Display range	0.00 ... 19 999 999.99 kWh
Description	Displays the energy consumption (cumulative energy consumption over the life of the FI).

Information

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

P713	Braking resistor energy
Display range	0.00 ... 19 999 999.99 kWh
Description	"*Energy output via braking resistor*". Displays the energy consumption of the braking resistor (cumulative energy consumption over the life of the device).

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).

Information

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

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

Information

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

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	[-01] =	0.0 ... 500.0 A	[-02] =	-32.00 ... 32.00 A
Arrays	[-01] =	Actual current	Current on the output of the frequency inverter	
	[-02] =	Actual injection voltage	Effective value of the injection current This array element is only relevant for sensorless control with injection signal (**P300 = 3**).	
Description	Displays the actual current.			

P720	Act. torque current
Display range	-500.0 ... 500.0 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	Current voltage		
Display range	0 ... 500 V		
Arrays	[-01] =	Current voltage	AC voltage on the output of the frequency inverter
	[-02] =	Actual injection voltage	Effective value of the injection voltage This array is only relevant for sensorless control with injection signal (**P300** = 3).
Description	Displays the current voltage.		

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.	

Information

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

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

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 ... 500.0 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.	

Information

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

P733	Phase V current	S
Display range	0.0 ... 500.0 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 ... 500.0 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		
Arrays	[-01] = TTL encoder	[-04] = Value from speed observer (The speed is determined by alternative measuring methods and by calculation.)	
	[-02] = HTL encoder	[-05] = Universal (only UART)	
	[-03] = Sin/Cos encoder		
Scope of application	**[-01], [-03], [-05]** **SK 530P and higher**		
	[-02], [-04] **SK 500P and higher**		
Description	Displays the current speed supplied by the encoder. Depending on the encoder used, **P301** / **P605** must be set correctly.		

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

P737	Usage rate brakeres.
Display range	0 … 1000%
Description	"*Actual braking resistor usage rate*". In generator mode, this parameter provides information about the actual usage rate of the braking resistor (on condition that **P556** and **P557** are parameterised) or the actual modulation rate of the brake chopper (on condition that **P557 = 0**).

P738	Usage rate motor	
Display range	0 … 1000 %	
Arrays	[-01] = relative to I_{Nenn}	[-02] = relative to I^2t
Description	"*Actual usage rate of motor*". Displays the actual motor usage. Basis for the calculation is the motor data **P203** and the current which is actually consumed.	

Information

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

P739	Temperature	
Display range	-40 ... 150 °C	
Arrays	[-01] = Heatsink	Current temperature of the heat sink. This value is used for overtemperature switch-off **E001.0**.
	[-02] = Ambient dc-link	Current temperature of the interior of the power section of the inverter. This value is the basis for overtemperature switch-off **E001.1**.
	[-03] = Motor KTY	Displays the current motor temperature when monitoring with a temperature sensor.
	[-04] = Microcontroller	Current temperature of the microprocessor in the control section of the inverter. This value is the basis for overtemperature switch-off **E001.1**.
Description	Displays the current temperature values at various measuring points.	
Display	0 = Function is not supported	

Information

With the following parameter **P740** arrays **[-18]** to **[-27]** do not provide the actual correct operating value unless a mains voltage is applied (X1).

P740	PZD bus in		S
Display range	0000h … FFFFh		
Arrays	[-01] = Control word	Control word, source from **P509**	
	[-02] = Set value 1 … [-06] = Setvalue 5	Setpoint data from main setpoint **P510 [-01]**	
	[-07] = Res. stat.InBit P480	The displayed value depicts all Bus In Bit sources linked with an “OR”.	
	[-08] = Parameter data In 1 … [-12] = Parameter data In 5	Data during parameter transfer: Request ID (AK), parameter number (PNU), index (IND), parameter value (PWE 1/2)	
	[-13] = Set point 1 … [-17] = Setvalue 5	Setpoint data (**P510 [-02]**) from the master function value (Broadcast), if **P509 = 9** or **P509 = 10**	
	[-18] = Control Word PLC	Control word, source PLC	
	[-19] = Setvalue 1 PLC … [-23] = Setvalue 5 PLC	Setpoint data from the PLC	
	[-24] = Main set value	Main setpoint from the PLC	
	[-25] = Control byte 1 PLC	First auxiliary control word byte with defined special functionalities for IO control via PLC 01h Fixed frequency 1 02h Fixed frequency 2 04h Fixed frequency 3 08h Fixed frequency 4 10h Fixed frequency 5 20h Jog frequency 40h Maintain the freq. with motor potentiometer 80h Remove enable via analogue input	
	[-26] = Control byte 2 PLC	Second auxiliary control word byte with defined special functionalities for IO control via PLC 01h Bit0 fixedfreq.Array 02h Bit1 fixedfreq.Array 04h Bit2 fixedfreq.Array 08h Bit3 fixedfreq.Array 10h Bit4 fixedfreq.Array 20h Motor potentiometer function activated 40h Increase frequency, motor potentiometer 80h Reduce frequency, motor potentiometer	
	[-27] = Res. controlword FI	*“Resulting control word”* – Control word for the frequency inverter, which is formed from variable control words (depending on **P551**).	
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: (Chap. 8.10 "Scaling of set-/actual values")		

Information

With the following parameter **P741** arrays **[-07]** and **[-18]** to **[-24]** do not provide the actual correct operating value unless a mains voltage is applied (X1).

P741	**PZD bus out**		**S**
Display range	0000h … FFFFh		
Arrays	[-01] = Status word bus	Status word according to the selection in **P551**	
	[-02] = Bus actual value 1 … … [-06] = Bus actual value 5	Actual values according to **P543**	
	[-07] = Res.stat.OutBit P481	The displayed value depicts all Bus OUT Bit sources linked with an “OR”.	
	[-08] = Parameter data Out1 … … [-12] = Parameter data Out5	Data during parameter transfer	
	[-13] = Act. Value1 leadfct. … … [-17] = Act.value 5 Leadfct.	Actual values of master function **P502 / P503**	
	[-18] = Statusword PLC	Status word via PLC	
	[-19] = Actual value 1 PLC … … [-23] = Actual value 5 PLC	Actual values via PLC	
	[-24] = Res. statusword FI	“*Resulting status word*” – Status word from the frequency inverter	
Description	This parameter provides information about the current status word and the actual values that are transferred via the bus systems.		
Note	Scaling: 🕮 (Chap. 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	
Arrays	[-01] = Device type	Display of the device version
	[-02] = Extension XU5	Displays customer unit (SK XU5-…)
	[-03] = Extension CU5	Displays customer unit (SK CU5-…)
	[-04] = Addition.Interfaces	Displays communication interfaces
	[-05] = Functionalities	Displays device functions
Description	Display of the configuration of the device	

Display values

Value	Meaning
Array [-01] – Device type	
0200h	Basic
0201h	Advanced
0202h	PNT
0203h	ECT
0204h	EIP
0205h	POL
Array [-02] – Extension XU5	
0000h	No extension
0001h	STO
0002h	Industrial Ethernet
Array [-03] – Extension CU5	
0000h	No extension
0001h	STO
0002h	ENC (Encoder)
0003h	MLT (Multi IO)
0004h	Reserve
0005h	SAF (PROFIsafe module)
0006h	SS1
Array [-04] – Addition.Interfaces	
Bit 0	Interface for IOE present
Bit 1	TTL encoder interface
Bit 2	HTL encoder functionality for DIN
Bit 3	RS-232/RS-485 diagnostic interface (RJ12)
Bit 4	External 24 V supply
Bit 5	CAN/CANopen interface
Bit 6	CAN absolute encoder interface (ABS)
Bit 7	microSD card Interface
Bit 8	USB port
Bit 9	IO controller variant
Bit 10	CU5 interface
Array [-05] – Functionalities	
Bit 0	POSICON functionality (POS)
Bit 1	PLC functionality
Bit 2	Operation of PMSM possible
Bit 3	Operation of a reluctance motor possible (SRM)
Bit 4	Delta-sigma current measurement
Bit 5	Encoder extension

P745	Option Version			
Display range	-3276.8 … 3276.7			
Arrays	[-01] =	TU5 version	[-07] =	XU5 version
	[-02] =	TU5 revision	[-08] =	XU5 revision
	[-03] =	TU5 special version	[-09] =	XU5 special version
	[-04] =	CU5 version	[-10] =	XU5 Stack Version 1
	[-05] =	CU5 revision	[-11] =	XU5 Stack Version 2
	[-06] =	CU5 special version		
Scope of application	**[-01] … [-03]**	**SK 500P and higher**		
	[-04] … [-11]	**SK 530P and higher**		
Description	Software version for optional hardware extensions Have this data available in case of technical queries.			

P746	Option Status			S
Display range	0000h … FFFFh			
Arrays	[-01] = TU5	[-02] = CU5	[-03] = XU5	
Scope of application	**[-01] SK 500P and higher**	**[-02] SK 530P and higher**	**[-03] SK 500P and higher**	
Description	Displays the current status of the optional hardware extensions: 0 = Not ready 1 = Ready			

P747	Inverter Volt. Range
Display range	0 ... 3
Description	"*Inverter voltage range*". Indicates the mains voltage range for which this device is specified.
Display values	**Value | Meaning**

0	100 V … 200 V
1	200 V … 240 V
2	380 V … 480 V
3	400 V … 500 V

P748	Status CANopen			S
Display range	0000h … FFFFh			
Arrays	[-01] = Status CANopen	[-02] = Reserve	[-03] = Reserve	
Description	Displays the status of the system bus (CANopen)			
Display values	**Value**	**Designation**	**Meaning**	

Bit 0	24 V bus supply	24 V supply (Bus) present
Bit 1	Bus Warning	CANbus in "Bus Warning" status
Bit 2	Bus Off	CANbus in "Bus Off" status
Bit 3	Sysbus → Bus module online	External bus module (e.g. SK TU4-…) online
Bit 4	Sysbus → ZBG1 online	External IO extension 1 (e.g. SK EBIOE-...) online
Bit 5	Sysbus → ZBG2 online	External IO extension 2 (e.g. SK EBIOE-...) online
Bit 6	0 = CAN / 1 = CANopen	Active protocol
Bit 7	Reserved	
Bit 8	Bootsup 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

P750	Error statistics	S
Display range	0 ... 9999	
Arrays	[-01] … [-25]	
Description	Display of the error messages which have occurred during operation (**P714**).	
Note	Depending on the frequency of the errors, the entries in the arrays are displayed in descending order. Therefore Array [-01] shows the error message which has occurred most frequently.	

P751	Counter statistics	S
Display range	0 ... 9999	
Arrays	[-01] … [-25]	
Description	Display of the frequency with which the errors according to **P750** have occurred.	
Note	The arrays of parameters **P750** and **P751** are directly related. Example: In **P751 [-01]**, the number of error messages according to **P750 [-01]** are displayed.	

P752	Last extended error
Display range	0 ... 65535
Arrays	[-01] … [-10]
Description	This parameter stores the last 10 errors from **P700 [-04]**.
Note	Depending on the frequency of the errors, the entries in the arrays are displayed in descending order. Therefore, Array [-01] displays the error message, which has occurred most frequently.

P765	Act. pulse frequency	S
Display range	0.0 ... 16.0 kHz	
Description	Displays the *actual pulse frequency*. It can deviate from the set pulse frequency (**P504**), depending on the load or if the frequency inverter is in derating.	

P780	Device id	
Display range	0 … 9 and A … Z	
Arrays	[-01] = … [-12]	
Description	Display of the device's serial number (12-digit)	
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] … [-10]
Description	"*Operating time, last fault*". If a fault occurs, a time stamp is set on the basis of the operating hours counter **P714** and saved in **P799**. Array [-01]. [10] corresponds to the last faults 1 ... 10.

5.1.10 Parameters for bus communication

Parameter group P8xx is used to set the parameters for the bus communication. A detailed description can be found in manual BU 0620.

6 Operating status messages

In case of deviations from the normal operating status, a message is output.

There are:

- **Error messages**

  Faults cause the device to switch off.

- **Extended error messages**

  Faults in conjunction with the operation of an absolute encoder. They cause the device to switch off.

- **Warning messages**

  A limit value was reached. The device will continue to run.

- **Inhibit message** (switch-on inhibit):

  External influences prevent the start.

The messages will be indicated as follows:

- **LED display**
- **Control panel** (optional)
- **Information parameter** (**P700**)

Faults prevent further operation of the frequency inverter. If the cause for a fault is no longer present, the error message can be acknowledged as follows:

- Switch the mains off and on again, or
- Parameterise the digital input with the “Fault acknowledgem.” function (**P420**), or
- Deactivate the “Enable” if no other digital input is parameterised with the “Fault acknowledgem.” function, or
- Via the optional control panel, or
- Error acknowledgement via bus.

External influences can set the frequency inverter into the “Not ready” or “Switch-on inhibit” state and thus prevent a start. The cause for a switch-on inhibit is not indicated via LED display.

6.1 Display of messages

LED indicators

There are two areas with LED indicators on the frequency inverter.

