INTELLIGENT DRIVESYSTEMS, WORLDWIDE SERVICES

BU 0600 – en

NORDAC *PRO* (SK 500P)

Users Manual for Frequency Inverters

NORD® DRIVESYSTEMS

Documentation

Designation:	**BU 0600**	
Material No.:	**6076002**	
Series:	NORDAC *PRO*	
Frequency inverter series:	SK 500P, SK 510P, SK 530P, SK 550P	
Frequency inverter types:	SK 5xxP-250-123- ... SK 5xxP-221-123-	(0.25 … 2.2 kW, 1~ 230 V, Out: 3~ …230 V)
	SK 5xxP-250-340- ... SK 5xxP-551-340-	(0.25 … 5.5 kW, 3~ 400 V, Out: 3~ …400 V)

Version list

Title, Date	Order number	FI software version	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

Table 1: Version list

Copyright notice

Publisher

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

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1 General

The NORDAC *PRO* (SK 500P - SK 550P) series is based on the tried and tested NORD platform. The frequency inverters are characterised by their compact design and optimum control characteristics, and have uniform parametrisation.

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

The power range is from 0.25 kW to 5.5 kW.

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

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

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

Information

Accessories

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

1.1 Device characteristics

The NORDAC *PRO* series is available in various versions. The following gives an overview of the essential characteristics of the particular versions.

Characteristic SK …	500P/510P	530P	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 synchronous motors (Permanent Magnet Synchronous Motor)	x	x	X	
Operation permissible on network forms: TN, TT, IT [1)]	x	x	x	🕮 Section 2.6.3.2
DC coupling / Link voltage coupling	x	x	x	🕮 Section 2.6.3.5
Brake management for mechanical holding brake	x	x	x	🕮 Section 2.6.3.1
Brake chopper (braking resistor optional)	x	x	x	🕮 Section 2.6.3.4
Integrated EMC mains filter for Class A1 / Category C2 limits	x	x	x	🕮 Section 8.3
Can be mounted next to each other without additional spacing	x	x	x	🕮 Section 2
Extensive monitoring functions	x	x	x	🕮 Section 7
Status LEDs (FI / Bus)	x / x	x / x	x / x	🕮 Section 6.1
Status LEDs ((Industrial Ethernet)	-	-	x	🕮 BU 0620
Stator resistance measurement	x	x	x	🕮 Section 5.1.4, P220
Automatic determination of precise motor data	x	x	x	
Internal 24 V power supply unit to supply the control board	x	x	x	

Characteristic SK …	500P/510P	530P	550P	Additional information
Operating manual	**BU 0600**			
Legend x = Present; - = Not present; O = Optionally available				
External 24 V DC supply for the control board voltage supply with automatic switch-over between the internal and external 24 V DC power supply	–	x	x	🕮 Section 2.6.4
RS-232 diagnostic interface via RJ12 connection	x	x	x	
RS-232 diagnostic interface via USB-C connection	–	x	x	
RS-485 interface via RJ12 connection	x	x	x	
USS and Modbus RTU on board	x	x	x	
(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	🕮 Section 2.6.4
Parameters pre-set with standard values	x	x	x	🕮 Section 5
4 switchable parameter sets	x	x	x	
Parameterisation with NORDCON-Software, NORDCON *APP* or external ParameterBox SK …-3H / -3E via RJ12	x	x	x	
Parameterisation possible with NORDCON-Software via USB interface without mains connection or 24 V DC power supply ("in the box")	–	x	x	
Programmable direct current braking	x	x	x	🕮 Section 5.1.3, P108
Energy-saving function (automatic load-dependent flux optimisation)	x	x	x	🕮 Section 8.7

Characteristic SK …	500P/510P	530P	550P	Additional information
Operating manual	BU 0600			
Legend x = Present; - = Not present; O = Optionally available				
Load monitor	x	x	x	🕮 Section 5.1.7, P525-P529
Lifting gear functionality	x	x	x	🕮 Section 5.1.3, P107, P114
Process controller / PID controller	x	x	x	🕮 Section 8.2
Safe pulse block (STO / SS1)[2], two channel[3]	–	O	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	🕮 Section 2.6.4
HTL encoder connection [4]	x	x	x	🕮 Section 2.6.4
Speed feedback via incremental encoder input (TTL) [4]	–	x	x	
CANopen absolute encoder evaluation	x	x	x	🕮 BU 0610
Universal encoder interface (SSI, BISS, Hiperface, EnDat and SIN/COS)	–	O	O	
Number of digital inputs / outputs [6]	5 / –	6 / 2	6 / 2	🕮 Section 2.6.4
Number of analogue inputs / outputs	2 / 1	2 / 1	2 / 1	
Number of relay messages	2	2	2	
PTC input with potential isolation [7]	–	1	1	
Removable control panel (SK TU5-CTR)	O	O	O	🕮 Section 3.2
Function extension with customer unit SK CU5-… [8]	-	x	x	🕮 Section 3.1

1) IT network; manual adaptation of hardware configuration required
2) Optional SK CU5-STO interface
3) SK 510P: STO and SS1, single channel, on board
4) for speed control and/or positioning (POSICON)
5) Optional SK CU5-MLT interface
6) PTC evaluation via digital input (DI5) possible
7) PTC evaluation via digital input (DI5) also possible
8) 1 x per FI

Table 2: Overview of FI characteristics

1.2 Delivery

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

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

Important! This also applies if the packaging is undamaged.

1.3 Scope of delivery

NOTICE!

Defect in the device

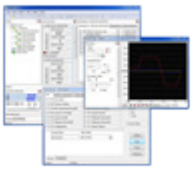
Use of impermissible accessories and options, e.g. options for other inverter series, may result in defects of connected components.

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

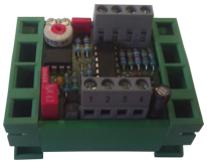
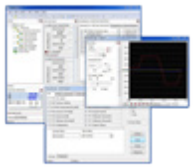
Standard version:

- IP20
- Integrated brake chopper
- Integrated EMC mains filter for limit curve A1, Category C2
- Blank cover for technology unit slot
- Covering for the control terminals
- Operating instructions on CD

Available accessories:

	Designation	Example	Description
Control and parametrisation options	**Technology units for attachment to the inverter**		For commissioning, parametrisation and control of the FI. **SK TU5-CTR** 📖 Section 3.2
	Technology units for installation in the control cabinet		For commissioning, parametrisation and control of the FI. **SK CSX-3E** 📖 BU 0040
	Hand-held control boxes		For controlling the device, **Model SK POT- …** 📖 BU 0040
	NORDCON **MS Windows ® - based software**		For commissioning, parametrisation and control of the FI. 📖 www.nord.com NORDCON
	NORDAC *ACCESS BT*		NORDAC *ACCESS BT* in combination with the NORDCON APP is used for mobile parameterisation of the FI. 📖 BU 0960
	NORDCON *APP*		
	MicroSD card, 128 MB	 Part No.: 275292200	Plug-in data storage for parameter exchange **SK TIE5-SD-Card-IND1**
	USB cable	 Part No.: 275292100	Connects the frequency inverter to a PC **SK CE-USB-C-PC-USB-3m**

Designation		Example	Description
Braking resistor	**Chassis-mounted braking resistor**		Dissipates generated energy from the drive system by conversion into heat, e.g. during braking **Type SK BR2…** 📖 Section 2.6.3.4
	Bottom-mounted braking resistor		Places a load on the motor and brakes it **Type SK BRU5…** 📖 Section 2.6.3.4
Choke	**Motor choke**		Reduces interference (EMC) from the motor cable and compensates for cable capacitances **Type SK CO5…** 📖 Section 2.4.2
	Mains choke		Reduces current harmonics and charging currents on the mains side **Type SK CI5…** 📖 Section 2.4.1.1
Mains filter	**Chassis-mounted mains filter**		Reduces interference (EMC) **Type SK HLD …** 📖 Section 2.5
Electronic brake rectifier			Directly controls electro-mechanical brakes **SK EBGR-1** 📖 TI059_19140990

Designation	Example	Description
IO extension		External IO extension (analogue and digital) **SK EBIOE-2** 🕮 TI 275900210
Signal converter ± 10 V		Signal converter from bipolar to unipolar analogue signals **Type signal converter ± 10 V** 🕮 TI 278910320
Connection module V/F converter		Signal converter for conversion of the 0 – 10 V analogue signals from a potentiometer into pulse signals for evaluation at the digital input of the frequency inverter **Type connection module V/F converter** 🕮 TI 278910310
Software (Free download)		
NORDCON **MS Windows ® - based software**		For commissioning, parametrisation and control of the FI. 🕮 www.nord.com NORDCON
NORDCON *APP*		The NORDCON *APP* in combination with the NORDAC *ACCESS BT* is used for mobile commissioning, parameterisation and control of the FI. 🕮 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 fieldbus 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 (e.g. blind plugs for cable glands). Otherwise there is a risk of serious or fatal injuries caused by electric shock or bursting electrical components such as powerful electrolytic capacitors.

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

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

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

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

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

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

Power plug connectors must not be pulled out while they are connected to the power supply. Failure to comply with this may cause arcing, which in addition to the risk of injury, also results in a risk of damage or destruction of the device.

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

The heat sink and all other metal components as well as the surfaces of power plug connectors may heat up to temperatures in excess of 70°C.

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

All work on the device, e.g. transportation, installation, commissioning and maintenance work must be carried out by qualified personnel (observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national accident prevention regulations). In particular, the general and regional installation and safety regulations for work on high voltage systems (e.g. VDE) must be complied with, as must the regulations concerning correct use of tools and the use of personal protection equipment.

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

Further information can be found in this documentation.

2. Qualified experts

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

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

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

3. Correct purpose of use – general

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

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

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

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

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

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

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

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

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

4. Phases of life

Transport, storage

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

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

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

Installation and assembly

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

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

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

Electrical connection

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

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

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

Information regarding EMC-compliant installation such as shielding, earthing, location of filters and routing of cables can be found in the documentation for the devices and in the technical information manual TI 80-0011. This information must always be observed even with inverters with a CE label. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

In case of a fault, inadequate earthing may result in electric shock, possibly with fatal consequences.

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

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

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

Set-up, troubleshooting and commissioning

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

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

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

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

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

Operation

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

All covers must be kept closed during operation.

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

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

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

Maintenance, repair and decommissioning

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

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

Disposal

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

5. Potentially explosive environment (ATEX)

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

1.5 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 information is used on the product.

Symbol	Supplement to symbol [1]	Meaning
	DANGER 300 s	**DANGER** **Electric shock** The device contains powerful capacitors. Because of this, there 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 can 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. • Maintain an adequate distance to adjacent components or provide protection against contact.
		***NOTICE!*** **EDS** The device contains electrostatically sensitive components, which can be easily damaged by incorrect handling. • Avoid all contact (indirect contact by tools or similar, or direct contact) with PCBs and their components.

1) Texts are written in English.

Table 3: Warning information on the product

1.7 Standards and approvals

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

Approval	Directive		Applied standards	Certificates	Code
CE *(European Union)*	Low Voltage	2014/35/EU	EN 61800-5-1 EN 60529 EN 61800-3 EN 50581	C310601	CE
	EMC	2014/30/EU			
	RoHS	2011/65/EU			
UL *(USA)*			UL 61800-5-1	E171342	c UL us LISTED IND.CONT.EQ. E171342
CSA *(Canada)*			C22.2 No.274-13	E171342	
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	EAC

Table 4: Standards and approvals

1.7.1 UL and CSA approval

File No. E171342

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

(📖 section 7.2 "Electrical data ")

UL / CSA conditions according to the report

Information

- ”Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with 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.
- “For use in Pollution Degree 2 and Overvoltage Category III environments only”, or equivalent.
- “Maximum Surrounding Air Temperature 40°C.”
- “The source shall be derived from a non-corner grounded type TN or IT AC source not exceeding 277 V phase to earth”, or equivalent.

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” (240V for 1-phase models or 480V for 3-phase models), “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated _____ Amperes, and _____Volts”, as listed in [1)]
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”.
1	“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”.
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.”.
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) 7.2 "Electrical data "

1.8 Type code / nomenclature

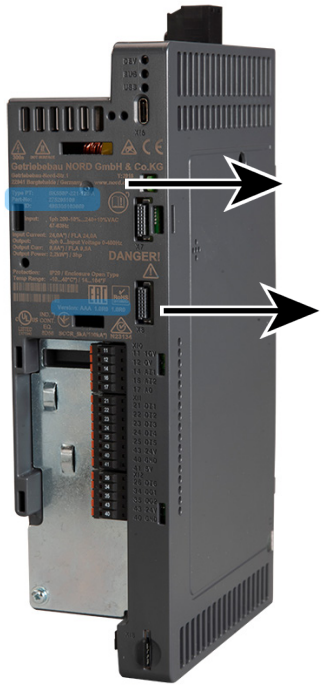
Unique type codes have been defined for the individual modules and devices. These provide individual details of the device type and its electrical data, protection class, fixing version and special versions. A differentiation is made according to the following groups:

	Frequency inverters

	Optional modules

1.8.1 Rating plate

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



Type:	SK 550P-750-123-A
Part No.:	275295106
ID:	49S305103669

Version:	1.0R0
	AAA

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

Frequency inverter type code

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

- (-xxx): Version variant or special version [1]
- A: Radio interference filter: O = without, **A** = Class **A1(C2)**
- 340: Mains voltage: x23 = 230 V, x**40** = **400** V
- 3: Number of mains phases: 1xx = single phase, **3**xx = **3**-phase [2]
- 7: Digits before decimal point for power: **0** = **0**.xx, 1 = 0x.x0, 2 = 0xx.0
- 370: Device rated power: 250 = 0.25 kW, **37**0 = 0.**37 kW**, ... 551 = 5.5 kW
- 530P: Frequency inverter series: SK 500P, SK 510P, **SK 530P**, SK 550P

1) Optional. Only stated if relevant.
2) Designation 3 also includes combined devices which are intended for single and three-phase operation (please refer to the technical data).

Type code for option modules

SK TU5-CTR(-xxx)

- (-xxx): Version variant or special version [1]
- CTR: Option type: [2]
  - **CTR =** **ControlBox** (removable control unit)
  - STO = Interface for STO functionality
  - ENC = Universal encoder interface
  - MLT = Universal encoder interface with STO functionality
- TU5: Group: **TU5** = **Technology unit**, CU5 = Customer unit

1) Optional. Only stated if relevant.
2) Option type **CTR** is implemented as **TU5** (technology unit). All other options are implemented 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 equipment requires sufficient ventilation for protection against overheating .For this the 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.

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 entry temperature limit is not exceeded (📖 Section 7 "Technical data"). If this is the case, it is recommended that an "obstacle" (e.g. a cable duct) is mounted between the inverters so that the direct air flow (rising warm air) is interrupted.

Heat dissipation: If the frequency inverter is installed in a control cabinet, adequate ventilation must be ensured. The heat dissipation in operation is approx. 5 % (according to the size and equipment of the device) of the rated power of the frequency inverter.

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 inverter is mounted vertically. This enables optimum convection, which ensures fault-free operation.

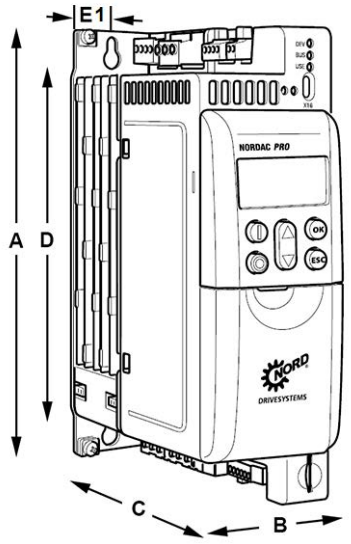
Frequency inverter type		Overall dimensions (as delivered)			Fixing dimensions (Wall mounting)			
		A	W	C	D	E1	E2	∅
	Size	Height	Width	Depth	Hole spacing length	Hole spacing width	Hole spacing edge	Diameter
SK 5xxP-250-… to SK 5xxP-750-…	**1**	200	65.3	140.6	180	22	–	5.5
SK 5xxP-111-…	**2**	240	65.3	140.6	220	22	–	5.5
SK 5xxP-151-… to SK 5xxP-221-…	**2**	241.5	65.3	140.6	220	22	–	5.5
SK 5xxP-301-… to SK 5xxP-501-…	**3**	286	90.5	174.1	266	–	50	5.5

All dimensions in [mm]

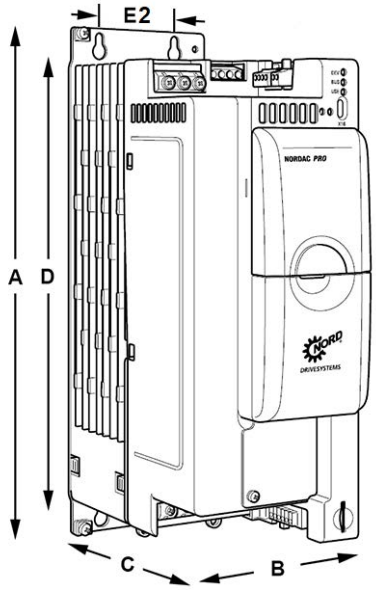
Information

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

Sizes 1 and 2



Size 3



2.2 EMC Kit

Depending on the size and configuration various EMC kits are available as options

Size	Motor connection	IO ports	Customer unit SK CU5-… [1]
1	SK HE5-EMC-MS-HS12 Part No.: 275 292 300	SK HE5-EMC-IS-HS1 Part No.: 275 292 304	SK HE5-EMC-CS-HS12 Part No.: 275 292 310
2	SK HE5-EMC-MS-HS12 Part No.: 275 292 300	SK HE5-EMC-IS-HS2 Part No.: 275 292 305	SK HE5-EMC-CS-HS1y2 Part No.: 275 292 310
3	SK HE5-EMC-MS-HS34 [2] Part No.: 275 292 301	SK HE5-EMC-IS-HS3 Part No.: 275 292 306	SK HE5-EMC-CS-HS3 Part No.: 275 292 311

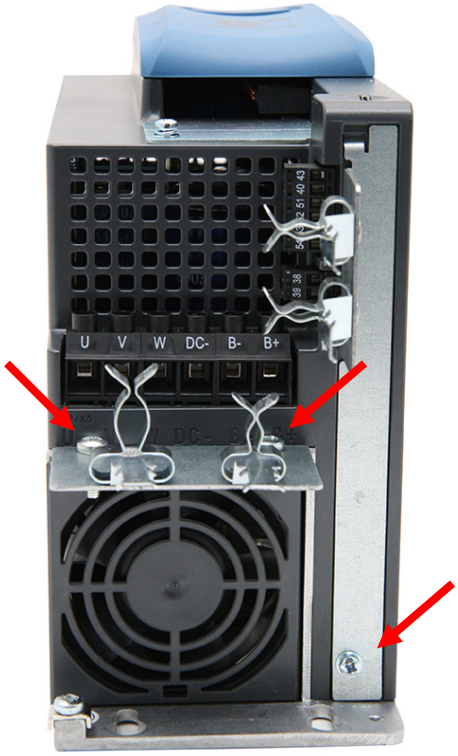
1) SK 530P and higher

2) temporarily

Sizes 1 and 2	Size 3
	

1 Motor connection

Assembly

Sizes 1 and 2	Size 3
EMC Kit SK HE5-EMC-MS-HS12	EMC Kit SK HE5-EMC-MS-HS34
	
The screw mounting facility for fastening the EMC kit for the motor connection SK HE5-EMC-MS-HS12 is located on the underside of the frequency inverter.	The EMC kit for the motor connection SK HE5-EMC-MS-HS34 is fastened to the top of the frequency inverter with three screws.
	

2.3 Braking resistor (BR)

⚠ CAUTION

Hot surfaces

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

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

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

Information

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

During dynamic braking (frequency reduction) of a three-phase motor, electrical energy is returned to the inverter. An external braking resistor can be used in order to prevent the FI from being shut down due to overvoltage. With this, 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 7.5 kW** (230 V: up to 4,0 kW) a standard bottom-mounted resistor **(SK BRU5-..., IP40)** can be used. Approval: UL, cUL

SK BRU5-…

Figure 2: 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 inverters		Type	Material No.	R [Ω]	P [W]	Short circuit power[1] [kW]	Connection
230 V	0.25 ... 0.75 kW	**SK BRU5-1-240-050**	275 299 004	240	50	0.75	2 x 1.9 mm², AWG 14/19 L = 0.12 m
	1.1 ... 2.2 kW	**SK BRU5-2-075-200**	275 299 210	75	200	3.0	
400 V	0.25 ... 0.75 kW	**SK BRU5-1-400-100**	275 299 101	400	100	1.5	
	1.1 ... 2.2 kW	**SK BRU5-2-220-200**	275 299 205	220	200	3.0	
	3.0 ... 5.5 kW	**SK BRU5-3-100-300**	275 299 309	100	300	4.5	

[1] Once within 120 s for a maximum duration of 1.2 s

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

Frequency inverters		Type	Material No.	R [Ω]	P [W]	Short circuit power[1] [kW]	Connection
400 V	3.0 ... 4.0 kW	**SK BR2-100/400-C[2]**	278 282 040	100	400	12	Terminals
	5.5 kW	**SK BR2-60/600-C**	278 282 060	60	600	18	

[1] Once within 120 s for a maximum duration of 1.2 s
[2] 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 block" 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 inverter (fan).

Bi-metal temperature switch							
For SK...	**Material number**	**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, AWG 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 details of the braking resistor temperature switch

2.3.2 Dimensions of bottom-mounted braking resistor SK BRU5

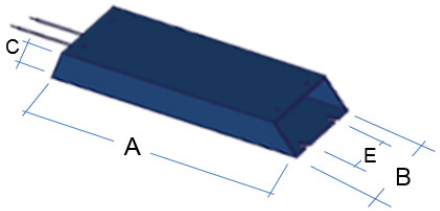
Resistor type	Size	A	W	C	Fastening dimensions[1)]	
					E	∅
SK BRU5-1-240-050 **SK BRU5-1-400-100**	BG 1	240	66	40	-	5.5
SK BRU5-2-220-200 **SK BRU5-2-075-200**	BG 2	280	66	40	-	5.5
SK BRU5-3-100-300	Size 3	340	91	50	50	5.5

1) Size 1 and Size 2: 2 x 1 Attachment point
BG 3: 2 x 2 Attachment points

All dimensions in mm
All values are provisional values

Table 8: Dimensions of bottom-mounted braking resistor SK BRU5-...

Example SK 550P, BG2 and BRU5-…

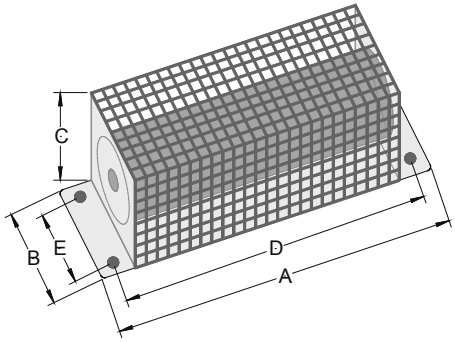


Dimensions

Figure 3: Illustration of mounting the BRU5 on the frequency inverter

2.3.3 Dimensions of chassis BR SK BR2

Resistor type	A	W	C	Fixing dimensions			Weight
				D	E	∅	
SK BR2-100/400-C	178	100	252	150	90	4.3	1.6
SK BR2- 35/400-C							
SK BR2- 60/600-C	385	92	120	330	64	6.5	1.7
SK BR2- 22/600-C							
All dimensions in mm							[kg]



SK BR2-...
(Schematic diagram, design varies according to output)

Table 9: Dimensions of chassis braking resistor SK BR2-...