- The LED indicators **(1)** relate to the frequency inverter and are labelled as follows:
  - DEV: Device status
  - BUS: System bus communication status
  - USB: USB connection status

- The LED indicators **(2)** are not labelled and relate to the communication in Industrial Ethernet for the SK 550P, see BU 0620.

The LED labelled **"DEV"** indicates the general device status.

Status	Meaning
Off	• FI not ready for operation, no mains or control voltage
Lights up green	• FI is enabled
Flashing green (4 Hz)	• FI is in switch-on inhibit
Flashing green (0.5 Hz)	• FI is ready to switch-on but not enabled
Flashing green (variable frequency)	• FI works in overload range • Flashing sequence indicates the degree of overload
Flashing green and red alternately (4 Hz)	• Warning
Flashing red (2 Hz/ 1 Hz)	• Output of the error group (e.g. 3x flashing = error group E003).
Flashing green and red	• FI in Update mode
Flashing green and red simultaneously	• Update data are communicated

The LED labelled **“BUS”** indicates the status of communication at the system bus level.

Status	Meaning
Off	• No process data communication
Lights up green	• Process data communication active
Flashing green (4 Hz)	• Bus warning
Flashing red (4 Hz)	• Monitoring error P120 or P513 (E10.0/E10.9)
Flashing red (1 Hz)	• Field bus interface telegram timeout (E10.2/E10.3)
Lights up red	• System bus in state “Bus off”

The LED labelled **“USB”** indicates the status of the USB connection.

Status	Meaning
Orange off	• USB driver in PC not correctly initialised
Orange lights up	• USB connection active
Lights up red	• USB connection error

ControlBox Display

The ControlBox 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 ControlBox flashes and the error can be acknowledged with the Enter key.

In contrast, warning messages are prefixed with "C" ("**Cxxx**") and cannot be acknowledged. They disappear automatically when the reason for them is no longer present or the frequency inverter has switched to the "Error" state. Display of the message is suppressed if the warning appears during parameterisation.

The present warning message can be displayed in detail at any time in array element [**-02**] of parameter (**P700**).

The reason for an existing disabled switch on cannot be displayed with the ControlBox.

ParameterBox display

The ParameterBox displays the messages in plain text.

Control panel

The following options are available:

- Plug-on control panel with 7-segment display (ControlBox SK TU5-CTR)
- Plug-on control panel with plain text display (ParameterBox SK TU5-PAR)
- Cable-connected control panel with 7-segment display (SimpleControlBox SK CSX-3E and SK CSX-3H)
- Cable-connected control panel with plain text display (ParameterBox SK PAR-3E/-3H and SK PAR-5H)

	ControlBox SK TU5-CTR	**SimpleControlBox SK CSX-3E/H**	**ParameterBox SK TU5-PAR SK PAR-3E/-3H/-5H**
Fault			
Labelling	e.g. E001.1	e.g. E001	e.g. “Inverter overtemp.”
Current fault details	P700 [-01]	P700 [-01]	P700 [-01]
Last faults	P701 [-01] … [-05]	P701 [-01] … [-05]	P701 [-01] … [-05]
Additional information on last faults	P702 to P706/ P799, each [-01] … [-05]	P702 to P706/ P799, each [-01] … [-05]	P702 to P706/ P799, each [-01] … [-05]
Acknowledgement	The fault display flashes if the fault is no longer present. Acknowledge the message with the Enter or OK key.		

⚠ WARNING

Automatic starting

The device may be started and therefore start the drive and the connected machinery on acknowledgement of the message. This can result in severe or fatal injuries.

- Secure the drive against movement (e.g. by mechanical blocking).
- Ensure that there are no persons within the area of action and the danger area of the system.

Warnings (are only displayed as long as their cause is present.)			
Labelling	e.g. C001.1	e.g. C001	e.g. “Inverter overtemp.”
Details	P700 [-02]	P700 [-02]	P700 [-02]
Inhibit message (switch-on inhibit)			
Labelling	Underscores flash slowly	No display	“Volt. blocked by IO“
Details	P700 [-03]	P700 [-03]	P700 [-03]

6.2 Messages

Fault messages

Coding		Error message	Cause • Remedy
Group	Number		
E001	**1.0**	**Inverter overtemp.**	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. • Reduce or increase ambient temperature • Check fan or cabinet ventilation • Check the device for dirt Further notes: • see (**P739)** for temperature display
E001	**1.1**	**Intern. inverter temp**	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. • Reduce or increase ambient temperature • Check fan or cabinet ventilation • Check the device for dirt Further notes: • see (**P739**) for temperature display
E002	**2.0**	**Motor overtemp.PTC**	Motor temperature sensor (PTC resistor), the separate PTC resistor input X11:25; X4 or KTY / PT1000 have triggered at the analogue input (P400 = 48) • Reduce motor load • Increase motor speed • Install external motor fan or check the function Further notes: • Check parameter setting (**P425**)
E002	**2.1**	**Motor overtemp.I²t**	The inverter has detected an impermissible motor temperature (motor I^2t). • Reduce motor load • Increase motor speed • Repeat stator resistance measurement (Chap. 5.1.4 "Motor data / characteristic curve parameters")
E002	**2.2**	**Overtemp. DIN**	The digital input function **P420 / P480 {13}** *“PTC resistor input”* has triggered. The digital input is “low”. • Check connection and thermostat

E003	**3.0**	**Overcurrent I²t lim.**	The current limit (I^2t) has been exceeded (e.g more than 1.5x the rated current for 60 s). • Reduce motor load • Check system for blockage or overload • Check rotary encoder settings (resolution, defect, connection) Further notes: • Adjust the current limit by changing the pulse frequency (**P504**).
E003	**3.1**	**Overcurrent chopper**	The current limit (I^2t) of the brake chopper has been exceeded (e.g more than 1.5 x rated current for 60 s). • Avoid overcurrent in braking resistor • Check braking resistor values (**P555**, **P556**, **P557** and **P554**, if available)
E003	**3.2**	**Overcurrent IGBT**	The drive is running above its possible power (220 % overcurrent). • Reduce motor load • Check the available power of the frequency inverter via derating tables (e.g. increased pulse frequency) • Brake chopper current too high • Very high peak loads or blockage • For fan drives: Enable flying start (**P520**)
E003	**3.3**	**Overcurrent IGBTfast**	The drive is running above its possible power (230 % overcurrent). • Reduce motor load • Check the available power of the frequency inverter via derating tables (e.g. increased pulse frequency) • Brake chopper current too high • Very high peak loads or blockage
E003	**3.4**	**Overcurrent chopper**	Brake chopper current too high • Avoid overcurrent in braking resistor
E003	**3.7**	**Power limit input**	Input current too high. Continuous overload at FI Input. Shutdown for 150% overload within 60 s. • Reduce motor load • Check system for blockage or overload Further notes: • Shortening of the shutdown time due to – Higher loads – Frequent overloads • If the mains voltage is in the lower tolerance range, the input current increases

E004	**4.0**	**Module overcurrent**	Module error (short-term) • Short circuit or earth fault at the FI output (motor cable or motor) • Optional braking resistor, defect/check • Optional motor choke, defect/check Further notes • Other causes of error: – Wrong size of breaking resistor – Motor cable too long • For devices with Safe Pulse Block:: – Cable resistance too high or voltage at Safe Pulse Block too low • Do not disconnect **P537**! **Note: The error may significantly reduce the service life of the device or even destroy it**
E004	**4.1**	**Overcurrent measurem.**	Pulse switch-off (**P537**) has been reached three times within 50 ms. • Reduce motor load • Check system for blockage or overload Further notes: • Error message is only possible if (**P112**) and (**P536**) are switched off • Check motor data settings on the device (**P201** … **P209**) and check motor dimensioning • Check ramp times (**P102/P103**)
E005	**5.0**	**Overvoltage Ud**	DC link voltage is too high. → The drive is overloaded during the braking process. → The braking resistor itself or connections and cables to the braking resistor are defective. • Check dimensioning of the braking resistor Further notes: • Extend deceleration time (**P103**) • Extend quick stop time (**P426**) • Speed fluctuation (for example due to high inertia loads) → if necessary set the <U/f characteristic curve (**P211, P212**) • Set switch-off mode (**P108**) with delay (not permissible for lifting equipment)
E005	**5.1**	**Mains overvoltage**	Mains voltage is too high. • Check if the device is suitable for electrical connection to the supply network (Chap. 7)

E006	**6.0**	**Charging error**	DC link voltage is too low. • Check if the device is suitable for electrical connection to the supply network (see (Chap. 7))
E006	**6.1**	**Mains low voltage**	Mains voltage is too low. • Check if the device is suitable for electrical connection to the supply network (see (Chap. 7))
E007	**7.0**	**Mains Phase Failure**	Error at mains connection side • Check all mains phases for availability (see technical data (Chap. 7)) • Mains is asymmetrical
E007	**7.1**	**Phasefailure dc-link**	Mains phase error • Check all mains phases for availability (see technical data (Chap. 7))
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 (factory setting). • EMC interferences (see also **E020**)
E008	**8.1**	**Inverter ID error**	Initialisation error • Switch the mains voltage off and on again • EEPROM defective
E008	**8.4**	**Internal EEPROM error** (Database version incorrect)	The configuration of the frequency inverter was not correctly identified. • Switch the mains voltage off and on again.
E008	**8.7**	**EEPROM copy differs**	The configuration of the frequency inverter was not correctly identified. • Switch the mains voltage off and on again
E009	**9.0 … 9.9**	**Communication error**	Error message for SK TU5-CTR → 🕮 Manual BU 0040

E010	**10.0**	**Bus time-out**	Telegram time-out of bus system (CAN, CANopen, USS): Voltage supply for the bus system is missing. • Check data cable connections Further notes: • Data transfer defective Check (**P513)**. • Check the program sequence of the bus protocol • Check the bus master • Check the 24 V supply of the internal CAN/CANopen Bus • Node guarding error (internal CANopen) • Bus-Off error (internal CANbus)
E010	**10.1**	**System-error option**	Bus interface system error • Further details can be found in the respective supplementary bus instructions I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	**10.2**	**Bus time-out option**	Bus interface telegram time-out by PLC • Telegram transmission defective • Check the physical bus connections • Check the program sequence of the bus protocol • Check the bus master • PLC is in “STOP” or “ERROR” status
E010	**10.3**	**System-error option**	Bus interface system error • Further details can be found in the respective supplementary bus instructions I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	**10.4**	**Init-error option**	Initialisation error bus interface • Restart the frequency inverter (switch the voltage supply off and on again) • Check the bus interface power supply • DIP switch position of a connected I/O extension module defective • Check parameter **P746**
E010	**10.5** **10.6** **10.7**	**System-error option**	Bus interface system error • Further details can be found in the respective supplementary bus instructions I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	**10.8**	**Error option**	• Communication error between frequency inverter and bus interface
E010	**10.9**	**Missing Option /P120**	The module entered in parameter (**P120**) is not present. • Check connections and cables on both sides

E011	**11.0**	**Control terminals**	Communication error to CU module • Internal customer unit (internal data bus) defective 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 device and screening well. **Note:** With this error, it may be possible that the stored position (**P619**) is no longer correct and that the rotor position may be lost with a PMSM.
E011	**11.1**	**CU version**	The firmware of the customer unit of type SK CU5 is not compatible. • The customer unit or the frequency inverter requires a firmware update

E012	**12.0**	**External Watchdog**	Time monitoring of digital inputs A digital input has been set to the “Watchdog” function and the expected pulse failed to appear. • Check the digital inputs Further notes: • Check setting **P420** • Check setting **P460**
E012	**12.1**	**Limit moto./Customer**	The drive switch-off limit has triggered. • Reduce motor load • Check system for blockage or overload Further notes: • Check settings **P534 [-01]**
E012	**12.2**	**Limit gen.**	The machine drives the motor and puts it into generator operation. The generator switch-off limit has triggered. • Reduce (generator) motor load • Check system for overload Further notes: • Check settings **P534 [-02]**
E012	**12.3**	**Torque limit**	A parameterised limit value for the torque has been reached. • Limit from potentiometer or setpoint source has switched off (**P400 = 12**)
E012	**12.4**	**Current limit**	Limit from potentiometer or setpoint source has switched off (**P400 = 14**).
E012	**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 Further notes: • Change limit values (**P525 … P527**) • Increase delay time (**P528**) • Change monitoring mode (**P529**)
E012	**12.8**	**Analog in. minimum**	Switch-off due to undershooting of the 0 % adjustment value (**P402**) with setting (**P401**) "0-10V with switch-off on error 1“or “…2“.
E012	**12.9**	**Analog in. maximum**	Switch-off due to undershooting of the 100 % adjustment value (**P403**) with setting (**P401**) "0-10V with switch-off on error 1“or “…2“.