2.3.4 Monitoring of the braking resistor

To prevent overload of the braking resistor, it should be monitored during operation. The most reliable method is thermal monitoring with a temperature switch which is mounted directly on the braking resistor.

2.3.4.1 Monitoring with a temperature switch

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

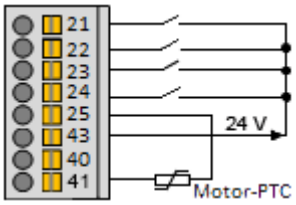
Typically, evaluation of the temperature switch is carried out by an external control system.

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} "Block voltage".

Example, SK 5xxP

- Connect the temperature switch to digital input 4 (Terminal 43 / 24)
- Parameter **P420** to function {10} "Block voltage"

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.



2.3.4.2 Monitoring with current measurement and calculation

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

This software-assisted indirect monitoring is activated by setting parameter **P556** "Braking resistor" and **P557** "Braking resistor power". The actual calculated resistor load can be read out in parameter **P737** "Braking resistor load". Overload of the braking resistor results in a shut-down of the frequency inverter with the error message E3.1 "Overcurrent Chopper I²t“

Information

The supported indirect monitoring using measurement of electrical data and calculation is based on standard 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 or its environment may be damaged due to excess temperatures.

Reliable temperature monitoring is only possible with the use of 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 versions are available for mains protection:

- **Mains chokes** are incorporated in the supply cable immediately in front 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.

Mains input chokes reduce the charging current and harmonics from the mains. Chokes fulfil several functions:

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

Use of mains chokes is recommended e.g.:

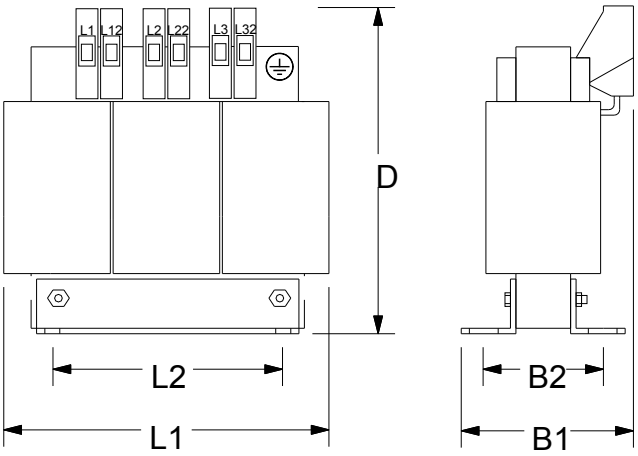
- If the proportion of the installed inverter power exceeds 20 % of the installed transformer power.
- For very hard mains or capacitive compensation systems
- In case of large voltage fluctuations due to switching

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

2.4.1.1 Mains choke SK CI5

Type SK CI5- chokes are intended for a maximum supply voltage of 230 V or 500 V at 50/60 Hz.

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



Similar to illustration

Mains choke SK CI5-230/xxx

Inverter ID SK 5xxP	Mains choke 1 x 230 V			L1	B1	D	Detail: Fastening			Connection	Weight
	Type	Continuous current [A]	Inductance [mH]				L2	B2	Assembly		
0.25 ... 0.75 kW	**SK CI5-230/006** Material No.: 276993005	6	4.88	60	66	68	44	39	M3	4	0.6
1.1 ... 2.2 kW	**SK CI5-230/010** Material No.: 276993009	10	2.93	84	78	96	64	52	M4	4	1.4
3.0 ... 5.5 kW	**SK CI5-230/025** Material No.: 276993024	25	1.17	84	87	96	64	52	M4	10	1.4
							[mm]			[mm²]	[kg]

Mains choke SK CI5-500/xxx

Inverter ID SK 5xxP	Mains choke 3 x 400 … 600 V			L1	B1	D	Detail: Fastening			Connection	Weight
	Type	Continuous current [A]	Inductance [mH]				L2	B2	Assembly		
0.25 ... 0.75 kW	**SK CI5-500/004** Material No.: 276993004	4	3 x 7.35	80	60	116	71 or 56	45 or 38	M4	4	1.31
1.1 ... 2.2 kW	**SK CI5-500/008** Material No.: 276993008	8	3 x 3.68	120	85	135	105 or 90	70 or 39	M4	4	1.9
3.0 ... 5.5 kW	**SK CI5-500/016** Material No.: 276993016	16	3 x 1.84	120	95	135	105 or 90	80 or 49	M4	10	2.7
							[mm]			[mm²]	[kg]

2.4.2 Motor choke SK CO5

In preparation

2.5 Mains filter

In preparation

2.6 Electrical Connection

WARNING

Electric shock

Dangerous voltages can 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 (voltage source, connection cables, connection terminals are free of voltage using suitable measuring equipment.
- Use insulated tools (e.g. screwdrivers).
- DEVICES MUST BE EARTHED.

Information

Temperature sensor and PTC (TF)

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

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

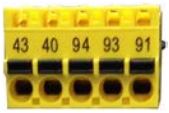
2.6.1 Overview of connections

Depending on the size of the frequency inverter, the connection terminals for the supply cables and the control cables are located in different positions. According to the configuration of the frequency inverter, various terminals are not 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 550P
X1	Mains	L1	L	3	X	X	X	X
		L2 / N	N					
		L3	–					
X2	Motor	U	–	3	X	X	X	X
		V	–					
		W	–					
X3	Braking resistor	B+	–	3	X	X	X	X
		B-	–					
		DC-	–					
X4	Thermistor	TF-	39	2	–	–	X	X
		TF+	38					
X5	Multi-function relay	K1.1	1	4	X	X	X	X
		K1.2	2					
		K2.1	3					
		K2.2	4					
X6	24 V	GND	40	1	–	–	X	X
		24V	44					

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

2.6.2 Wiring guidelines

The soft starters have been developed for use in an industrial environment. In this environment, electromagnetic interference can affect the device. In general, correct installation ensures safe and problem-free operation. To meet the limiting values of the EMC directives, the following instructions should be complied with.

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

   The shields of analogue setpoint cables should only be earthed on one side on the device.
4. The control cables should be installed as far as possible from power cables, using separate cable ducts, etc. Where cables cross, an angle of 90° should be ensured as far as possible.
5. Ensure that the contactors in the cabinet are interference protected, either by RC circuits in the case of AC contactors or by free-wheeling diodes for DC contactors, for which **the interference traps must be positioned on the contactor coils**. Varistors for over-voltage limitation are also effective.

   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.

In addition, EMC-compliant wiring must be ensured.

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

NOTICE!

Damage due to high voltage

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

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

2.6.3 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, PE)
- Motor cable connection X2 (U, V, W, PE)
- Braking resistor connection X3 (B+, B-)
- Link circuit connection (B+, DC-)

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

1. Ensure that the mains supply provides the correct voltage and is suitable for the current required (📖 Section 7 "Technical data").
2. Ensure that suitable electrical fuses with the specified nominal current range are installed between the voltage source and the device.
3. Mains cable connection: to terminals **L1-L2/N-L3** and **PE** (depending on device)
4. Motor connection: to terminals **U-V-W** and **PE**
5. The cable screening of a shielded motor cable must also be connected to a large area of the metallic screening bracket of the EMC Kit, however, at least to the electrically conducting mounting surface of the control cabinet.

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

Information

Connection cables

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

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

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

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

Frequency inverter	Tool	Type
Size 1 … 3	Screwdriver	SL / PZ1; SL / PH1

Table 10: Tools

Frequency inverter	Cable Ø [mm²]		AWG	Tightening torque	
Size	rigid	flexible		[Nm]	[lb-in]
1 … 3	0.2 … 6	0.2 … 4	24-10	0.5 … 0.6	4.42 … 5.31

Table 11: Connection data

2.6.3.1 Electromechanical brake

NOTICE!

Power supply for an electro-mechanical brake

Connection of an electro-mechanical brake to the motor terminals may cause destruction of the brake or the frequency inverter.

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

An electro-mechanical brake (holding brake) can be connected via one of the two multi-function relays (K1 / K2) to control terminal X5. In particular, take special note of parameters P107, P114 and P434.

2.6.3.2 Mains connection (PE, L1, L2/N, L3)

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.

Frequency inverter data		Permissible mains data	
Voltage	**Power**	**1 ~ 230 V**	**3 ~ 400 V**
230 V AC	0.25 … 2.2 kW	X	
400 V AC	0.25 … 5.5 kW		X
Connections		L/N = L1/L2	L1/L2/L3

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

Adaptation to IT networks

⚠ WARNING

Unexpected movement in case of mains faults

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

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

NOTICE!

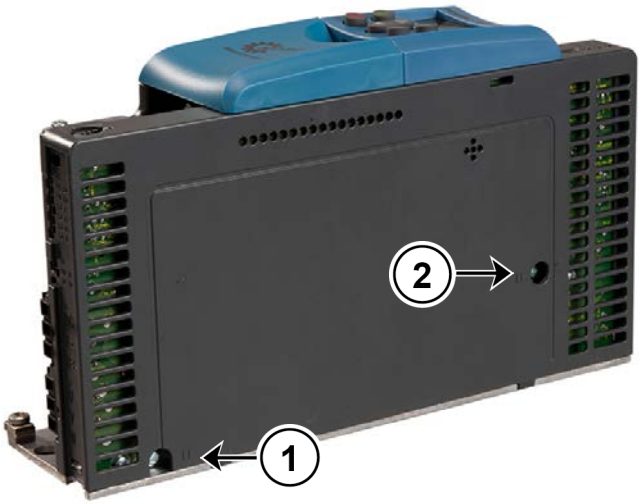
Operation in IT networks

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

- Connect a braking resistor to dissipate excess energy.

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 is carried out via two screw connections. The two screws must be removed from the housing to enable IT network operation.



1) Motor output 2) Mains input

Use with differing supply networks or network types

The frequency inverter may only be connect to and operated in supply networks which are explicitly stated in this section (🕮 Section 2.6.3.2 "Mains connection (PE, L1, L2/N, L3)"). Operation in **deviating network types** may be possible, but must be **explicitly checked and approved by the manufacturer in advance**.

2.6.3.3 Motor cable (U, V, W, PE)

The motor cable may have a **total length of 100 m** if it is a standard cable type (take EMC into consideration). If a screened motor cable is used, or if the cable is laid in a well-earthed metal conduit, the total length should not exceed **30 m** (connect cable shield to PE, on both sides).

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

Information

Multiple motor operation

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.

2.6.3.4 Braking resistor (B+, B-)

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

⚠ CAUTION

Hot surfaces

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

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

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

2.6.3.5 DC coupling (B+, DC-)

NOTICE!

Link circuit overload

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

- It is essential to observe the criteria which are summarised below for setting up the DC supply / link circuit coupling of frequency inverters.
- For direct current coupling of single-phase devices, it is essential to take care that coupling to the same external conductor is used.

In drive engineering, DC-coupling is advisable if motors act as drivers and generators at the same time in the system. Here, 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 addition, the energy balance can be made even more efficient with the use of a regenerative feedback unit or an input/feedback unit. *In principle, wherever possible devices with the same power should be connected together for DC coupling. Furthermore, only devices which are ready for operation (whose link circuits are charged) may be coupled.*

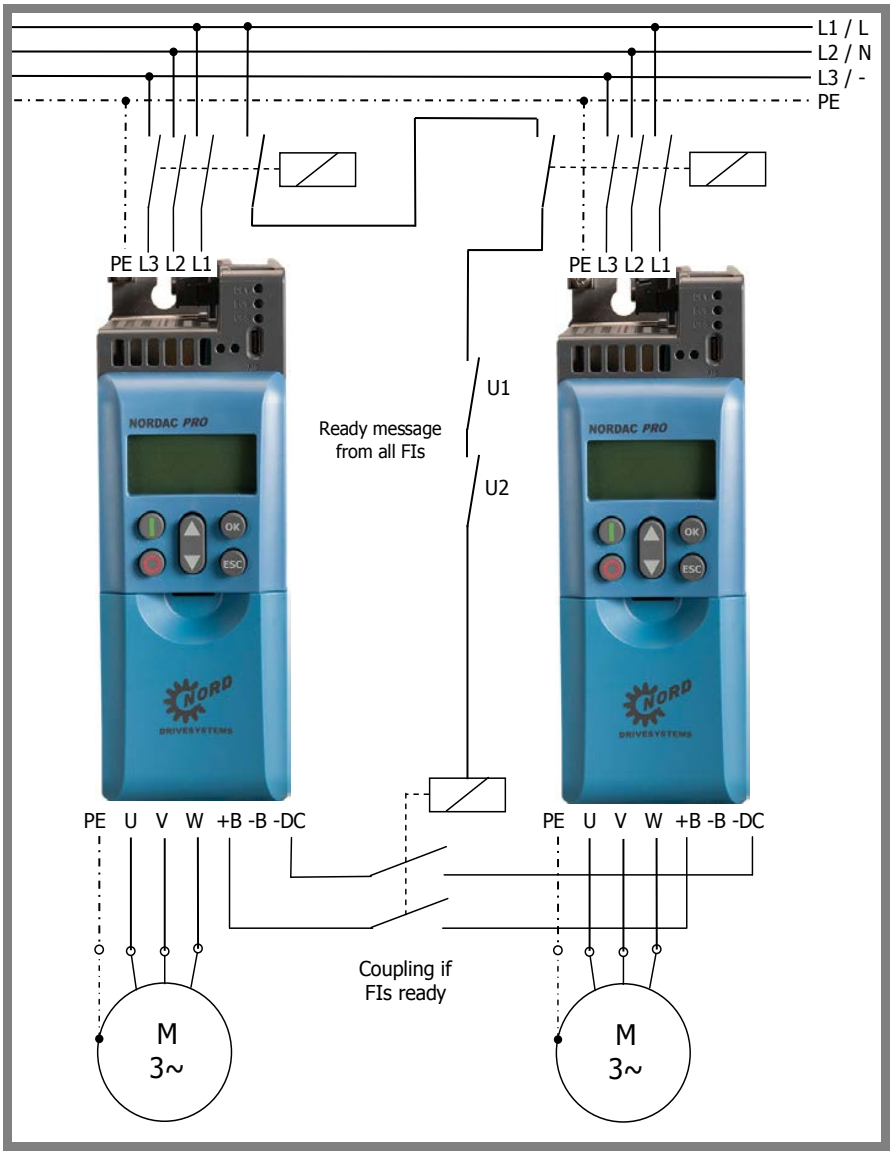


Figure 4: Illustration of a DC-coupling

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 danger that all the frequency inverters will be charged by a single one.
3 Ensure that the coupling is disconnected as soon as one of the devices is no longer ready for operation.
4 For a 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.

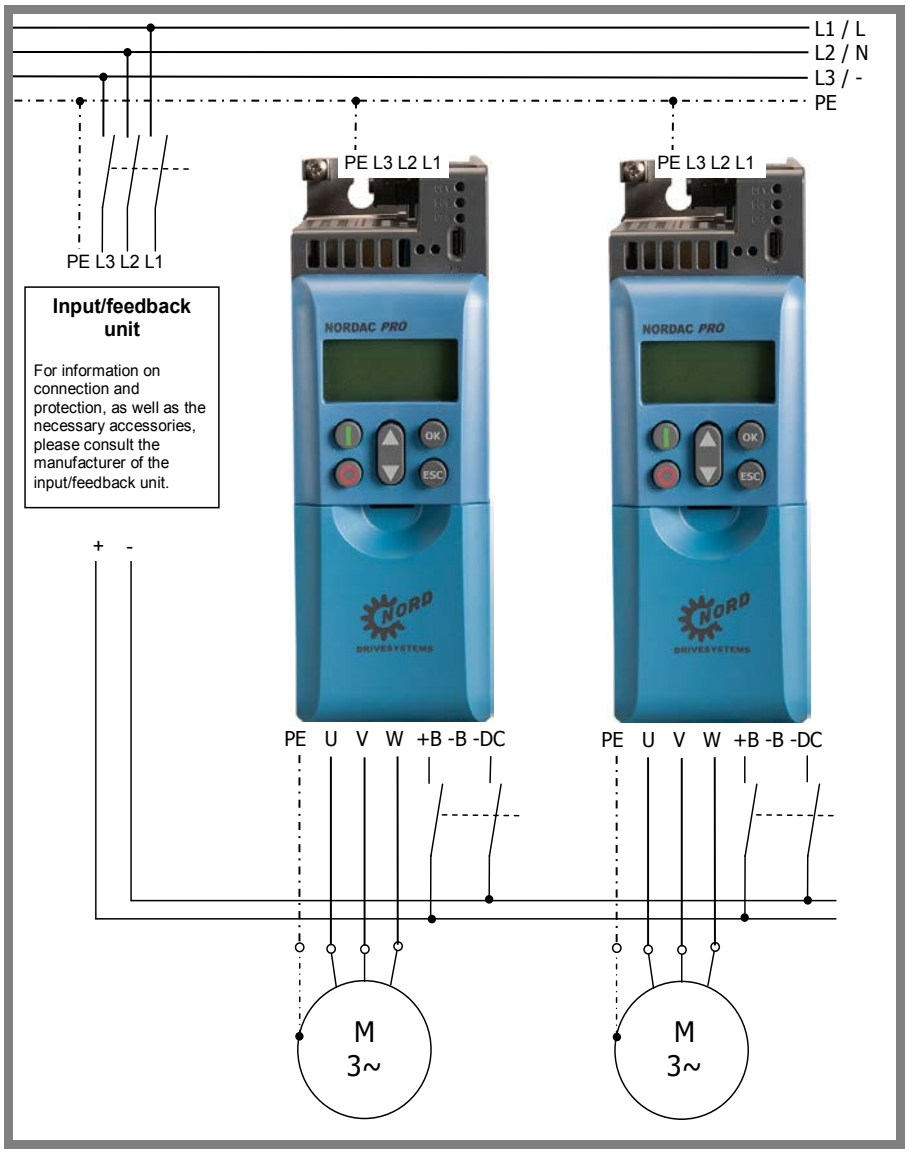


Figure 5: Diagram of a DC coupling with an input/feedback unit

The following points must be taken into account in relation to a DC supply:

1. Use a connecting cable which is as short as possible between the DC bus and the devices to be connected. The connection and protection of the devices in the DC circuit must be carried out for cable protection and the maximum cross-section of the device.
2. The link circuits of the individual frequency inverters must be protected with suitable fuses.
3. The frequency inverters only obtain their supply via the link circuit. Electrical isolation is carried out via the power circuit breakers which must be provided in the supplies to the devices.
4. Set **P538** = 4 "DC Supply".

2.6.4 Electrical connection of the control unit

The control connections differ 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		X10 … X12	X4, X6, X13, X15
Rigid cable Ø	[mm²]	0.14 … 1.5	0.14 … 2.5
Flexible cable Ø	[mm²]	0.14 … 1.5	0.14 … 1.5
AWG standard		26-16	26-14
Tightening torque	[Nm]	Clamping	0.5 … 0.6
	[lb-in]		4.42 … 5.31

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

Information

5 V / 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

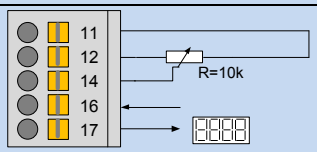
Cable laying

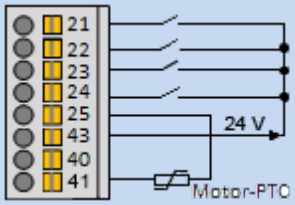
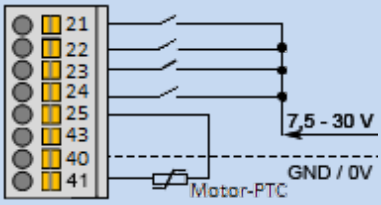
All control cables (including thermistors) must be routed separately from the mains and the motor cables to prevent interference in the device.

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.

Meaning, Functions		Description / Technical data		
Terminal			Parameter	
No.	Designation	Meaning	No.	Function of factory setting
PTC input X4 (SK 530P or higher)		Monitoring of motor temperature using PTC		
		If the device is installed near the motor, a shielded cable must be used. EN 60947-8 On: > 3.6 kΩ Off: < 1.65 kΩ Measurement voltage 5 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 VAC, 24 VDC, < 60 VDC in circuits with safe isolation, ≤ 2 A		
1 **2**	K1.1 K1.2	Test multi-function relay 1	P434 [-01]	External brake (applied on enabling)
3 **4**	K2.1 K2.2	Test multi-function relay 2	P434 [-02]	Fault (closes when FI ready / no fault)
Control voltage connection X6 (SK 530P or higher)		Supply voltage for the FI 24 V … 30 V, min. 1000 mA, depending on the load on inputs and outputs and use of options		
44	24V	Voltage input, connection optional. If no control voltage is available, the control voltage can be supplied via an internal mains unit.	-	-
40	GND / 0V	Reference potential GND	-	-

<table>
<tr><td colspan="2" rowspan="2">Analogue inputs/outputs X10</td><td colspan="4">Actuation of device by external controller, potentiometer or similar.</td></tr>
<tr><td colspan="3">Analogue input: For control of the output frequency of the FI.
Analogue output: For external display or further processing in a following machine.
Switch-over between current and voltage setpoints (or actual values) is performed automatically.
The possible digital functions are described in Parameter P420.</td><td> 
</td></tr>
<tr><td>11</td><td>10 V</td><td colspan="2">10V reference voltage, 10V, 5 mA, not short-circuit protected</td><td>-</td><td>-</td></tr>
<tr><td>12</td><td>0 V</td><td colspan="2">Reference potential for analogue signals, 0 V analogue</td><td>-</td><td>-</td></tr>
<tr><td>14</td><td>AI1</td><td>Analogue input 1</td><td rowspan="2">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.</td><td>P400 [-01]</td><td>Setpoint frequency</td></tr>
<tr><td>16</td><td>AI2</td><td>Analogue input 2</td><td>P400 [-02]</td><td>No function</td></tr>
<tr><td>17</td><td>AO</td><td>Analogue output</td><td>U = 0 ... 10 V,
I = 0 ... 20 mA,
Ri = 165 Ω,
reference potential GND, max. load current: 20 mA</td><td>P418 [-01]</td><td>No function</td></tr>
</table>

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. Limiting frequency:max. 150 kHz	P420 [-01]	ON right
22	DI2	Digital input 2		P420 [-02]	ON left
23	DI3	Digital input 3		P420 [-03]	Parameter set bit0
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	24V	24V supply voltage **output**. Power supply provided by the FI for controlling the 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 the 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 [-01]	No function
35	DO2	Digital output 2	P434 [-02]	No function
43	24V	Output voltage,VO/24 V	–	–
40	GND	Reference potential for digital signals, 0 V digital	–	–

Encoder (TTL) X13 (SK 530P or higher)		Monitoring of motor temperature using PTC			
43	24V	Output voltage, VO/24 V		-	-
40	GND	Reference potential for digital signals, 0 V		-	-
51	A+	Track A	TTL, RS 422, 16 … 8192 impulses/revolution. Limiting frequency: max. 1 MHz	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		

System bus (CANopen) X15		Evaluation of an absolute encoder		
		The CANopen interface can be used to evaluate an absolute encoder. Further details can be found in manual BU 0610. Baud rate … 500 kBaud; Termination resistor R = 240 Ω ; DIP switch 2; Recommended: Implement strain relief		
90	SHD	Shielding	P503 P509	
40	GND	Reference potential for digital signals, 0 V		
76	CAN-	CAN_L		
75	CAN+	CAN_H		

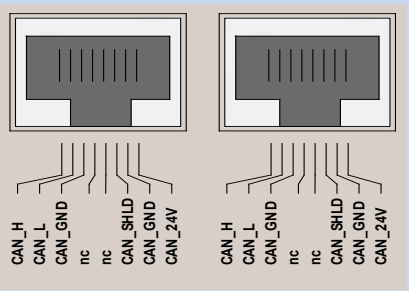
Two options exist for the CANopen connection:

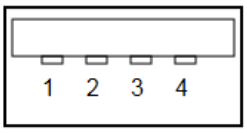
1. Double terminal SK TIE5-CAO-WIRE-2x4P

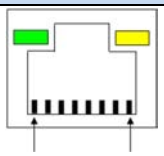
Part No. 275292201

Connections of these terminals corresponds to the connection of the standard terminal for the CANopen system bus X15, however with two connection options each.