E013	**13.0**	**Encoder error**	Missing signals from encoder (TTL), slip error • Check connections and cables on both sides • Check the mechanical installation of the encoder (encoder shaft is at a halt when slip error monitoring is active) Further notes: • Check encoder type and parameterisation • Check voltage supply • Check cable routing (EMC)
E013	**13.1**	**Speed slip error**	The difference between measured and calculated speed has exceeded a limit value. • Check mechanical installation of (TTL) encoder • Check system for blockage or overload Further notes: • Check limit values (**P327**) and (**P328**) • Increase acceleration times The inverter is in derating mode. The current required for acceleration is not available (see FAQ).
E013	**13.2**	**Disconnect. control**	The slip error switch-off monitoring has triggered. The motor could not follow the setpoint. • Check system for blockage or overload Further notes: • Check motor data (**P201** … **P209**) • Check Star Delta connection • Check encoder settings (**P300**) and following in servo mode • Increase setting value for torque current limit in (**P112**) • Increase setting value for current limit in (**P536**) • Check deceleration time (**P103**) and extend if necessary
E013	**13.3**	**Slipfault encoder**	Incorrect direction of rotation of the encoder • Check connections
E013	**13.4**	**HTL slip error**	In the operating state “Ready for switch-on” (FI not enabled), the frequency inverter has detected a speed ≠ 0 of the encoder. • Check mechanical installation of encoder • Check system for overload • Check function of the holding brake if present
E013	**13.5 … 13.9**	**Reserved**	Error message for POSICON → 🕮 Manual BU 0610
E014	**---**	Reserved	POSICON → error message see supplementary manual BU 0610
E015	**---**	Reserved	
E016	**16.0**	**Motor phase failure**	A motor phase is not connected. • Check connections and cables on both sides • Check the motor Further notes: • Check (**P539**)
E016	**16.1**	**Magn. current watch**	Required exciting current not achieved at moment of switch-on. • Check connections and cables on both sides • Check the motor Further notes: • Check (**P539**) • Check motor data (**P201** … **P209**)

E016	**16.2**	**Change phase direct.**	The motor phase sequence (U – V – W) has been changed during operation (enable). Further notes: • Check parameter values in (**P583**) • Has parameter set (**P100**) been switched over?
E018	**---**	**Reserved**	Error message for “Safe Pulse Block”, see supplementary instructions
E019	**19.0**	**Parameter ident.**	Automatic identification of the connected motor has failed. • Check connections and cables on both sides • Check the motor Further notes: • Check motor data (**P201** … **P209**)
E019	**19.1**	**Rotorposition**	Incorrect data with regard to the rotor position due to: • Incorrect result for rotor position identification by test signal method (**P330**) • Impermissible switching of the parameterised control method (**P300**) with enabled drive
E019	**19.2**	**Rotorpos.North/South**	• Incorrect result for rotor position identification by test signal method • Control method “CFC open-loop-inje” (**P300**): Error caused by flying start attempt (**P520**) at speed < 10 Hz
E019	**19.3**	**Rotor position adjustment**	The rotor position coupled by the zero pulse deviates considerably from the rotor position determined by the test signal method (**P330**). • Motor phases are not correctly connected Connect motor phase “U” to motor connection terminal “U” of the frequency inverter. Further notes: • Adjust encoder offset PMSM (**P334**)
E022	**---**	**Reserved**	Error message for PLC → 🕮 Manual BU 0550
E023	**---**	**Reserved**	Error message for PLC → 🕮 Manual BU 0550
E024	**---**	**Reserved**	Error message for PLC → 🕮 Manual BU 0550
E025	**---**	**Reserved**	Error message for POSICON → 🕮 Manual BU 0610
E090	**90.0**	**Extended error**	The FI has received an error code from an external module it does not know. • FI update required • The new, extended error code can be read from **P700 [-04]**

E091	**91.0**	**Update error**	Update failed
E091	**91.1**	**Update file**	The update file is defective Error during identification of the update file.
E091	**91.2**	**Update timeout**	The update file transfer took too long or the connection to the PLC/PC was interrupted during the transfer.
E091	**91.3**	**Type update file**	Update is not possible because parameter **P853 [-01] = 0**.
E099	**99.0**	**System error**	Internal error. • Restart device **Note:** With this error, it may be possible that the stored position (**P619**) is no longer correct and that the rotor position may be lost with a PMSM.
E110	**---**	**Reserved**	Error message for functional safety → 🕮 Manual BU 0630
E200	**---**	**Reserved**	Error message for bus → 🕮 Manual BU 0620
E220	**---**	**Reserved**	Error message for bus → 🕮 Manual BU 0620
E299	**---**	**Reserved**	Error message for bus → 🕮 Manual BU 0620

Warning messages

Coding		Warning message	Cause • Remedy
Group	Number		
C001	**1.0**	**Inverter overtemp.**	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. • Reduce or increase ambient temperature • Check fan or cabinet ventilation • Check the device for dirt Further notes: • see **P739** for temperature display
C002	**2.0**	**Motor overtemp. PTC**	Warning from the motor temperature sensor (trigger limit reached) • Reduce motor load • Increase motor speed • Install external motor fan or check the function Further notes: • Check parameter setting **P425**
C002	**2.1**	**Motor overtemp. I2t**	The inverter has detected an impermissible motor temperature (motor I^2t). • Reduce motor load • Increase motor speed • Repeat stator resistance measurement (Chap. 5.1.4 "Motor data / characteristic curve parameters")
C002	**2.2**	**Ext resistor temp.**	Temperature sensor (e.g. braking resistor) has been triggered. The digital input is “low”. • Check connection and temperature sensor

C003	**3.0**	**Overcurrent I²t lim.**	The current limit (I^2t) has been exceeded (e.g more than 1.3 x rated current for 60 s). • Reduce motor load • Check system for blockage or overload • Check rotary encoder settings (resolution, defect, connection) Further notes: • Adjust the current limit by changing the pulse frequency (**P504**).
C003	**3.1**	**Overcurrent chopper**	The current limit (I^2t) of the brake chopper has been exceeded (e.g more than 1.3 x rated current for 60 s). • Avoid overcurrent in braking resistor Further notes: • Check braking resistor values (**P555, P556, P557** and **P554**, if available)
C003	**3.5**	**Torque limit**	The limit value of the torque generating current (parameterised, mechanical load limit) has been reached. • Check system for blockage or overload Further notes: • Check value in **P112**.
C003	**3.6**	**Current limit**	The limit value of the FI output current (parameterised FI load limit) has been reached. • Check system for blockage or overload Further notes: • Check **P536**

C003	**3.7**	**Real power**	Input current too high. Drive is running at the load limit.
			• Reduce motor load
			• Check system for blockage or overload
			Further notes:
			• Shortening of the shutdown time due to
			  - Higher loads
			  - Frequent overloads
			• If the mains voltage is in the lower tolerance range, the input current increases

C003	**3.8**	**Total current < > 0**	The total current of the three phases (L1, L2, L3) is monitored. This warning is output if a threshold value is exceeded. The warning indicates a defect in the current measurement hardware.

C004	**4.1**	**Overcurrent measurem.**	The pulse disconnection (**P537**) has been achieved. • Reduce motor load • Check system for blockage or overload Further notes: • Error message is only possible if (**P112**) and (**P536**) are switched off • Check motor data settings on the device (**P201 … P209**) and check motor dimensioning • Check ramp times (**P102/P103**)
C008	**8.0**	**Parameter loss**	One of the cyclically saved messages such as operating hours or enabling time could not be saved successfully. The warning expires as soon as saving can be successfully performed again.
C012	**12.1**	**Limit moto./Customer**	The motor switch-off limit is reached. • Reduce motor load • Check system for blockage or overload Further notes: • Check settings **P534 [-01]**
C012	**12.2**	**Limit gen.**	The machine drives the motor and puts it into generator operation. Warning: 80% of the generator switch-off limit have been reached. • Reduce (generator) motor load • Check system for overload Further notes: • Check settings **P534 [-02]**
C012	**12.5**	**Load monitor**	Overshooting or undershooting of permissible load torques (**P525 … P529**) for half of the time set in (**P528**). • Adjust load Further notes: • Change limit values (**P525 … P527**) • Increase delay time (**P528**) • Change monitoring mode (**P529**)

C025	**---**	Reserved	POSICON → error message see supplementary manual BU 0610
C026	**26.0**	**microSD card not inserted**	• microSD card inserted incorrectly • microSD card defective
C026	**26.1**	**Incompatible data set**	• microSD card inserted incorrectly • microSD card defective
C026	**26.2**	**MicroSD card write error**	• microSD card inserted incorrectly • microSD card defective
C026	**26.3**	**SD card not recognised**	• microSD card inserted incorrectly • microSD card defective
C090	**90.0**	**Subsystem**	The FI has received a warning number from another unknown device. • Update inverter
C091	**91.0**	**FW update active**	Update active Part of the inverter is in update mode.

Messages on switch-on inhibit, “not ready”

Coding		Reason for switch-on inhibit, “not ready”	Cause • Remedy
Group	Number		
I000	**0.1**	**Volt. blocked by IO**	The input which is parameterised with the “Voltage disable” function (**P420/P480**) is not set (“Low”). • Set input (“High”) • Check connections and cables on both sides Further notes: • Check parameterisation of digital functions (**P420**/ **P480**)
I000	**0.2**	**Quick stop by IO**	The input which is parameterised with the “Quick stop” function (**P420/P480**) is not set (“Low”). • Set input (“High”) • Check connections and cables on both sides Further notes: • Check parameterisation of digital functions (**P420**/ **P480**)
I000	**0.3**	**Volt. blocked by Bus**	If “Source control word” (**P509**) is not 0 or 1, Bit 1 is not set in the control word (“Low”). Further notes: • Set Bit 1 to “High“ in the control word
I000	**0.4**	**Quick stop by Bus**	If “Source control word” (**P509**) is not 0 or 1, Bit 2 is not set in the control word (“Low”). Further notes: • Set Bit 2 to “High“ in the control word
I000	**0.5**	**Enable at start**	An enable signal was applied during the switch-on phase of the frequency inverter (mains or control voltage “ON”). Or the frequency inverter switches from the “Fault” or “Switch-on inhibit” state to the “Ready” state although the enable is still active. • Deactivate enable signal Further notes: • Activate “Automatic starting“ (**P428**) NOTICE! Risk of injury! Drive starts up immediately! • Check enable signals – Digital inputs (**P420**) – BusIO In (**P480**) – Control word (**P740**)

I000	**0.6**	**Volt. blocked by PLC**	Information message for PLC → see supplementary manual BU 0550
I000	**0.7**	**Quickstop by PLC**	Information message for PLC → see supplementary manual BU 0550
I000	**0.8**	**Right dir. locked**	Switch-on inhibit with inverter shut-off activated by: • **P540** or by “Block enable right” (**P420 = 31**, **73**) The frequency inverter switches to "Ready to switch-on" status.
I000	**0.9**	**Left dir. locked**	Switch-on inhibit with inverter shut-off activated by: • **P540** or by “Block enable left” (**P420 = 32, 74**) The frequency inverter switches to "Ready to switch-on" status.
I006	**6.0**	**Charging error**	Charging relay not energised, because: • Mains / link voltage too low • Mains voltage failure
I011	**11.0**	**Analog Stop**	If an analogue input of the frequency inverter or connected IO extension is configured for wire break detection (2 … 10 V signal or 4 … 20 mA signal) the frequency inverter changes to the status “ready for switch-on” of the analogue signal undershoots the value 1 V or 2 mA. This also occurs if the relevant analogue input is parameterised to function “0” (no function). • Check connection
I014[1)]	**14.4**	**Reserved**	Information message for POSICON → 🕮 Manual BU 0610
I018[1)]	**18.0**	**Reserved**	Information message for “Safe stop” function → 🕮 supplementary manual

1) Indication of operating mode (message) on the *ParameterBox* or virtual operating unit of the *NORD CON-Software*: **"Not ready"**

6.3 FAQ operational problems

Fault	Possible cause	Remedy
Device will not start (all LEDs off)	• No mains voltage or wrong mains 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
For various parameters: • No access to the parameters • No adoption of parameter changes • Display values “0“	• 24 V-DC supply present but no mains voltage or wrong mains voltage	• Check connections and supply cables • Check switches / fuses

Table 15: FAQ operational problems

7 Technical data

7.1 General Data

Function	Specification	
Power range	230 V device	0.25 … 2.2 kW: In: 1~ 230 V, Out: 3~ … 230 V
	400 V device	0.25 … 160 kW: In: 3~ 400 V, Out: 3~ … 400 V
Output frequency	0.0 ... 400.0 Hz	
Pulse frequency	4.0 ... 16.0 kHz, standard setting = 6 kHz Power reduction > 8 kHz for 230 V device, >6 kHz for 400 V device	
Typical overload capacity	150% for 60 s, 200% for 3.5 s	
Energy efficiency	IE2 (Chap. 7.2)	
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	
Ambient temperature	-10 °C ... +40 °C (S1-100% ED); -10 °C ... +50 °C (S3-70% ED 10 min)	
Storage and transport temperature	-20 °C ... +60 °C	
Long-term storage	< 50 °C ((Chap. 9.1 "Maintenance information "))	
Protection class	IP20, NEMA Open Type, NEMA 1	
Max. installation altitude above sea level	Up to 1000 m:	No power reduction
	1000 m to 2000 m:	1% / 100 m power reduction, overvoltage category 3
	2000 m to 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: 2M1
	Operation (IEC 60721-3-3):	Mechanical: 3M4 Climatic: 3K3
Waiting period between 2 x “Mains on”	60 s for all devices in normal operating cycle	
Protective measures against	• Frequency inverter overtemperature • Over and undervoltage	• Short circuit, earth fault • Overload
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic curve, VFC open-loop CFC open-loop, CFC closed-loop	
Motor temperature monitoring	I^2t motor (UL approved), PTC / bimetallic switch	
Interfaces (integrated)	RS485 (USS / Modbus RTU) RS232 (single slave) USB (SK 530P and higher)	CANopen SK 550P and higher: PROFINET IO, EtherCAT, Ethernet/IP, POWERLINK
Electrical isolation	Control terminals (digital and analogue inputs)	
Connection terminals	Details and tightening torques of screw terminals (Chap. 2.5.3)and (Chap. 2.5.4).	
External supply voltage	18 … 30 V DC, ≥ 800 mA	
Analogue setpoint input / PID input	2 x 0 … 10 V, 0/4...20 mA, scalable, digital 7.5 ... 30 V	
Analogue setpoint resolution	12 bit based on measurement range	
Setpoint consistency	Analogue < 1%, digital < 0.02 %	
Digital input	5 x (2.5 V) 7.5 ... 30 V, Ri = (2.2 kΩ) 6.1 kΩ, cycle time = 1 ... 2 ms + SK 530P and higher: 1 x 7.5 30 V, Ri = 6.1 kΩ, cycle time = 1 .. . 2 ms	
Control outputs	2 x relay 28 VDC / 230 VAC, 2 A (output 1/2 - K1/K2) SK 530P and higher: 2 x DOUT 24 V, 20 mA	
Analog output	U = 0 ... 10 V; I = 0 … 20 mA scalable	

7.2 Technical data for determining the energy efficiency level

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

Information

Calculation basis for the energy efficiency level

The energy efficiency specifications come from calculations according to **DIN EN 61800** *"Adjustable speed electrical power drive systems – Part 9-2: Ecodesign for power drive systems, motor starters, power electronics and their driven applications – Energy efficiency indicators for power drive systems and motor starters"*.