2. RJ45 Adapter

		Baud rate … 500 kBaud The RJ45 sockets are connected in parallel internally. Termination resistor R = 240 Ω  2 x RJ45: Pin No. 1… 8		
1	CAN_H	CAN/CANopen signal	P503 P509	
2	CAN_L			
3	CAN_GND	Reference potential for digital signals, 0 V		
4	nc	No function		
5	nc			
6	CAN_SHLD	Cable shield		
7	CAN_GND	Reference potential for digital signals, 0 V		
8	CAN_24V	External 24 V DC power supply		

USB Communication interface X16 (SK 530P or higher)		Connection of the FI to a PC (alternatively to the RJ12 interface) for communication with NORDCON software		
		USB 2.0 Type C (SK 530P or higher)		
1	+5V	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 -	

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 🕮 Section 1.3.

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 input

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 min-1 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.

Unlike incremental encoders, for *sine encoders or SIN/COS encoders* the signals are not in the form of pulses, but rather in the form of sine signals (shifted by 90°).

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 can occur that can cause encoder signal problems or destruction of the encoder.

Information

Rotation direction

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

Alternatively, the motor phase sequence can be changed via parameter **P583**. In this way the direction of rotation can be changed using the software only.

Incremental encoders

According to the resolution (pulse number), incremental encoders generate a defined number of pulses for each rotation of the encoder shaft (Track A / Track A inverse) With this, the precise speed of the encoder or motor can be measured by the frequency inverter. By the use of 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 a rotary encoder with TTL signals. Parameterisation of the corresponding functions is made with the parameters from the group "Control parameters" (**P300** et seq.). TTL encoders enable the best performance for control of a drive unit with frequency inverters SK 530P and higher.

HTL encoder

The digital inputs DIN 3 and DIN 4 are used to connect an encoder with an HTL signal. Parameterisation of the corresponding functions is performed with parameters **P420 [-03/-04]**.

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	**X11: 25**	DI5
Track 0 inverse	Black	**-**	-	-	-
Cable shield	Connect to a large area of the frequency inverter housing or shielding bracket				

Table 12: Colour and contact assignments for NORD TTL / HTL incremental encoders

Information

Incremental encoder data sheet

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

2.7 Fans

2.7.1 Removing the fan

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

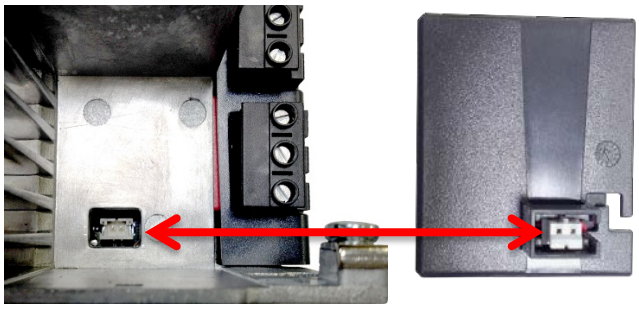
1.

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.



3 Options

3.1 Overview of option modules

The function of the frequency inverter can be extended with a ControlBox SK TU5-CTR, a customer unit SK CU5-… (SK 530P and higher) and other option modules. The options can be plugged in. Either a blank cover or an SK TU5 module can be attached to an SK CU5 module.

SK TU5-CTR

SK CU5-…

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

ControlBox

Module	Designation	Description	Data	Material No.	Info
SK TU5-CTR	ControlBox	Commissioning, parameterisation and control of the frequency inverter	5-digit, 7-segment display, keyboard	275297000	Installation in the SK TU5 slot

Customer units

Module	Interface	IOs	Material No.	Info
SK CU5-MLT	Encoder interface: TTL, SIN/COS, Hiperface, Endat, Biss, SSI Functional safety: STO, SSI	4 IO (usable as DIN or DOUT)	275298200	Functional safety: 2-channel connection BU 0630
SK CU5-STO	Functional safety: STO, SSI	1 Safe DI	275298000	

Other option modules

Module	Interface	Data	Material No.	Info
SK EBGR-1	Electronic brake rectifier	Extension for direct control of an electro-mechanical brake, IP20, snap-on rail mounting	19140990	TI 19140990
SK EBIOE-2	IO extension	Extension with 4 DI, 2 AI, 2 DO und 1 AO, IP20, snap-on rail mounting	275900210	TI 275900210

Installation

Information

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

Installation of a technology unit separate from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

Installation must be carried out as follows:

1. Switch off the mains voltage, observe the waiting period
2. Push the control terminal cover down slightly or remove
3. Remove the blank cover by activating the release mechanism at the lower edge and removing it with an upward rotating movement
4. Hook the technology unit onto the upper edge and press in lightly until it engages. Take care that the connector strip makes proper contact
5. Close the control terminal cover again

Blank cover and control terminal cover

SK TU5-CTR

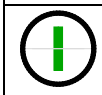
SK CU5-…

3.2 SK TU5-CTR

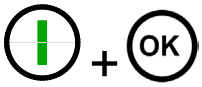
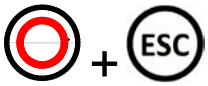
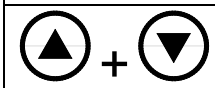
The SK TU5-CTR ControlBox is used for commissioning, configuring and controlling the frequency inverter. It is mounted directly on the slot for technology units or on the SK CU5 module. Communication with the inverter and the power supply of the module are provided by a contact rail. The module cannot be used independently from the inverter.

Display is by means of a five digit seven segment LCD display. Control is via six control keys.

3.2.1 Control keys

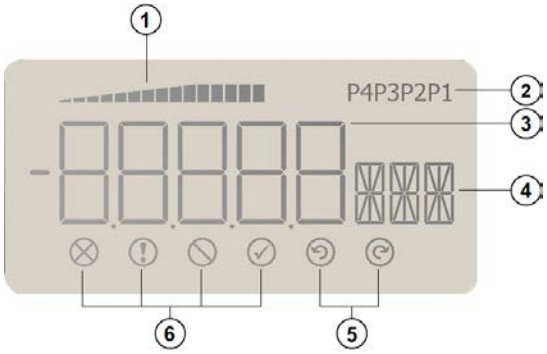
		Frequency inverter	**parameterisation**
	Start key	Switches on the FI The frequency inverter is now enabled with the set jog frequency (**P113**). A pre-set minimum frequency (**P104**) is at least provided. Parameter "Interface" **P509** and **P510** must = 0.	Disables parameterisation mode.
	Stop key	Switches off the FI. The output frequency is reduced to the absolute minimum frequency (**P505**) and the frequency inverter shuts down.	
	Selection key	Increases the frequency. Both selection keys pressed simultaneously = Quick stop.	Enables parameterisation mode. Increases the parameter value.
	Selection key	Reduces the frequency Both selection keys pressed simultaneously = Quick stop.	Enables parameterisation mode. Reduces the parameter value.
	OK key	Saves the set frequency value. The version number is displayed during the switch-on phase.	Saves the changed parameter value or switches between parameter number and parameter value.
	Esc key	Changes the direction of rotation.	If a changed value is not to be saved, the parameter mode can be exited by pressing the Esc key.

Further functions can be accessed via combinations of two or more keys:

	If the inverter is switched on: Switch to the parameter level	
	Trigger quick stop by enabling with the keyboard	
	Reset the value to the default setting	
	Flashing:	Only the last 5 bars flash: Warning, inverter overloaded Over a long period this results in a shutdown with an I²t error or a PT error
	Lights:	Depending on the number of bars which are displayed the inverter has a load of 0 % (0 bars) to ≥ 150 % (15 bars).

3.2.2 Display

3.2.2.1 Displays



1 Inverter load display (with 100% value)
2 Parameter set display
3 Five digit 7-segment display with prefix and 4 x point
4 Three digit 14-segment display for units
5 Enable right and enable left
6 4 Inverter status displays

3.2.2.2 Operation

5-digit, 7-segment LED display	Operating mode	Display	Comments
	Ready for operation without setpoint present		If the underscores flash slowly the frequency inverter is not ready for operation: • Switch-on inhibit: Function “safe pulse block“ or "quick stop active" • Enable signal present before the frequency inverter is ready for operation
	In operation	Numerical display 	Display of actual frequency.
	In case of fault	Displays the present fault message. Display lights up red. 	Slow flashing of the display indicates that the fault is no longer present and the error message can be acknowledged.
	Parameterisation	Parameter value 	Parameter group: Example motor data (P2 - -))
			Parameter number: Example nominal speed (P202)
			Parameter value Example: 1360 rpm

3.2.2.3 Status displays

	Fault present		FI is ready to switch-on
	Warning present		Enable (rotates left) present
	Switch-on inhibit present		Enable (rotates right) present

3.2.3 Control

The frequency inverter can only be controlled via the control panel, if it has not been previously enabled via the control terminals or via a serial interface (**P509 = 0** and **P510 = 0**).

Once the control panel has been mounted on the frequency inverter and provided with power, the display briefly shows the type of device and the rated power. After this the display for readiness to operate is shown.

If the Start key is pressed, the frequency inverter changes to the operating display (selection **P001**). The frequency inverter supplies 0 Hz or the minimum frequency (**P104**) or jog frequency (**P113**) which has been set.

Parameter set display

In the operating display (**P000**) the parameter set display shows the actual parameter set and for parameterisation (≠ **P000**), the parameter set which is being parameterised.

For control of the frequency inverter via the control panel, the parameter set can be switched over via **P100** even during operation.

Frequency setpoint

The actual frequency setpoint depends on the setting in the parameters "Jog frequency" (**P113**) and "Minimum frequency" (**P104**). This value can be altered during keyboard operation with the value keys ▲ and ▼ and permanently stored in **P113** as the jog frequency by pressing the OK key.

Emergency stop:

By simultaneously pressing the ▼ und ▲ keys, a quick stop can be initiated.

3.2.4 Parameterisation

Switching to parameter mode is performed in different ways depending upon the operating states and the enabling source.

1. If enabling is not present via the control panel, control terminals or a serial interface, switch-over from the operating value display to parameterisation mode can be made directly with ▼ or ▲.
2. If an enable is present via the control terminals or a serial interface and the frequency inverter is producing an output frequency, it is also possible to switch to the parameterisation mode directly from the operating value display using the ▼ or ▲ keys.
3. If the frequency inverter has been enabled via the control panel (Start key) access to the parameter is not possible via the control panel.

Changing parameter values

Each parameter has a parameter number → P x x x. The significance and description of the parameters can be found in Section 🕮 5 "Parameter".

1. Press ▼ or ▲, to access the parameter area. The display changes to the menu group display P 0 _ _ ... P 8 _ _.
2. Press the Start key to open the menu group. All parameters are arranged in order in a ring structure in the individual menu groups. It is therefore possible to scroll forwards and backwards within this section.
3. Select the required parameter with ▼ or ▲ and press the OK key.
4. Change the setting with▼ or ▲ and confirm the changed setting by pressing the OK key.

As long as a changed value has not been confirmed by pressing OK key, the value display will blink; this value is not stored in the frequency inverter.

Press the ESC key to exit from the menu.

Menu structure with the ControlBox

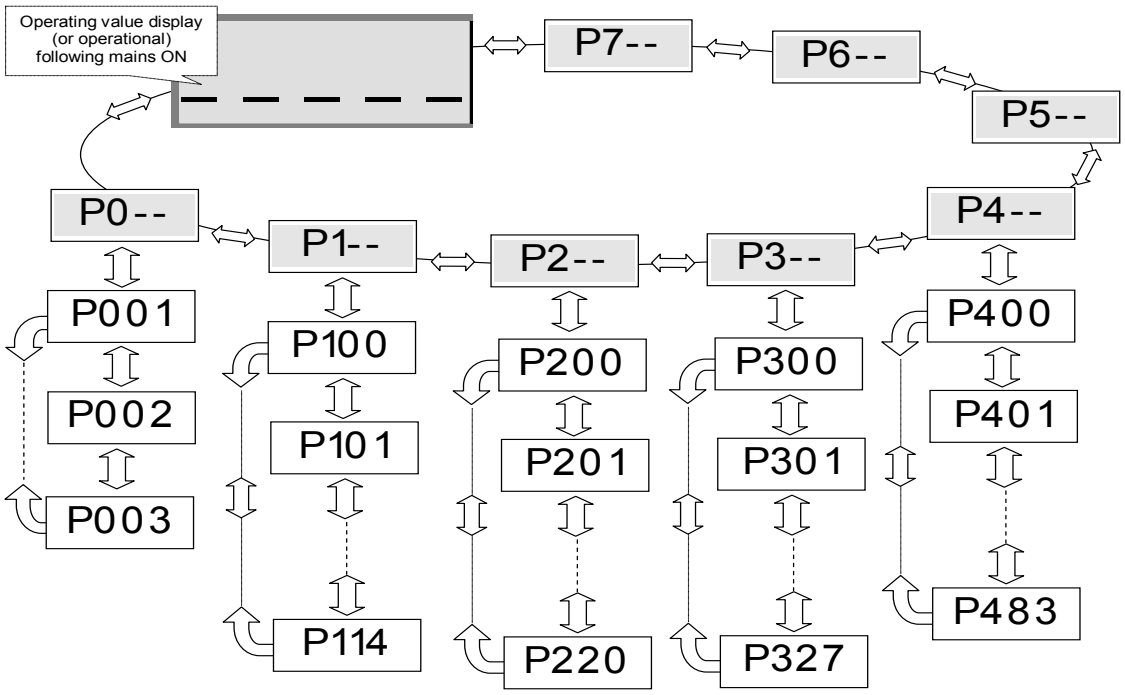
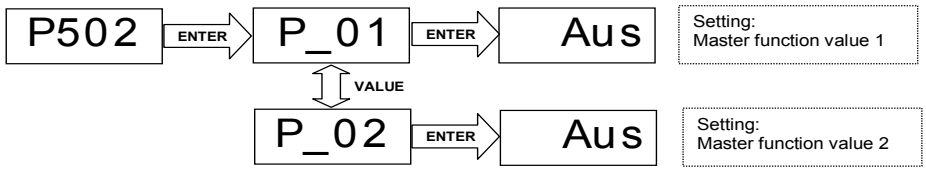


Figure 6: ControlBox menu structure

Information

Some parameters such as **P420** and **P502** have additional levels (Arrays), in which further settings can be made, e.g.:



3.3 Frequency addition and subtraction via control boxes

If the parameter P549 (PotentiometerBox Function) is set to 4 “Frequency addition” or 5 “Frequency subtraction”, a value can be added or subtracted using the **value keys** 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.

As soon as the inverter is enabled, the ControlBox switches to the operating display. Parameterisation is then no longer possible. Enabling via the ControlBox or ParameterBox is also no longer possible in this mode, even if **P509 = 0** and **P510=0**.

3.4 Connection of multiple devices to one parametrisation tool

In principle it is possible to access several frequency inverters via the **ParameterBox** (SK PAR-3X) 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. Supply the CAN-Bus with power (24 V).
3. Parameterisation

Parameters		**Settings on the FI**							
No.	**Designation**	**FI 1**	**FI 2**	**FI 3**	**FI 4**	**FI 5**	**FI 6**	**FI 7**	**FI 8**
P503	Master func. output	4 (system bus 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 baud rate	5 (250 kBaud)							
P515	CAN address	32	34	36	38	40	42	44	46

To adopt the addresses, the 24 V supply of the CAN bus must be completely switched off for approx. 30 sec.

4. 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 actual software status:

NORDCON	≥ 02.07.00.06
ParameterBox	≥ 4.6 R2

4 Commissioning

⚠ WARNING

Unexpected movement

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

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

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

4.1 Factory settings

All frequency inverters supplied by Getriebebau NORD are pre-programmed with the default setting for standard applications with 4 IE3pole standard motors (same voltage and power). For use with motors with other powers or number of poles, the data from the rating plate of the motor must be input into parameters **P201 ... P207** of the menu group >Motor data<.

Information

All data from IE3 /IE4motors can be pre-set with parameter **P200**. After use of this function has been successful, this parameter is reset to *0 = no change*! The data are automatically loaded once into parameter **P201 ... P209** and can be compared with the data on the motor type plate.

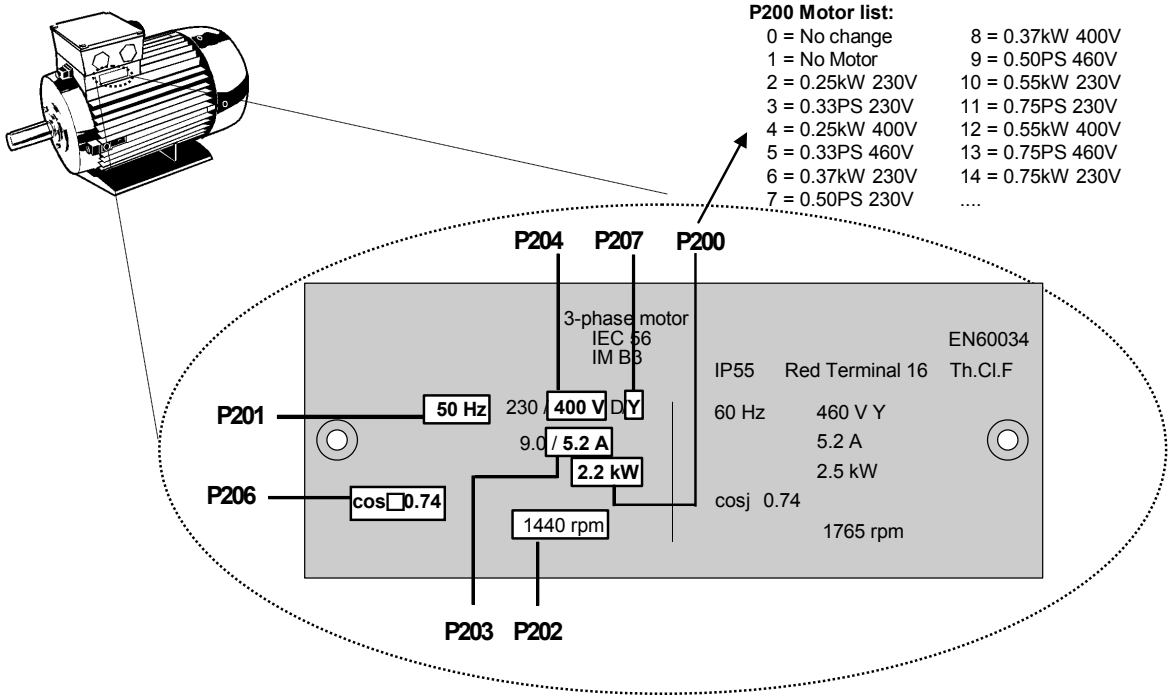


Figure 7: Motor type plate

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

In order 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 **P208**.

Motor data for IE1 / IE2 motors are provided via the **NORDCON** software. With the aid of the "Import motor parameter" function (also refer to the manual for the **NORDCON** software BU 0000), the required data set can be selected and imported into the frequency inverter.

4.2 Selecting the operating mode for motor control

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

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

4.2.1 Explanation of the operating modes (P300)

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

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

   This operating mode is based on a voltage-governed flux oriented control method (Voltage Flux Control Mode (*VFC*)). This is used for both ASMs as well as PMSMs. In association with the operation of asynchronous motors this is often referred to as "ISD control".
   Control is carried out without the use of encoders and exclusively on the basis of fixed parameters and the measurement results of actual electrical values. No specific control parameter settings are necessary for the use of this mode. However, parameterisation of the precise motor data is an essential prerequisite for efficient operation.
   As a special feature for the operation of an ASM there is also the possibility of control according to a simple V/f characteristic curve. This mode of operation is important if several motors which are not mechanically coupled are to be operated with a single frequency inverter, or if it is only possible to determine the motor data in a comparatively imprecise manner.
   Operation according to a V/f characteristic curve is only suitable for drive applications with relatively low demands on the quality of speed control and dynamics (ramp times ≥ 1 s). For machines which tend to have relatively large mechanical vibrations due to their construction, control according to a V/f characteristic curve can also be advisable. Typically, V/f characteristic curves are used to control fans, certain types of pump drives or agitators. Operation according to a V/f characteristic curve is activated via parameters (P211) and (P212) (each set to "0").