Simplifications are included in the calculation methods of the standard!

Manufact	FI type	Rel. losses [1] (rel. motor stator frequency / rel. torque-producing current)								Standby [2]	Standby [2] (UKCA)	IE rating
		90/100	90/50	50/100	50/50	50/25	0/100	0/50	0/25			
	NORDAC *PRO* SK 5xxP-	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[W]	[%]	
Getriebebau NORD GmbH & Co. KG	250-340	7,7	7,0	7,2	6,8	6,7	6,9	6,6	6,6	7,5	2,99	IE2
	370-340	6,5	5,6	5,9	5,4	5,3	5,6	5,3	5,3	7,5	2,02	IE2
	550-340	4,7	3,9	4,2	3,7	3,6	3,9	3,6	3,6	7,5	1,36	IE2
	750-340	4,1	3,1	3,5	2,9	2,7	3,2	2,8	2,7	7,5	1,00	IE2
	111-340	4,2	3,2	3,6	3,0	2,7	3,3	2,9	2,7	7,1	0,65	IE2
	151-340	3,8	2,7	3,2	2,5	2,2	2,9	2,4	2,2	7,1	0,47	IE2
	221-340	3,4	2,3	2,8	2,1	1,8	2,4	2,0	1,8	7,1	0,32	IE2
	301-340	3,3	2,2	2,7	2,0	1,7	2,3	1,9	1,7	7,9	0,26	IE2
	401-340	3,6	2,5	3,0	2,3	2,0	2,7	2,2	2,0	7,9	0,20	IE2
	551-340	3,0	1,9	2,4	1,7	1,5	2,1	1,6	1,4	7,9	0,14	IE2
	751-340	2,9	2,0	2,7	1,9	1,7	2,7	1,9	1,6	9,6	0,13	IE2
	112-340	3,1	2,1	3,0	2,0	1,7	2,9	2,0	1,7	10,6	0,10	IE2
	152-340	2,7	1,7	2,5	1,7	1,4	2,5	1,6	1,4	13,9	0,09	IE2
	182-340	2,9	1,9	2,8	1,8	1,5	2,7	1,8	1,5	14,0	0,08	IE2
	222-340	2,8	1,8	2,7	1,8	1,4	2,7	1,7	1,4	17,8	0,08	IE2
	302-340	3,0	1,5	2,4	1,4	1,1	2,0	1,3	1,0	22,7	0,08	IE2
	372-340	2,9	1,5	2,3	1,3	1,0	2,0	1,2	1,0	22,7	0,06	IE2
	452-340	2,5	1,2	1,8	1,0	0,7	1,4	0,9	0,7	20,5	0,05	IE2
	552-340	2,6	1,2	1,9	1,0	0,7	1,5	0,9	0,7	20,5	0,04	IE2
	752-340	2,6	1,2	1,8	0,9	0,7	1,4	0,8	0,6	25,5	0,03	IE2
	902-340	2,7	1,2	1,9	1,0	0,7	1,5	0,8	0,6	25,5	0,03	IE2
	113-340	1,7	0,9	1,4	0,8	0,5	1,2	0,7	0,5	47,3	0,04	IE2
	133-340	1,9	1,0	1,6	0,9	0,6	1,4	0,8	0,6	48,1	0,04	IE2
	163-340	2,0	1,0	1,7	0,9	0,6	1,4	0,8	0,6	49,8	0,03	IE2

1) Power losses in % of the rated apparent output power

2) Standby losses in % of the rated output power

7.3 Electrical data

The following tables contain the data which is relevant for UL

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

By use of a mains choke, the input current is reduced to approximately the value of the output current (Chap. 2.4.1.2 "SK CI1 and SK CI5 mains chokes").

7.3.1 Electrical data 230 V

Device type	SK 5xxP	-250-123-	-370-123-	-550-123-	-750-123-	
	Size	1	1	1	1	
Nominal motor power (4-pole standard motor)	230 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	
	240 V	1/3 hp	½ hp	¾ hp	1 hp	
Mains voltage	230 V	1 AC 200 … 240 V, ± 10%, 47 … 63 Hz				
Input current	rms	4.2 A	5.2 A	6.5 A	8.5 A	
	FLA	4.1 A	5.1 A	6.4 A	8.3 A	
Output voltage	230 V	3 AC 0 – Mains voltage				
Output current	rms	1.7 A	2.4 A	3.2 A	4.2 A	
	FLA	1.7 A	2.4 A	3.1 A	4.1 A	
Min. braking resistor	Accessories	240 Ω	190 Ω	140 Ω	100 Ω	
Pulse frequency	Range	4 – 16 kHz				
	Factory setting	6 kHz				
Max. ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	
	S3 70%, 10 min.	50 °C	50 °C	50 °C	50 °C	
Type of ventilation		Free convection		Blower, temperature-controlled Switching thresholds: 1) ON = 57 °C, OFF = 47 °C		
		General fuses (AC) (recommended)				
	Slow-blowing	6 A	6 A	10 A	10 A	

						Fuse Type		I_{sc} kA 2)		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
x				J					x	6 A	8 A	10 A	15 A	
x					x			x		15 A	15 A	15 A	20 A	
		x				x		x		15 A	20 A	–	–	
		x					x	x		–	–	25 A	35 A	

1) Short test run after connection of the mains voltage

2) Maximum permissible mains short circuit current with mains

Device type	SK 5xxP	-111-123-	-151-123-	-221-123-		
	Size	2	2	2		
Nominal motor power (4-pole standard motor)	230 V	1.1 kW	1.5 kW	2.2 kW		
	240 V	1.5 hp	2 hp	3 hp		
Mains voltage	230 V	1 AC 200 … 240 V, ± 10%, 47 … 63 Hz				
Input current	rms	12.7 A	16.8 A	22.4 A		
	FLA	12.4 A	16.5 A	22.0 A		
Output voltage	230 V	3 AC 0 – Mains voltage				
Output current	rms	5.7 A	7.3 A	9.6 A		
	FLA	5.6 A	7.2 A	9.5 A		
Min. braking resistor	Accessories	75 Ω	62 Ω	46 Ω		
Pulse frequency	Range	4 – 16 kHz				
	Factory setting	6 kHz				
Max. ambient temperature	S1	40 °C	40 °C	40 °C		
	S3 70%, 10 min	50 °C	50 °C	50 °C		
Type of ventilation		Blower, temperature-controlled Switching thresholds: 1) ON = 57 °C, OFF = 47 °C				
		General fuses (AC) (recommended)				
Slow-blowing		16 A	20 A	20 A		

						Fuse Type		I_{sc} kA 2)		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
x				J					x	20 A	25 A	30 A		
		x					x	x		50 A	70 A	90 A		
x					x			x		25 A	30 A	30 A		

1) Short test run after connection of the mains voltage

2) Maximum permissible mains short circuit current with mains

7.3.2 Electrical data 400 V

Device type	SK 5xxP…	-250-340-	-370-340-	-550-340-	-750-340-	-111-340-
	Size	1	1	1	1	2
Nominal motor power (4-pole standard motor)	400 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	1.1 kW
	480 V	1/3 hp	½ hp	¾ hp	1 hp	1½ hp
Output power	kVA	0.5	0.7	1.0	1.3	1.7
Mains voltage	400 V	EN: 3 AC 380 … 480 V, -20% / +10%, 47 … 63 Hz UL: 3 AC 380Y/220...480Y/277 V -20%/+10% 47-63 Hz				
Input current	rms	1.1 A	1.3 A	1.8 A	2.3 A	3.3 A
	FLA	1.0 A	1.2 A	1.7 A	2.1 A	3.0 A
Output voltage	400 V	3 AC 0 – Mains voltage				
Output current	rms	1.0 A	1.3 A	1.8 A	2.4 A	3.1 A
	FLA	0.9 A	1.2 A	1.6 A	2.2 A	2.9 A
Min. braking resistor	Accessories	390 Ω	390 Ω	390 Ω	300 Ω	220 Ω
Pulse frequency	Range	4 – 16 kHz				
	Factory setting	6 kHz				
Max. ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	40 °C
	S3 70%, 10 min.	50 °C	50 °C	50 °C	50 °C	50 °C
Type of ventilation		Free convection		Blower, temperature-controlled Switching thresholds:[1] ON = 57 °C, OFF = 47 °C		
		General fuses (AC) (recommended)				
	Slow-blowing	6 A	6 A	6 A	6 A	6 A

						Fuse Type		I_{sc} kA [2]		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J					x	6 A	6 A	6 A	6 A	10 A
	x				x			x		15 A	15 A	15 A	15 A	15 A
			x			x		x		10 A	10 A	10 A	10 A	–
			x				x	x		–	–	–	–	35 A

1) Short test run after connection of the mains voltage

2) Maximum permissible mains short circuit current with mains

– Not available!

Device type	**SK 5xxP…**	**-151-340-**	**-221-340-**	**-301-340-**	**-401-340-**	**-551-340-**
	Size	**2**	**2**	**3**	**3**	**3**
Nominal motor power (4-pole standard motor)	400 V	1.5 kW	2.2 kW	3.0 kW	4.0 kW	5.5 kW
	480 V	2 hp	3 hp	4 hp	5 hp	7.5 hp
Output power	kVA	2.3	3.3	4.4	5.9	7.9
Mains voltage	400 V	EN: 3 AC 380 … 480 V, -20% / +10%, 47 … 63 Hz UL: 3 AC 380Y/220...480Y/277 V -20%/+10% 47-63 Hz				
Input current	rms	4.3 A	6.6 A	8.4 A	10.8 A	14.9 A
	FLA	4.0 A	6.1 A	7.7 A	9.9 A	13.7 A
Output voltage	400 V	3 AC 0 – Mains voltage				
Output current	rms	4.0 A	5.6 A	7.5 A	9.5 A	12.5 A
	FLA	3.7 A	5.2 A	7.0 A	8.9 A	11.6 A
Min. braking resistor	Accessories	180 Ω	130 Ω	91 Ω	74 Ω	60 Ω
Pulse frequency	Range	4 – 16 kHz				
	Factory setting	6 kHz				
Ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	40 °C
	S3 70%, 10 min.	50 °C	50 °C	50 °C	50 °C	50 °C
Type of ventilation		Blower, temperature-controlled Switching thresholds:[1]; ON = 57 °C, OFF = 47 °C				
		General fuses (AC) (recommended)				
	Slow-blowing	6 A	10 A	10 A	16 A	16 A

						Fuse Type		I_{sc} kA [2]		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J					x	10 A	15 A	25 A	30 A	30 A
	x			RK5				x		–	–	25 A	30 A	30 A
	x				x			x		15 A	15 A	25 A	30 A	30 A
			x				x	x		35 A	35 A	60 A	60 A	60 A

1) Short test run after connection of the mains voltage

2) Maximum permissible mains short circuit current with mains

– Not available!