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

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

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

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

4.2.2 Overview of control parameter settings

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

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

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

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

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

4.2.3 Motor control commissioning steps

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

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

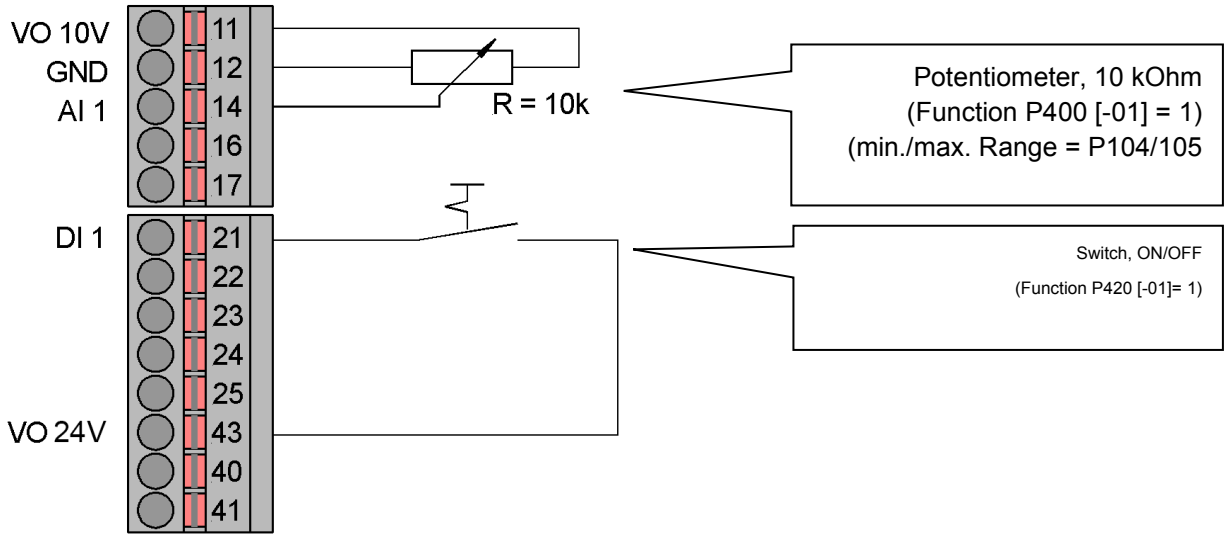
Information

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

4.3 Minimum configuration of control connections

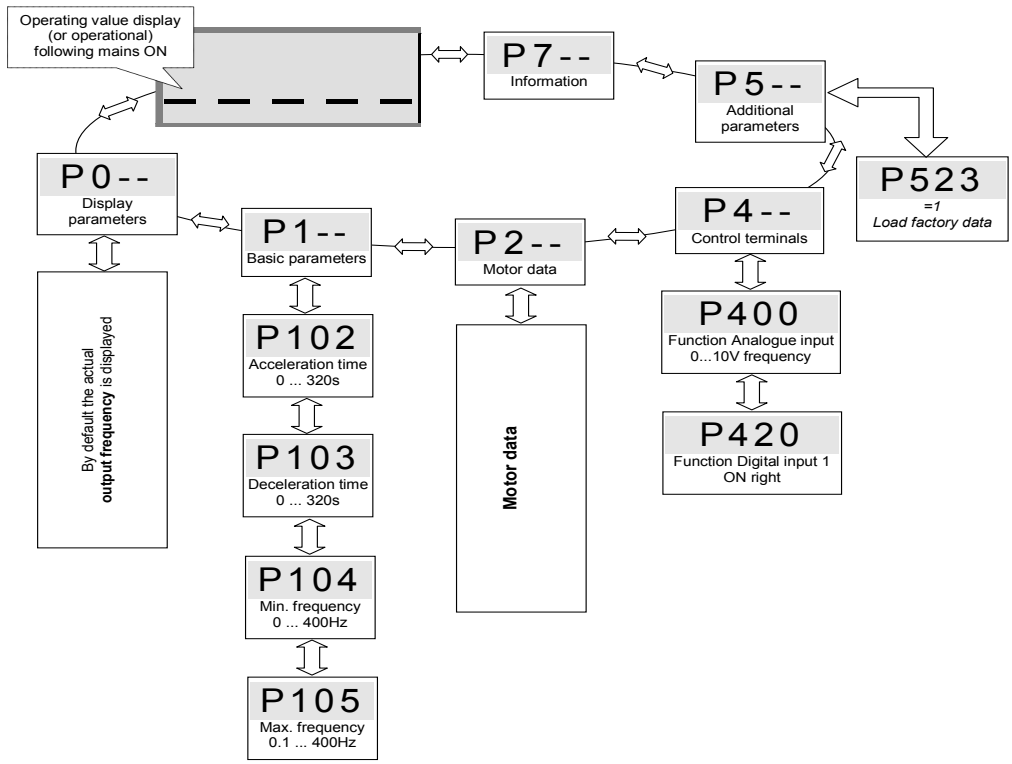
If the frequency inverter is to be controlled via the digital and analogue inputs, this can be implemented immediately in the condition as delivered. Settings are not necessary for the moment.

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 precision of regulation by the frequency inverter and the associated optimum speed precision of the motor is achieved at all times. As the temperature measurement starts immediately after (mains) switch-on of the frequency inverter, the frequency inverter provides immediate optimum control, even if the motor has a considerably increased in temperature after an intermediate "Mains off / Mains on" of the frequency inverter.

Information

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

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

Information

Pay attention to polarity

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 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 [%]	P403[xx][1] 100 % Adjustment [%]
KTY84-130	2.7	15.4	26.4
PT100	2.7	3.6	4.9
PT1000	2.7	26.8	33.2

1) Xx = Parameter array, depending on the analogue input used

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

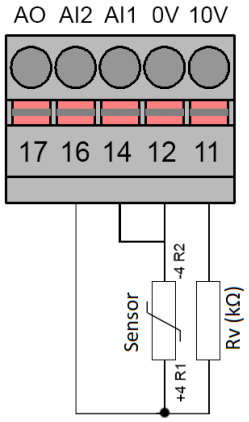
Taking into account the relevant values for the 0% adjustment [P402] and 100% adjustment [P403], these examples can be used for all of the approved temperature sensors which are stated above.

Information

Due to self-heating, the maximum measurement current according to the data sheet must be taken into account for selection of the PT1000/PT100.

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]**

5 Parameter

WARNING

Unexpected movement

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

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

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

WARNING

Unexpected movement due to parameter changes

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

Therefore:

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

⚠ WARNING

Unexpected movement due to overload

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

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

To prevent any risk, the following must be observed:

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

A description of the relevant parameters for the frequency inverter can be found below. Access to the parameters is made with a parameterisation tool (e.g. NORDCON software) or a control or parameterisation unit, (also refer to 1.3 "Scope of delivery") 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.

Access to the parameters is only possible if the control unit of the frequency inverter is active:

- Via the mains voltage
- Via 24 V (X6)
- Via USB (X6)

Note: With power supply via USB the parameter for setting the Ethernet dialect cannot be changed.

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 parameter	(P0--)	Parameter 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 in 🕮 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 in 🕮 BU0620)

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 display** (parameter name)		**S**	**P**
Setting range (or display range)	Display of typical display format (e.g. (bin = binary)) of 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 FI, or to which it is set after carrying out "Restore factory settings" (see parameter P523).		
Scope of Application	List of 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 8: Explanation of parameter description

Information

Parameter description

Unused lines of information are not listed.

Notes / Explanations

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

5.1 Parameter overview

Operating displays

P000 Operating display	**P001** Display selection	**P002** Display factor
P003 Supervisor code	**P004** Password	**P005** Change password

DS402 parameter

P020 Target speed	**P021** Actual speed after ramp	**P022** Actual speed
P023 Speed	**P024** Acceleration	**P025** Brakes
P026 Quick stop	**P027** Percentage speed	**P028** Control word
P029 Status word	**P030** Stop mode	**P031** Operating mode
P032 Actual operating mode	**P033** Torque setpoint	**P034** Digital input status
P035 Set digital outputs	**P046** Actual position	**P047** Slip error
P048 Target window	**P049** Set position	**P050** Encoder polarity
P051 Maximum speed profile	**P052** Positioning speed profile	**P053** Positioning profile type
P055 Position unit	**P056** Speed ratio	**P057** Feed constant
P058 Homing mode	**P059** Homing speed	**P060** Homing acceleration
P061 Homing offset	**P062** Actual speed	**P063** Speed target window
P064 Speed threshold value	**P065** Acceleration profile	**P066** Delay profile
P067 Quick stop delay	**P072** Profile speed	**P073** Actual torque
P074 Actual current	**P075** Actual DC 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 motor frequency	**P202** Nominal motor speed
P203 Nominal motor current	**P204** Nominal motor voltage	**P205** Nominal motor power
P206 Motor cos phi	**P207** Motor circuit	**P208** Stator resistance
P209 No-load current	**P210** Static boost	**P211** Dynamic boost
P212 Slip compensation	**P213** Amplification ISD control	**P214** Torque lead time
P215 Boost lead time	**P216** Boost lead time	**P217** Oscillation damping
P218 Modulation depth	**P219** Auto. flux adaptation	**P220** Par. identification
P240 PMSM EMF voltage	**P241** PMSM inductance	**P243** Reluct. angle IPMSM
P244 PMSM peak current	**P245** Power system stabilisation PMSM VFC	**P246** Moment of inertia
P247 Switchover frequency VFC PMSM		

Control parameters

P300 Control method	**P301** Encoder resolution	**P310** Speed controller P
P311 Speed controller I	**P312** Torque current controller P	**P313** Torque current controller I
P314 Limit of torque current control	**P315** Field curr. ctrl. P	**P316** Field curr. ctrl. I
P317 Field curr. ctrl. lim.	**P318** Field weakening controller P	**P319** Field weakening controller I
P320 Field weakening limit	**P321** Speed ctr. I brake release time	**P325** Encoder function
P326 Encoder speed ratio	**P327** Speed slip error	**P328** Speed slip delay
P330 Rotor starting position detection	**P331** Switch over freq. CFC ol	**P332** Hyst. switchover CFC ol
P333 Flux feedback CFC ol	**P334** PMSM Encoder offset	**P336** Rotor pos. identification mode
P350 PLC functionality	**P351** PLC setpoint selection	**P353** Bus status via PLC
P355 PLC integer setpoint	**P356** PLC long setpoint	**P360** PLC display value
P370 PLC status		

Control terminals

P400 Analog input function	**P401** Analog input mode	**P402** Analog input matching 0%
P403 Analog input matching 100%	**P404** Analog input filter	**P405** V/I Analog
P410 Min. freq. a-in 1/2	**P411** Max. freq. aux setpoint	**P412** Process ctrl. setpoint
P413 PID controller P comp.	**P414** PID controller I comp.	**P415** PID controller D comp.
P416 Ramp time PI setpoint	**P417** Analog output offset	**P418** function Analog output
P419 Standard Analog output	**P420** Digital inputs	**P423** Max. Safety SS1 time
P424 Safety digital input.	**P425** PTC input function	**P426** Quick stop time
P427 Quick stop on error	**P428** Automatic start	**P429** Fixed frequency 1
P430 Fixed frequency 2	**P431** Fixed frequency 3	**P432** Fixed frequency 4
P433 Fixed frequency 5	**P434** Digital output function	**P435** Dig. out scaling
P436 Dig. out. hysteresis	**P460** Watchdog time	**P464** Fixed frequency mode
P465 Fixed freq. Array	**P466** Minimum freq. process control	**P475** On/off switching delay
P480 Function BusIO In Bits	**P481** Function BusIO Out Bits	**P482** Standard BusIO Out Bits
P483 Hyst. BusIO Out Bits	**P499** Safety CRC	

Additional parameters

P500 Language	**P501** Inverter name	**P502** Master function value
P503 Master func. output	**P504** Pulse frequency	**P505** Absolute minimum freq.
P506 Auto. Fault acknowledgement	**P509** Control word source	**P510** Source setpoints
P511 USS baud rate	**P512** USS address	**P513** Telegram timeout
P514 CAN baud rate	**P515** CAN address	**P516** Skip frequency 1
P517 Skip freq. area 1	**P518** Skip frequency 2	**P519** Skip freq. area 2
P520 Flying start	**P521** Flying start Resolution	**P522** Flying start Offset
P523 Factory setting	**P525** Load control max.	**P526** Load control min.
P527 Load monitoring Freq.	**P528** Load monitoring delay	**P529** Mode Load control
P533 Factor I²t	**P534** Torque disconn. lim.	**P535** I²t motor
P536 Current limit	**P537** Pulse disconnection	**P538** Mains voltage Monitoring

P539	Output monitoring	**P540**	Mode phase sequence	**P541**	Set digital outputs
P542	Set analog out	**P543**	Bus actual value	**P546**	function Bus setpoint
P549	PotentiometerBox function	**P550**	µSD orders	**P551**	Drive profile
P552	CAN master cycle	**P553**	PLC setpoints	**P554**	Min. chopper threshold
P555	P - chopper limit	**P556**	Braking resistor	**P557**	Braking resistor power
P558	Flux delay	**P559**	DC run-on time	**P560**	Param. saving mode
P583	Motor phase sequence				