Device type	SK 5xxP…	-751-340-	-112-340-	-152-340-	-182-340-	-222-340-
	Size	4	4	5	5	5
Nominal motor power (4-pole standard motor)	400 V	7.5 kW	11 kW	15 kW	18.5 kW	22 kW
	480 V	10 hp	15 hp	20 hp	25 hp	30 hp
Output power	kVA	10.0	14.4	19.5	23.9	28.3
Mains voltage	400 V	EN: 3 AC 380 … 480 V, -20% / +10%, 47 … 63 Hz UL: 3 AC 380Y/220...480Y/277 V -20%/+10% 47-63 Hz				
Input current	rms	20.5 A	29.1 A	40.4 A	48.5 A	59.1 A
	FLA	18.8 A	26.7 A	37.0 A	44.5 A	54.2 A
Output voltage	400 V	3 AC 0 – Mains voltage				
Output current	rms	16.0 A	24.0 A	31.0 A	38.0 A	46.0 A
	FLA	14.9 A	21.0 A	27.0 A	34.0 A	40.0 A
Min. braking resistor	Accessories	44 Ω	29 Ω	23 Ω	18 Ω	15 Ω
Pulse frequency	Range	4 – 16 kHz				
	Factory setting	6 kHz				
Ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	40 °C
	S3 70%, 10 min.	50 °C	50 °C	50 °C	50 °C	50 °C
Type of ventilation		Blower, temperature-controlled Switching thresholds:[1]; ON = 57 °C, OFF = 47 °C				
		General fuses (AC) (recommended)				
	Slow-blowing	25 A	35 A	50 A	50 A	63 A

						Fuse Type		I_{sc} kA [2]		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J				x		75 A	100 A	–	–	–
	x				x			x		75 A	100 A	125 A	125 A	125 A

1) Short test run after connection of the mains voltage

2) Maximum permissible mains short circuit current with mains

– Not available!

Device type	SK 5xxP…	-302-340-	-372-340-	-452-340-	-552-340-	-752-340-
	Size	6	6	7	7	8
Nominal motor power (4-pole standard motor)	400 V	30.0 kW	37 kW	45 kW	55 kW	75 kW
	480 V	40 hp	50 hp	60 hp	75 hp	100 hp
Output power	kVA	tbd	tbd	tbd	tbd	tbd
Mains voltage	400 V	EN: 3 AC 380 … 480 V, -20% / +10%, 47 … 63 Hz UL: 3 AC 380Y/220...480Y/277 V -20%/+10% 47-63 Hz				
Input current	rms	83.9 A	101.5 A	126.0 A	154.0 A	210.0 A
	FLA	76.9 A	93.0 A	107.8 A	134.4 A	173.6 A
Output voltage	400 V	3 AC 0 – Mains voltage				
Output current	rms	60.0 A	75.0 A	90.0 A	110.0 A	150.0 A
	FLA	52.0 A	68.0 A	77.0 A	96.0 A	124.0 A
Min. braking resistor	Accessories	11 Ω	9 Ω	8 Ω	8 Ω	6 Ω
Pulse frequency	Range	4 – 16 kHz		3 – 8 kHz		
	Factory setting	6 kHz		4 kHz		
Ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	40 °C
	S3 70%, 10 min.	–	–	–	–	–
Type of ventilation		Blower, temperature-controlled Switching thresholds:[1]				
		ON = 57 °C, OFF = 47 °C		ON = 56 °C, OFF = 52 °C		
	Blower speed control	Between 47 °C (52 °C) and approx. 70 °C [2]				
		General fuses (AC) (recommended)				
	Slow-blowing	100 A	125 A	160 A	160 A	224 A

						Fuse Type		I_{sc} kA [3]		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J				x		–	–	–	–	–
	x				x			x		–	–	–	–	–

1) Short test run after connection of the mains voltage

2) In case of frequency inverter overload, the fan speed is increased to 100% regardless of the actual device temperature.

3) Maximum permissible mains short circuit current with mains

– Not available!

tbd Not defined yet.

Device type	SK 5xxP…	-902-340-	-113-340-	-133-340-	-163-340-	
	Size	8	9	9	10	
Nominal motor power (4-pole standard motor)	400 V	90 kW	110 kW	132 kW	160 kW	
	480 V	125 hp	150 hp	180 hp	220 hp	
Output power	kVA	tbd	tbd	tbd	tbd	
Mains voltage	400 V	EN: 3 AC 380 … 480 V, -20% / +10%, 47 … 63 Hz UL: 3 AC 380Y/220...480Y/277 V -20%/+10% 47-63 Hz				
Input current	rms	252 A	308 A	364 A	448 A	
	FLA	218.4 A	252 A	300 A	370 A	
Output voltage	400 V	3 AC 0 – Mains voltage				
Output current	rms	180 A	220 A	260 A	320 A	
	FLA	156 A	180 A	216 A	264 A	
Min. braking resistor	Accessories	6 Ω	3.2 Ω	3 Ω	2.6 Ω	
Pulse frequency	Range	3 – 8 kHz				
	Factory setting	4 kHz				
Ambient temperature	S1	40 °C	40 °C	40 °C	40 °C	
	S3 70%, 10 min.	–	–	–	–	
Type of ventilation		Blower, temperature-controlled Switching thresholds:[1]; ON = 56 °C, OFF = 52 °C				
Blower speed control		Between 52 °C and approx. 70 °C [2]	No speed control! [3]			
		General fuses (AC) (recommended)				
Slow-blowing		315 A	350 A	350 A	400 A	

						Fuse Type		I_{sc} kA [4]		**UL fuses (AC) UL approved**				
240 V AC	480 V AC	410 V DC	715 V DC	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J				x		–	–	–	–	–
	x				x			x		–	–	–	–	

1) Short test run after connection of the mains voltage

2) In case of frequency inverter overload, the fan speed is increased to 100% regardless of the actual device temperature.

3) The fans turn on sequentially (interval of approx. 1.8 s)

4) Maximum permissible mains short circuit current with mains

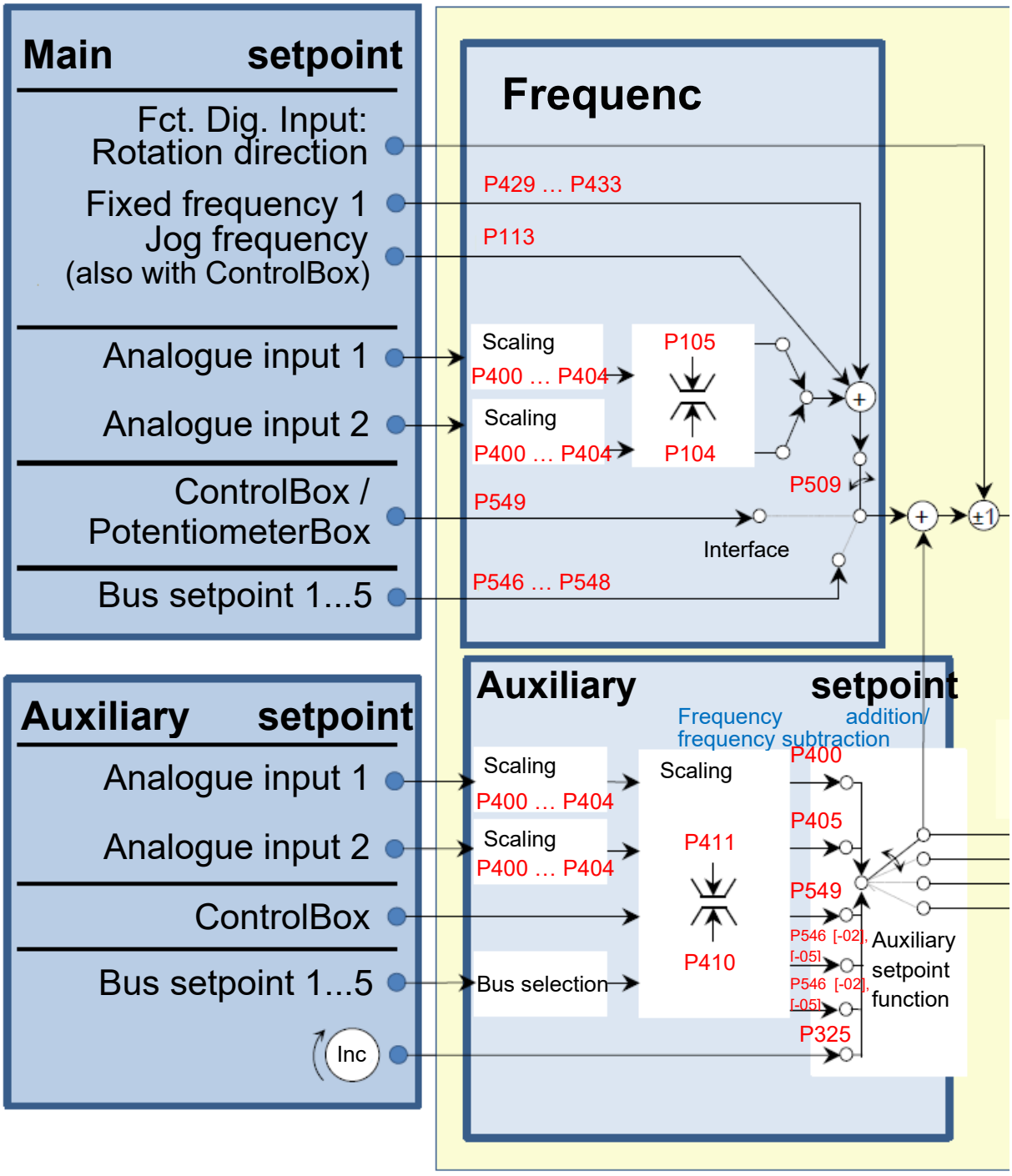
– Not available!

tbd Not defined yet.

8 Additional information

8.1 Setpoint processing

Representation of the setpoint processing.



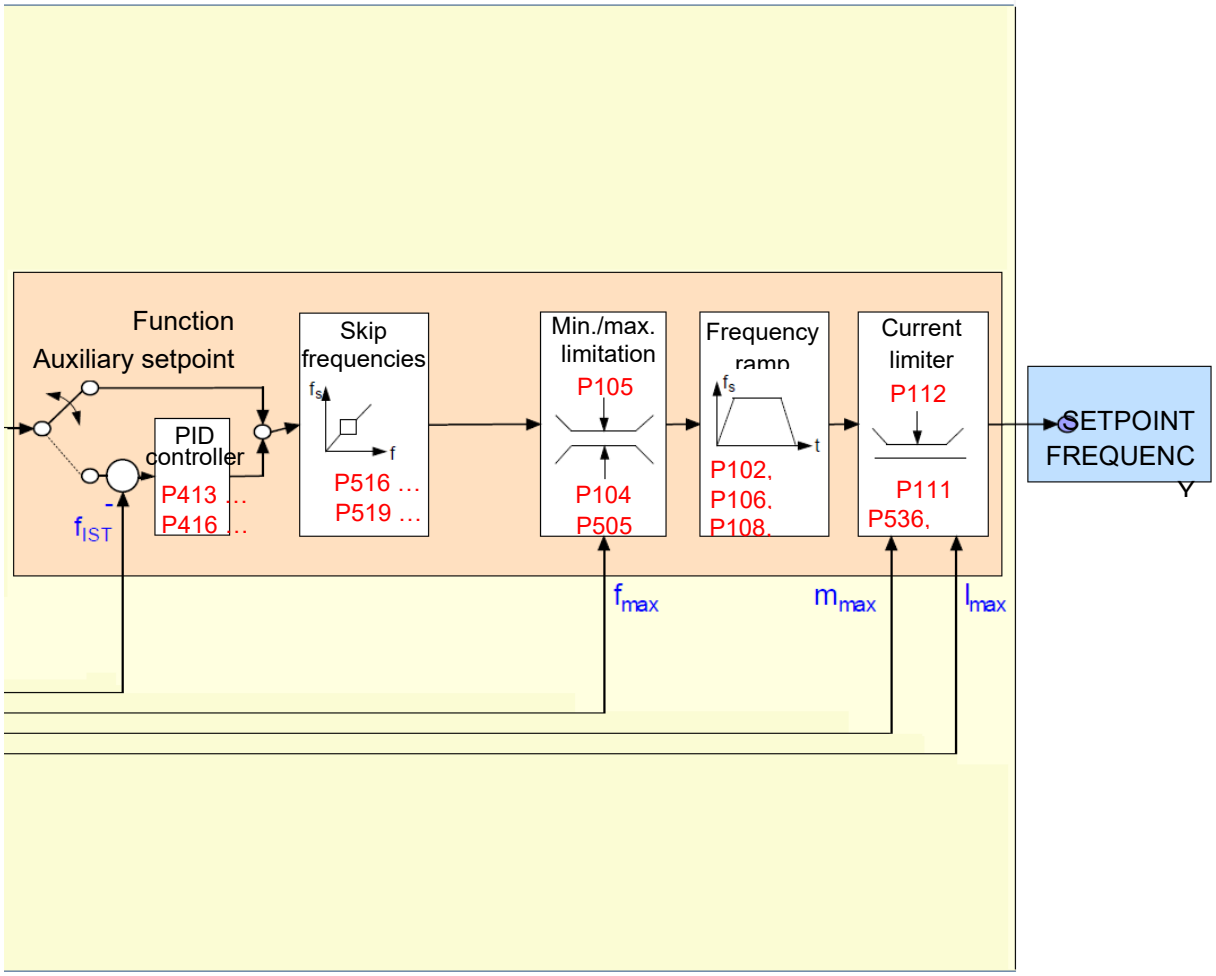
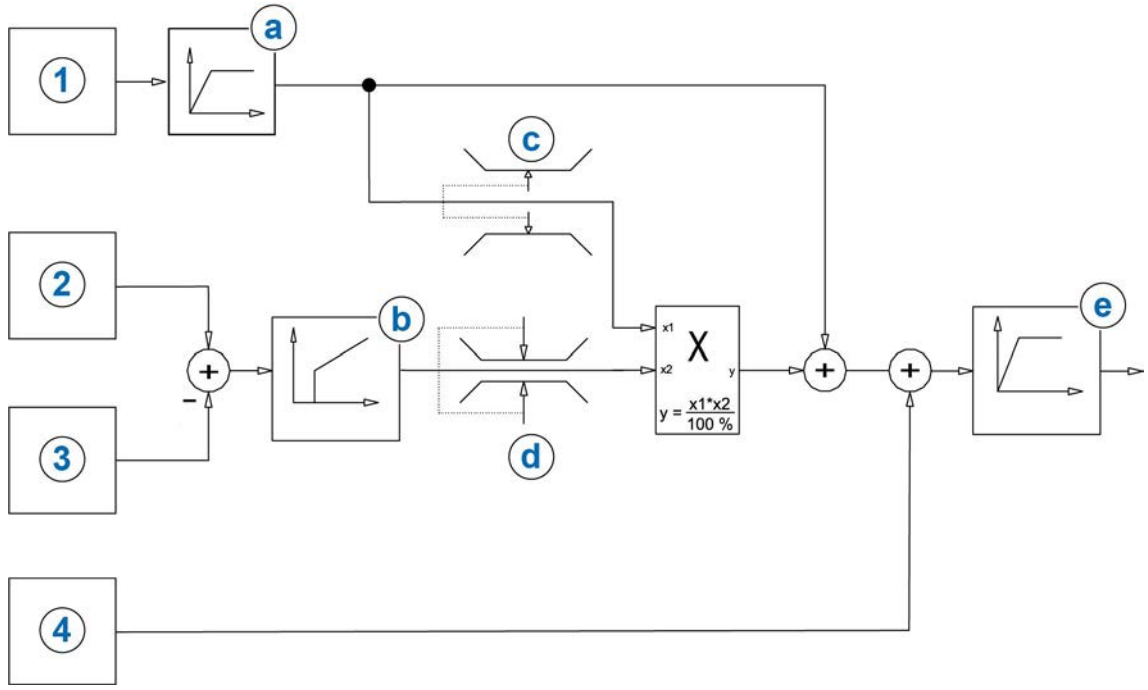


Illustration 7: Setpoint processing

8.2 Process controller

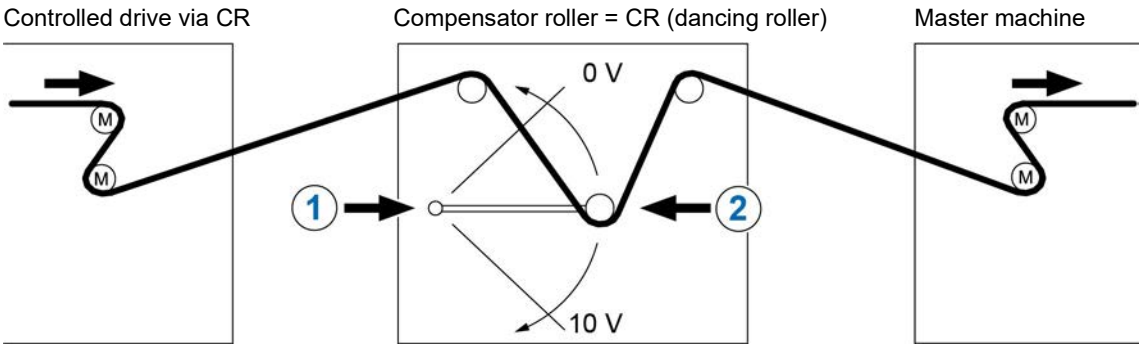
The process controller is a PI controller, with which the controller output can be limited. In addition, the output is scaled to a master setpoint on a percentage basis. This way, you can control a downstream drive with the master setpoint, and readjust with the PI controller.



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**

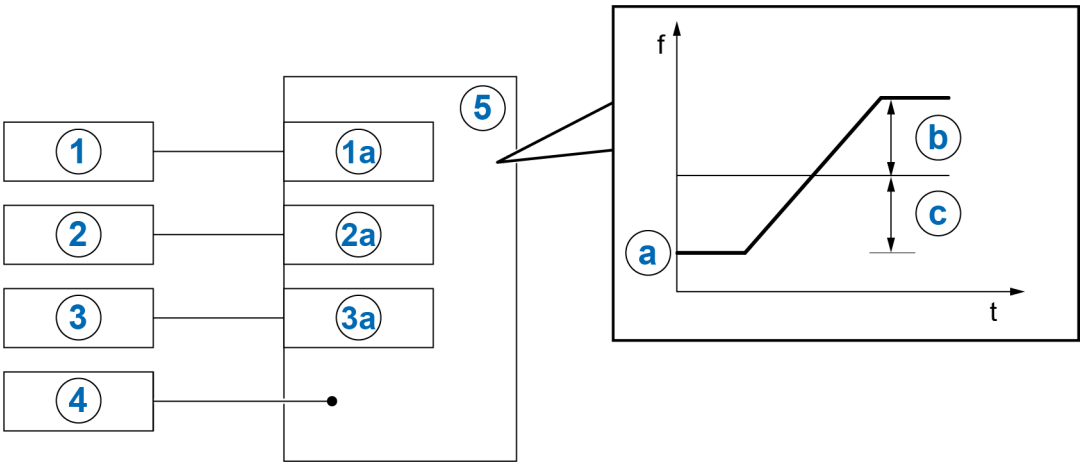
Figure 8: Flow chart: Process controller

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 9: Sample application: Dancing roller

8.2.2 Process controller parameter settings

Example: SK 500P, setpoint frequency: 50 Hz, control limits: ±25%

P105 (Maximum frequency) [Hz]	$\geq Set\ freq.[Hz] + \left(\frac{Set\ freq.[Hz] \times P415[\%]}{100\%}\right)$ Example: $\geq 50\ Hz + \frac{50\ Hz \times 25\%}{100\%} =$ **62.5 Hz**
P400 [-01] (Analog input func. 1):	**"4"** (Frequency addition)
P411 (setpoint frequency) [Hz]	Setpoint frequency with 10 V at analogue input 1 Example: **50 Hz**
P412 (nominal value process controller):	CR mid-range setting / Factory setting **5%** (adjust if necessary)
P413 (P controller) [%]:	Factory setting **10%** (adjust if necessary)
P414 (I controller) [% ms^{-1}]:	Recommended **100**% s^{-1}
P415 (limitation ±) [%]	Controller limitation (see above) **Note:** In the process controller function, parameter P415 is used as a controller limiter downstream from the PI controller. This parameter therefore has a double function. Example: **25%** of the setpoint
P416 (ramp before controller) [s]:	Factory setting **2 s** (if necessary, adjust to match control behaviour)
P420 (Digital input func. 1):	**"1"** Enable right
P400 [-02] (Analog input func. 2):	**"14"** Cur.val process ctrl

8.3 Electromagnetic compatibility (EMC)

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

8.3.1 General Provisions

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

1. *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 16: 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 (Chap. 8.3.2 "EMC evaluation").

- Use of shielded motor cables is essential in order to comply with 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.

Information

EMC kits

To reduce EMC interference according to the EMC Directive, so-called EMC kits may be used, which can be mounted on the appropriate places on the frequency inverter (see chapter 2.2 "EMC kit").

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 motor cable shielding must be connected to both sides (frequency inverter shield bracket and the metal motor terminal box). Depending on the device version (...-A or ...-O) and according to the type and use of mains filters or chokes, different permissible motor cable lengths result for compliance with the declared limit value classes.

Information

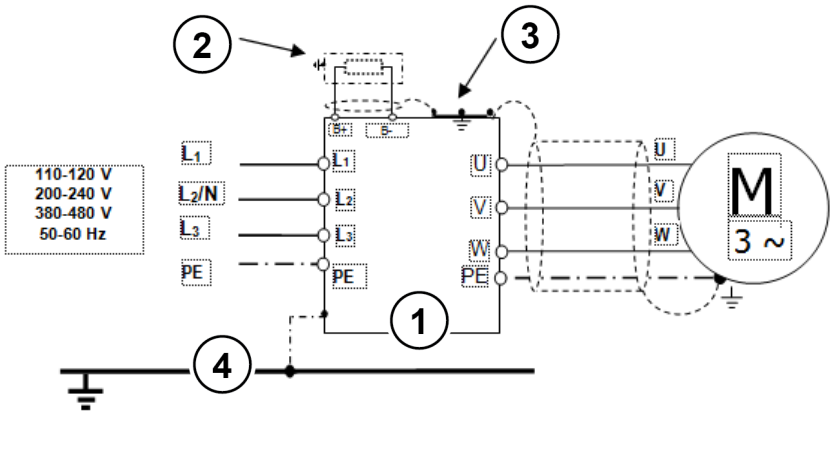
For connection of shielded motor cables with a length > 20 m, the current monitoring may respond, in particular with low-power frequency inverters, so that use of an output choke (SK CO5…) is also necessary.

Device type	Conducted emissions 150 kHz – 30 MHz		
	Class C3	Class C2	Class C1
SK 5xxP-250-123-A … SK 5xxP-550-123-A	-	20 m	-
SK 5xxP-750-123-A … SK 5xxP-221-123-A	-	20 m	5 m
SK 5xxP-250-340-A … SK 5xxP-550-340-A	-	20 m	-
SK 5xxP-750-340-A … SK 5xxP-551-340-A	-	20 m	5 m
SK 5xxP-751-340-A … SK 5xxP-222-340-A	-	20 m	-
SK 5xxP-302-340-A … SK 5xxP-163-340-A	20 m	-	-

Table 17: EMC, max. shielded motor cable length with regard to compliance with the limit value classes

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
		C1
Radiated emission (interference field strength)	EN 55011	C2
		-
Interference immunity EN 61000-6-1, EN 61000-6-2		
ESD, discharge of static electricity	EN 61000-4-2	6 kV (CD), 8 kV (AD)
EMF, high frequency electro-magnetic fields	EN 61000-4-3	10 V/m; 80 – 1000 MHz
Burst on control cables	EN 61000-4-4	1 kV
Burst on mains and motor cables	EN 61000-4-4	2 kV
Surge (phase-phase / phase-ground)	EN 61000-4-5	1 kV / 2 kV
Cable-led interference due to high frequency fields	EN 61000-4-6	10 V, 0.15 – 80 MHz
Voltage fluctuations and drops	EN 61000-2-1	+10 %, -15 %; 90 %
Voltage asymmetries and frequency changes	EN 61000-2-4	3 %; 2 %

Table 18: Overview according to product standard EN 61800-3



1	FI
2	Brake resistance (option)
3	shield angle
4	Functional earthing
PE	Protective earth

Figure 10: Wiring recommendation

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

C310601_0122

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 of the product series NORDAC PRO

- **SK 500P-xxx-123-.-.. , SK 500P-xxx-340-.-..**
  (xxx= 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751, 112, 152, 182, 222)
  also in these functional variants:
  SK 510P-... , SK 530P-... , SK 540P-... , SK 550P-...

  and the further options/accessories:
  SK TU5-... , SK CU5-... , SK PAR-3. , SK CSX-3. , SK SSX-3A, SK POT1-. , SK EBIOE-2, SK EBGR-1, SK TIE5-BT-STICK, SK EMC5-. , SK DRK5-. , SK BRU5-.-... , SK BR2-... , SK CI5-... , SK CO5-... , HLD 110-500/..

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 2019.

Bargteheide, 07.01.2022

U. Küchenmeister
Managing Director

pp F. Wiedemann
Head of Inverter Division

For devices with outputs greater than 22 kW in preparation.

NORD GEAR LIMITED

Member of the NORD DRIVESYSTEMS GROUP

NORD Gear Limited
11 Barton Lane, Abingdon, Oxfordshire, United Kingdom OX14 3NB | Tel. No.: +44 1235 534404 | Email: GB-Sales@nord.com

DoC number C350601_0123_EN_UKCA

Declaration of Conformity

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

SK 500P-xxx-123-.-.., SK 500P-xxx-340-.-..
(xxx = 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751, 112, 152, 182, 222)
also in functional variants:
SK 510P-..., SK 530P-..., SK 540P-..., SK 550P-...

and further options/accessories:
SK TU5-..., SK CU5-..., SK PAR-3., SK CSX-3., SK SSX-3A, SK POT-., SK EBIOE-2, SK EBGR-1, SK TIES-BT-STICK, SM EMC5-., SK DRK5-., SK BRU5-.-..., SK BR2-..., SK CI5-..., SK CO5-..., HLD 110-500/..

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, 11.01.2023

Andrew Stephenson
Managing Director

For devices with outputs greater than 22 kW in preparation.

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.

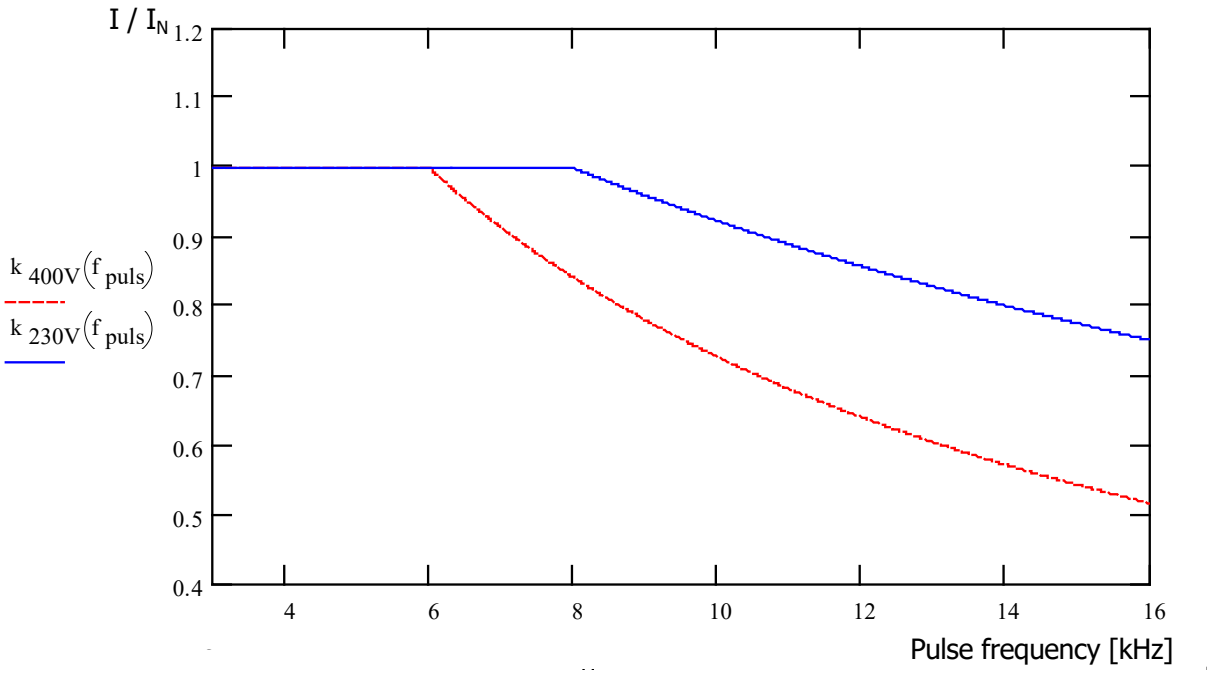


Figure 11: Heat losses due to pulse frequency

8.4.2 Reduced overcurrent due to time

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

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

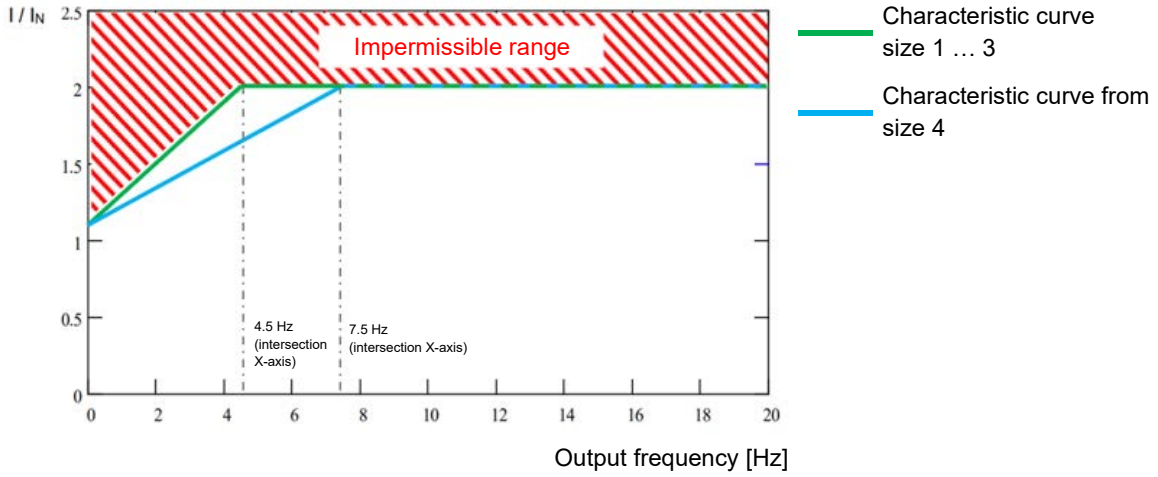
230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...8	110%	150%	170%	180%	180%	200%
10	103%	140%	155%	165%	165%	180%
12	96%	130%	145%	155%	155%	160%
14	90%	120%	135%	145%	145%	150%
16	82%	110%	125%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

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

Table 19: 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, from size 4 < 7.5 Hz), monitoring is provided to determine the temperature of the IGBTs (*insulated-gate bipolar transistor*) by means of high current. A pulse disconnection (**P537**) with variable limit is introduced so that no current can be assumed above the limit shown in the diagram. At standstill with 6 kHz pulse frequency, no current can thus be assumed 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 (10 ... 201) that can be set in parameter **P537** is limited to the value specified in the tables depending on the pulse frequency. Values below the limit can be adjusted as required.

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

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

400 V devices: Reduced overload capability (approx.) due to pulse frequency (**P504**) and output frequency **from size 4**								
Pulse frequency [kHz]	Output frequency [Hz]							
	7.5	6	5	4	3	2	1	0
3 ... 6	200%	180%	170%	155%	145%	130%	120%	110%
8	169%	152%	143%	131%	122%	110%	101%	93%
10	146%	131%	124%	113%	106%	95%	87%	80%
12	128%	115%	109%	99%	93%	83%	77%	71%
14	115%	103%	97%	89%	83%	74%	69%	63%
16	103%	93%	88%	80%	75%	67%	62%	57%

Table 20: 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.

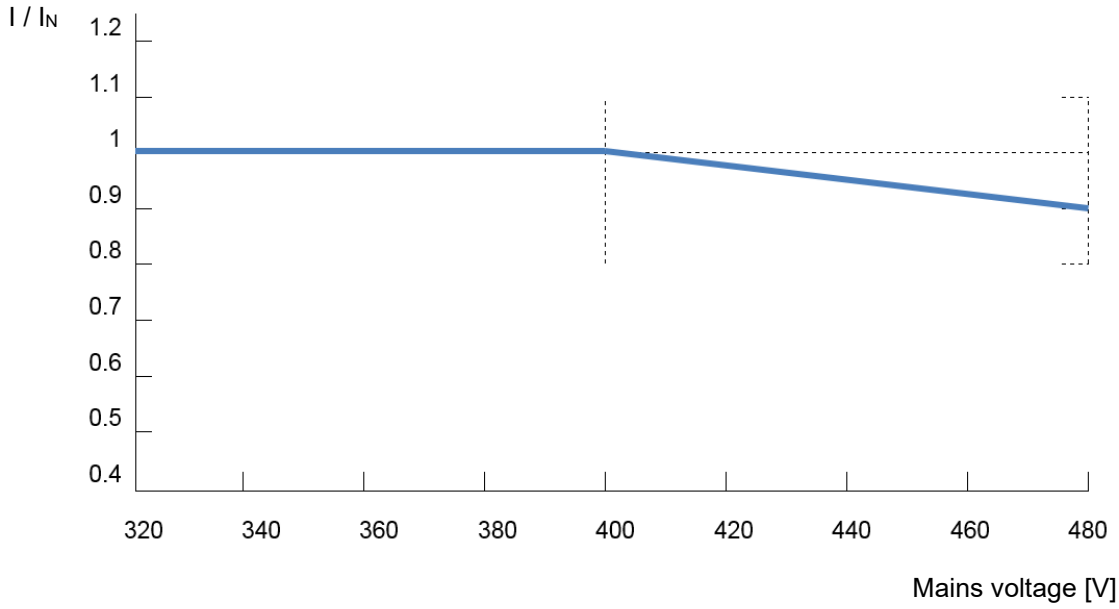


Figure 12: Reduced output current due to low voltage

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 Data")and Chapter 2.5.3.2 "Mains connection".

8.6 NORD system bus

8.6.1 Description

Communication between the various devices from Getriebebau NORD GmbH & Co. KG (frequency inverters and optional modules) and other accessories (absolute encoders) is carried out via a separate NORD system bus. The NORD system bus is a CAN field bus; communication is via the CANopen protocol. There are restrictions for the use of the system bus interface for SK 500P and SK 510P. These can be obtained from the following table:

Function	SK 500P/SK 510P	SK 530P/SK 540P	SK 550P
SK EBIOE-2/CU4//TU4-IOE	No	Yes	Yes
SK CU4-TU4-PBR as PROFIBUS gateway	No	Yes	Not advisable → Industrial Ethernet on board
CANopen absolute encoders	Yes	Yes	Yes
Master function – Master/slave	Yes	Yes	Yes
NORDCON tunnelling	Only passive	Yes	Yes
Industrial Ethernet gateway	Slave	Slave	Master

If a frequency inverter with an integrated, Ethernet-based field bus interface (SK 550P) is connected to further devices via the system bus, these can also be indirectly integrated into the field bus communication without a separate field bus interface. Several frequency inverters can be accessed via an SK 550P.

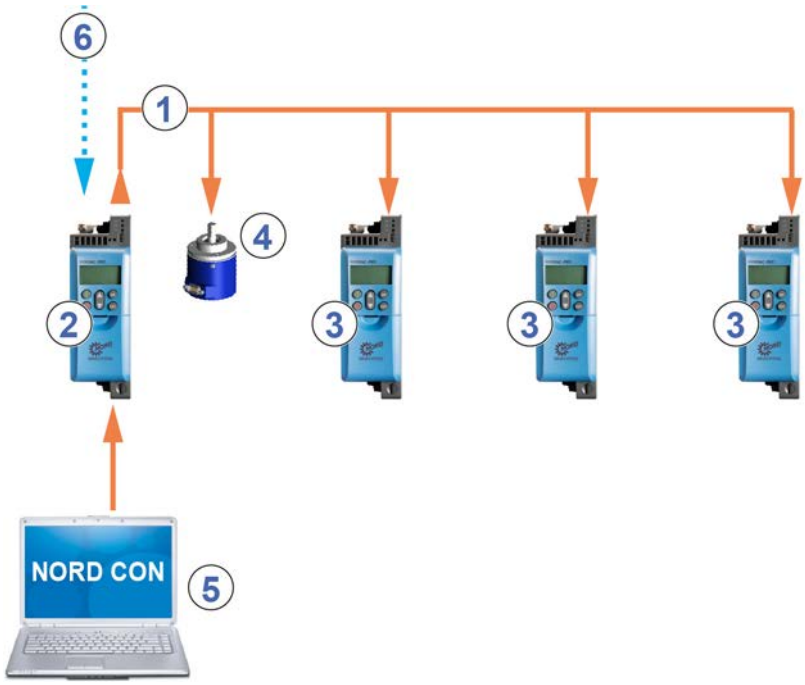


Figure 13: Example of the structure of a NORD system bus

Item	Description
1	NORD system bus (CAN field bus)
2	Frequency inverter with integrated, Ethernet-based SK 550P field bus interface
3	SK 5x0P frequency inverter
4	CANopen absolute encoder
5	NORDCON computer (on Windows®-based PC, on which the NORDCON parameterisation and control software is installed)
6	Field bus

8.6.2 NORD system bus participants

Up to 4 frequency inverters with the associated absolute encoders can be integrated into the NORD system bus. All participants on the NORD system bus must be assigned with a unique address (Node ID). The addresses of the frequency inverters are set with parameter **P515 [-01]** *"CAN bus address"*.

The address of connected standard absolute encoders from NORD is set via DIP switches. Absolute encoders must be assigned directly to a frequency inverter. This is carried out using the following equation:

Absolute encoder address = CAN bus address of the frequency inverter + 1

This results in the following matrix:

Device	FI1	AE1	FI2	AE2	…
Node ID (CAN bus address)	32	33	34	35	…

The termination resistor must be activated on the first and last participant in the system bus (📖 Frequency inverter manual). The bus speed of the frequency inverter must be set to "250 kbaud" (**P514** *"CAN bus baud rate"*). This also applies to any absolute encoders which are connected.

8.6.3 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 (switchable via DIP switches)
Baud rate	250 kBaud

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.

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).

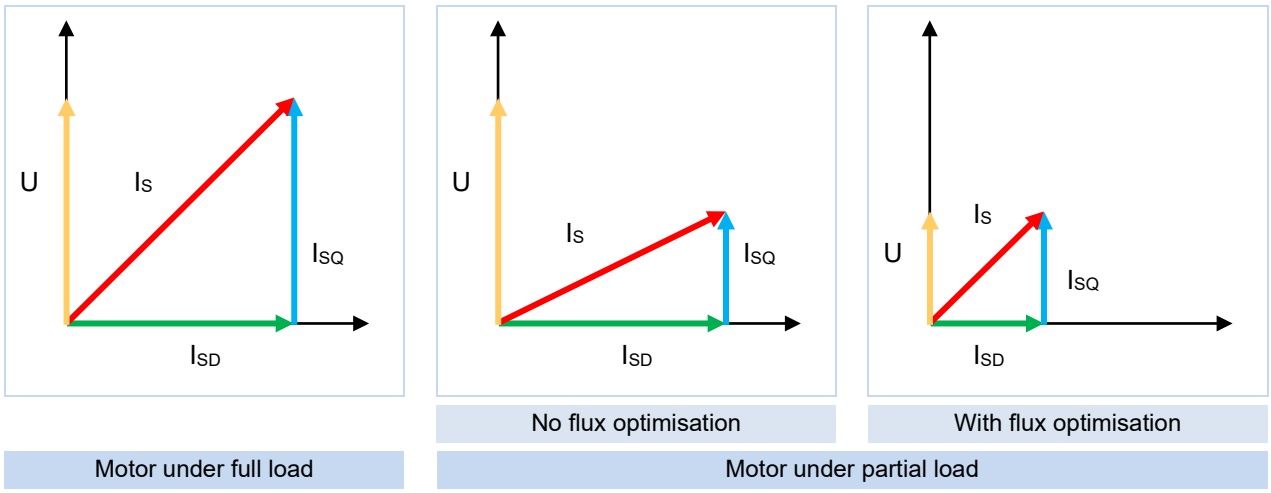
To prevent risk, the following must be observed:

- 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 14: 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 4.1 "Factory settings"). For operation with a 100 Hz characteristic curve, the use of specially calculated motor data is required (🕮 Section 8.8.3 "100 Hz characteristic curve (only 400 V devices)").

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.

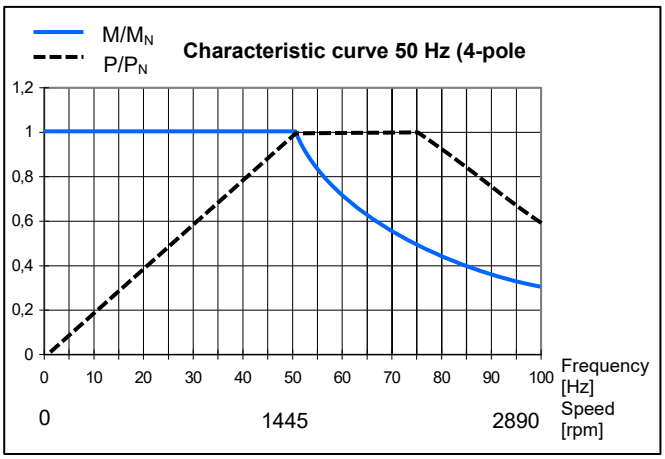


Figure 15: Characteristic curve 50 Hz

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**.

115 V / 230 V – frequency inverter

For 115 V devices, the input voltage is doubled in the device so that the required maximum output voltage of 230 V is achieved for the device.

The following data refers to a 230 V/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 5xxP-…**	**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	250-x23-	1,73	50	1365	1,3	230	0,25	0,79	Δ	39,9
71L/4	370-x23-	2,56	50	1380	1,89	230	0,37	0,71	Δ	22,85
80S/4	550-x23-	3,82	50	1385	2,62	230	0,55	0,75	Δ	15,79
80L/4	750-x23-	5,21	50	1395	3,52	230	0,75	0,75	Δ	10,49
90S/4	111-x23-	7,53	50	1410	4,78	230	1,1	0,76	Δ	6,41
90L/4	151-323-	10,3	50	1390	6,11	230	1,5	0,78	Δ	3,99
100L/4	221-323-	14,6	50	1415	8,65	230	2,2	0,78	Δ	2,78

1) At the rating point

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 5xxP-…**	**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
160M/4	112-340-	72,2	50	1455	20,9	400	11,0	0,85	Δ	1,08
160L/4	152-340-	98,1	50	1460	28,2	400	15,0	0,85	Δ	0,66
180MX/4	182-340-	122	50	1460	35,4	400	18,5	0,83	Δ	0,46
180LX/4	222-340-	145	50	1460	42,6	400	22,0	0,82	Δ	0,35

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)

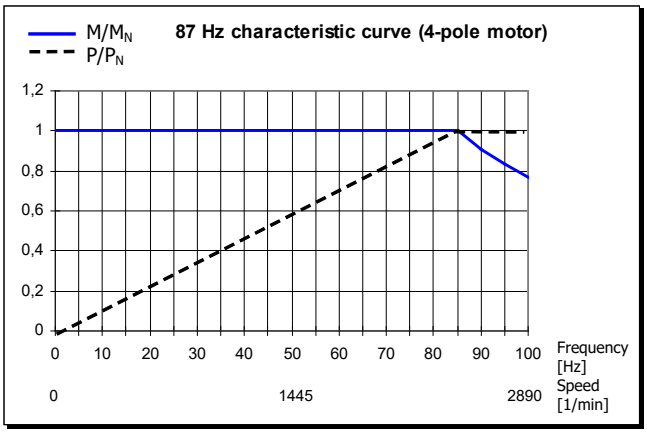


Figure 16: 87 Hz characteristic curve

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 5xxP-…	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
132S/4	112-340-	36,5	50	1450	20,0	230	5,5	0,8	Δ	0,72
132M/4	152-340-	49,6	50	1450	26,8	230	7,5	0,79	Δ	0,46
132MA/4	182-340-	60,6	50	1455	32,6	230	9,2	0,829	Δ	0,39
160MA/4	222-340-	72,2	50	1455	37	230	11	0,85	Δ	0,36

1) At the rating point

Motor (IE3) SK …	Frequency inverter SK 5xxP-…	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	250-340-	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
132 SP/4	112-340-	35,8	50	1465	18,9	230	5,5	0,8	Δ	0,503
132 MP/4	152-340-	49,0	50	1460	27,3	230	7,5	0,77	Δ	0,381
160 SP/4	182-340-	59,8	50	1470	29,0	230	9,2	0,88	Δ	0,295
160 MP/4	182-340-	71,7	50	1465	35,5	230	11,0	0,85	Δ	0,262

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.

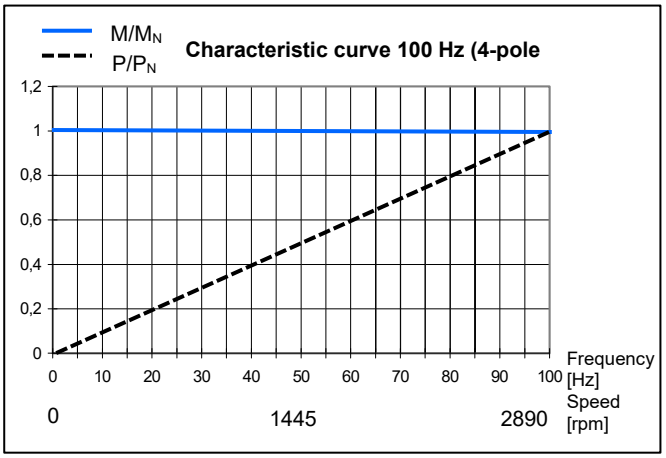


Figure 17: Characteristic curve 100 Hz

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 5xxP-…	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.										
63S/4	250-340-	0,90	100	2880	0,95	400	0,25	0,63	Δ	47,37
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
132MA/4	112-340-	35,49	100	2960	23,0	400	11,0	0,80	Δ	0,39

1) At the rating point

Motor (IE3) SK …	Frequency inverter SK 5xxP-…	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	250-340-	0,59	100	2885	0,58	400	0,18	0,61	Δ	66,7
63 LP/4	250-340-	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
132 MP/4	112-340-	29,6	100	2970	18	400	9,2	0,82	Δ	0,381
160 SP/4	112-340-	35,3	100	2975	21	400	11	0,85	Δ	0,295
160 MP/4	152-340-	48,2	100	2970	27,5	400	15	0,86	Δ	0,262
160 LP/4	182-340-	59,4	100	2975	34,4	400	18,5	0,85	Δ	0,169
180 MP/4	222-340-	70,4	100	2985	40,6	400	22	0,85	Δ	0,101

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

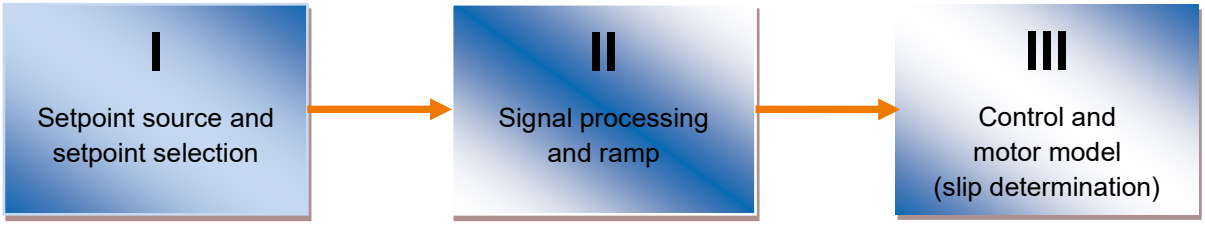
The following table contains details for the scaling of typical set-/actual values. These details relate to parameter (P400), (P418), (P543), (P546), (P740) or (P741).

Designation	**Analogue signal**		**Bus signal**						
Setpoints {Function}	Value range	Scaling	Value range	Max. value	Type	100% =	-100% =	Scaling	Limit absolute
Set point frequency { 1 }	0-10 V (10 V = 100%)	P104 … P105 (min - max)	±100%	16384	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P105	P105
Frequency addition { 4 }	0-10 V (10 V = 100%)	P410 … P411 (min - max)	±200%	32767	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P411	P105
Frequency subtract. { 5 }	0-10 V (10 V = 100%)	P410 … P411 (min - max)	±200%	32767	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P411	P105
Maximum frequency { 7 }	0-10 V (10 V = 100%)	P411	±200%	32767	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P411	P105
Cur.val process ctrl { 14 }	0-10V (10V=100%)	P105* U_{AIN} [V]/10 V	±100%	16384	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P105	P105
Nom.val process ctrl { 15 }	0-10 V (10 V = 100%)	P105* U_{AIN} [V]/10 V	±100%	16384	INT	4000h 16384	C000h -16385	4000h * f_{soll} [Hz]/P105	P105
Torque current limit { 2 }	0-10 V (10 V = 100%)	P112* U_{AIN} [V]/10 V	0-100%	16384	INT	4000h 16384	/	4000h * Torque [%] / P112	P112
Current limit { 6 }	0-10 V (10 V = 100%)	P536* U_{AIN} [V]/10 V	0-100%	16384	INT	4000h 16384	/	4000h * Current limit [%] / P536 * 100 [%]	P536
Ramp time { 49 } / Acceleration time { 56 } / Deceleration time { 57 }	0-10 V (10V =100%)	P102 / P103 U_{AIN} [V]/10 V	100%	32767	INT	7FFFh 32767	/	P102 / P103 Bus setpoint / 4000h	P102 / P105
Actual values {Function}									
Actual frequency { 1 }	0-10 V (10 V = 100%)	P201* U_{AOut} [V]/10 V	±100%	16384	INT	4000h 16384	C000h -16385	4000h * f [Hz]/P201	
Actual speed { 2 }	0-10 V (10 V = 100%)	P202* U_{AOut} [V]/10 V	±200%	32767	INT	4000h 16384	C000h -16385	4000h * n [rpm]/P202	
Current { 3 }	0-10 V (10 V = 100%)	P203* U_{AOut} [V]/10 V	±200%	32767	INT	4000h 16384	C000h -16385	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	INT	4000h 16384	C000h -16385	4000h * I_q [A]/(P112)*100 / √((P203)²-(P209)²)	
Freq. Master Value { 19 } … { 24 }	0-10 V (10 V = 100%)	P105* U_{AOut} [V]/10 V	±100%	16384	INT	4000h 16384	C000h -16385	4000h * f [Hz] / P105	
Speed from encoder { 22 }	/	/	±200%	32767	INT	4000h 16384	C000h -16385	4000h * n [rpm] / (P201 * 60s / Number of pole pairs)	

Table 21: Scaling of set-/actual values (selection)

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 22: 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.

   The approximate motor start temperature is determined by measuring the stator resistance. As of firmware version V 1.4 R0, the time of the measurement can be configured and is defined via parameter P336 "Mode Start ident.".

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

9 Maintenance and servicing information

9.1 Maintenance information

NORD frequency inverters are *maintenance-free* in normal operation(Chap. 7 "Technical data").

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.

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

AI (AIN)	Analog input
AO (AOUT)	Analogue output
BR	Braking resistor
DI (DIN)	Digital input
DO (DOUT)	Digital output
I / O	Input /Output
EEPROM	Non-volatile memory
EMKF	Electromotive force (induction voltage)
EMC	Electromagnetic compatibility
FI-(Switch)	Leakage current circuit breaker
FI	Frequency inverter
I/O	In / Out (Input / Output)
ISD	Field current (Current vector control)
LED	Light-emitting diode
PMSM	Permanent Magnet Synchronous motor (permanently excited synchronous motor)
S	Supervisor Parameter, P003
SH	"Safe stop" function
SW	Software version, P707
TI	Technical information / Data sheet (Data sheet for NORD accessories)

Key word index

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