Information

P700	Actual operating status	**P701**	Last error	**P702**	Freq. last error
P703	Current. last error	**P704**	Volt. last error	**P705**	Dc. link volt. last er.
P706	P set last error	**P707**	Software version	**P708**	Status of digital in.
P709	V/I analog inputs	**P710**	V/I analog outputs	**P711**	Digital output status
P712	Energy consumption	**P713**	Braking resistor energy	**P714**	Operating time
P715	Running time	**P716**	Actual frequency	**P717**	Actual speed
P718	Actual setp. freq.	**P719**	Actual current	**P720**	Act. torque current
P721	Actual field current	**P722**	Actual voltage	**P723**	Voltage -d
P724	Voltage -q	**P725**	Current cos phi	**P726**	Apparent power
P727	Mechanical power	**P728**	Input voltage	**P729**	Torque
P730	Field	**P731**	Parameter set	**P732**	Phase U current
P733	Phase V current	**P734**	Phase W current	**P735**	Speed encoder
P736	DC link current	**P737**	Braking resistor usage rate	**P738**	Motor load
P739	Temperature	**P740**	Process data bus In	**P741**	Process data bus Out
P742	Database version	**P743**	Inverter ID	**P744**	Configuration
P745	Module version	**P746**	Module status	**P747**	Inverter Volt. Range
P748	CANopen status	**P750**	Fault statistics	**P751**	Statistics counter
P780	Inverter ID	**P799**	Op.hrs. last fault		

5.1.1 Operating display

P000	Operating display
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]	Present supplied output frequency
1	Speed	[rpm]	Calculated speed
2	Setpoint frequency	[Hz]	Output frequency that corresponds to the present setpoint. This need not correspond with the current output frequency.
3	Current	[A]	Present measured output current
4	Torque current	[A]	Torque-forming output current
5	Voltage	[V AC]	Present AC voltage at the device output
6	Link voltage	[V DC]	The *"Link circuit 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 actual power factor
8	Apparent power	KVA	Calculated value of actual apparent power
9	Effective power	[kW]	Calculated value of actual effective power
10	Torque	[%]	Calculated value of actual torque
11	Field	[%]	Calculated value of actual rotating field in the motor
12	Hours of operation	[h]	Time for which mains voltage has been present on the device
13	Operating time Enable	[h]	*"Enabled operating hours"* is the time for which the device has been enabled.
14	Analogue input 1	[%]	Actual value present at analogue input 1 of the FI
15	Analogue input 2	[%]	Actual value present at analogue input 2 of the FI
16	… 18		*Reserved, POSICON*
19	Heat sink temperature	[°C]	Actual temperature of heat sink
20	Motor load	[%]	Average motor load based on known motor data P201 … P209
21	Brake load R	[%]	"*Braking resistor load*" is the average load on the braking resistor based on the known resistance data P556 … P557
22	Ambient UZW temp.	[°C]	Actual interior temperature of the FI
23	Motor temperature		measured via temperature sensor (KTY-84, PT100, PT1000)
24	… 29		*Reserved*
30	Actual setp. freq.	[Hz]	"*Actual motor potentiometer setpoint with saving*": P420 … = 71/72. With this function the setpoint can be read out or pre-set (without the drive running).
31	… 39		*Reserved*
40	PLC Ctrlbox value		Visualisation mode for PLC communication
41	… 59		*Reserved, POSICON*
60	R stator ident		Stator resistance determined by means of measurement P220
61	R rotor ident		rotor resistance determined by measurement (P220 Function 2)
62	L stray stator ident		stray inductance determined by measurement (P220 Function 2)
63	L stator ident		inductance determined by measurement (P220 Function 2)
64	… 65		*Reserved*

P002	Display factor	S
Setting range	0.01 … 9999.99	
Factory setting	{ 1 }	
Description	The selected operating value in parameter P001 "Display selection" is multiplied by the scaling factor in P000 and displayed in the "Operating display". It is therefore possible to display system-specific operating values e.g. 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	S
Setting range	- 32768 … 32767	
Factory setting	{ 0 }	
Description	Entry of the password from P005 to unlock all visible, editable parameters.	
Note	The value which is entered here is lost when the control board / the 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 editable parameters from unauthorised changes. Password protection can be temporarily suspended via P004.	
Note	The password is generally cancelled with setting "0" in P005.	

5.1.2 DS402 parameter

P020	DS402 target speed				S
Setting range	-24000 ... 24000 rpm				
Factory setting	{ 0 }				
Description	"*6042 target speed*". Sets target speed				

P021	DS402 Actual speed after ramp				S
Display range	-24000 ... 24000 rpm				
Default	{ 0 }				
Description	"*6043 Act. speed after ramp*".				

P022	DS402 Actual speed				S
Display range	-24000 ...24000				
Default	{ 0 }				
Description	"*6044 Actual speed*." displays the actual speed.				

P023	DS402 speed				S
Setting range	[-01] =	0 ... 24000 rpm	[-02] =	1 ... 24000 rpm	
Arrays	[-01] =	Minimum speed	[-02] =	Maximum speed	
Factory setting	[-01] =	{ 0 }	[-02] =	{ 1500 }	
Description	*"6046 Min/max speed"*. Sets minimum and maximum speed				

P024	DS402 acceleration				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 }	
Description	"*6048 acceleration*."				

P025	DS402 brake				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 }	
Description	"*6049 braking*."				

P026	DS402 Quick stop				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 }	
Description	"*604A Quick stop*."				

P027	DS402 Percentage speed after ramp	S
Display range	-32768 ... 32768	
Factory setting	{ 0 }	
Description	"*6053 Percentage speed after ramp.*"	

P028	DS402 Control word	S
Setting range	-32768 … 32768	
Factory setting	{ 0 }	
Description	"*6040 Control word*." Sets the control word	

P029	DS402 Control word	S
Display range	-32768 … 32768	
Factory setting	{ 0 }	
Description	“*6041 Status word*.“ Displays the status word.	

P030	DS402 Stop mode	S
Setting range	0 … 2	
Factory setting	{ 2 }	
Description	“605D Stop mode.“ Sets the stop mode	

Setting values	Value	Function	Description
	0	Disable voltage	
	1	Brake ramp P025	
	2	Quick stop P026	

P031	DS402 Operating mode	S
Setting range	-1 … 6	
Factory setting	{ 2 }	
Description	“*6060 Operating mode*.“ Sets the operating mode.	

Setting values	Value	Function	Description
	-1	NORD mode	
	0	Reserved	
	1	Profile position mode	
	2	Velocity mode	
	3	Profile velocity mode	
	4	Profile torque mode	
	5	Reserved	
	6	Homing mode	

P032	DS402 Actual Operating mode	S
Display range	-1 … 6	
Factory setting	{ 3 }	
Description	“*6061 Actual operating mode*“ displays the actual operating mode.	

Setting values	Value	Function	Description
	-1	NORD mode	
	0	Reserved	
	1	Profile position mode	
	2	Velocity mode	
	3	Profile velocity mode	
	4	Profile torque mode	
	5	Reserved	
	6	Homing mode	

P033	DS402 Torque setpoint	S
Setting range	-400 … 400 %	
Factory setting	[-01] = { 100 }	
Description	“*6071 Target torque*.“ Sets the torque setpoint.	

P034	DS402 Digital input status		S
Display range	-2147483648 … 2147483647		
Factory setting	{ 0 }		
Description	„*60FD Act. Digital in.*“ Displays the state of the actual digital inputs.		
Setting values	**Value**	**Function**	**Description**
	Bit: 0	Negative limit switch	
	Bit: 1	Positive limit switch	
	Bit: 2	Home switch	
	Bit: 3	… 15: reserved	
	Bit: 16	Digital input 1	Basic device
	Bit: 17	Digital input 2	Basic device
	Bit: 18	Digital input 3	Basic device
	Bit: 19	Digital input 4	Basic device
	Bit: 20	Digital input 5	Basic device
	Bit: 21	Digital input 6	Basic device
	Bit: 22	Digital input 7	Basic device
	Bit: 23	Digital input 8	Basic device
	Bit: 24	Digital input 9	Basic device
	Bit: 25	Digital input 10	Basic device
	Bit: 26	Digital input 11	Basic device
	Bit: 27	Digital input 12	Basic device
	Bit: 28	Analog input 1	Digital function
	Bit: 29	Analog input 2	Digital function

P035	DS402 Set digital outputs		S
Setting range	-2147483648 … 2147483647		
Factory setting	{ 0 }		
Description	“*60FE Digital output*.“ Sets digital output.		
Setting values	**Value**	**Function**	**Description**
	Bit: 0	Set brake	
	Bit: 1	… 15 reserved	
	Bit: 16	Test multi-function relay 1	
	Bit: 17	Test multi-function relay 2	
	Bit: 18	Digital output 1	
	Bit: 19	Digital output 2	
	Bit: 20	Digital output 3	CU5
	Bit: 21	Digital output 4	CU5
	Bit: 22	Digital output 5	CU5
	Bit: 23	Digital output 6	CU5
	Bit: 24	Digital output AOUT1	

P046	DS402 Actual position			S
Display range	[-01] =	-2147483648 … 2147483647 inc		
	[-02] =	-2147483,648 … 2147483,647 rev		
Arrays	[-01] =	6063 Act.Pos Inc.	[-02] =	6064 Actual position
Factory setting	All { 0 }			
Description	Displays the actual position as an incremental value or number of rotations.			

P047	DS402 Slip error			S
Setting range	[-01] =	0 … 2147483,647 rev	[-02] =	0 ... 32767 ms
Arrays	[-01] =	6065 Pos. slip error	[-02] =	6066 Time slip error
Factory setting	[-01] =	{ 0 }	[-02] =	{ 200 }
Description	Displays the position and delay of slip errors			

P048	DS402 Time window			S
Setting range	[-01] =	0 … 2147483.647 rev	[-02] =	0 ... 32767 ms
Arrays	[-01] =	6067 Pos. target window	[-02] =	6068 Target window Time
Factory setting	[-01] =	{ 0.1 }	[-02] =	{ 200 }
Description	Sets the position and delay of the target window			

P049	DS402 Position setpoint	S
Setting range	-2147483,648 … 2147483,647 rev	
Factory setting	{ 0 }	
Description	“*607A Position setpoint*“. Sets the position setpoint	

P050	DS402 Encoder polarity	S
Setting range	0 … 192	
Factory setting	{ 0 }	
Description	“*607E Encoder polarity*.“ Sets the encoder polarity	

Setting values	Value	Function	Description
	Bit 0	… 5 reserved	
	Bit 6	Inverse speed polarity	
	Bit 7	Inverse position polarity	

P051	DS402 Maximum speed profile	S
Setting range	0 ... 24000 rpm	
Factory setting	{ 1500 }	
Description	“*607F Max speed profile*“. Sets the maximum speed profile	

P052	DS402 Pos. speed profile	S
Setting range	0 ... 24.000 rev	
Factory setting	{ 1500 }	
Description	“*6081 Speed profile*”. Sets the speed profile position	

P053	DS402 Positioning profile type	S
Setting range	0 … 1	
Factory setting	{ 0 }	
Description	“*6086 Position type*.“ Sets the positioning profile type.	

Setting values	Value	Function	Description
	0	Linear ramp	
	1	$\sin^2$ ramp	

P055	DS402 Position unit			S
Setting range	0 … 1			
Factory setting	{ 0 }			
Description	"*608A Positioning unit*." Sets the unit for positioning.			
Setting values	**Value**	**Function**	**Description**	
	0	rev [rotations]		
	1	m [Metre		

P056	DS402 Speed ratio			
Setting range	-2147483647 … 2147483647			
Arrays	[-01] =	6091_1 Speed ratio	[-02] =	6091_2 Speed reduction ratio
Factory setting	All { 0 }			
Description	Sets the speed ratio and speed reduction ratio			

P057	DS402 Feed constants			S
Setting range	[-01] =	1 … 2147483647 m	[-02] =	1 … 2147483647 rev
Arrays	[-01] =	6092_1 Feed constant.	[-02] =	6092_2 Feed speed
Factory setting	[-01] =	{ 1 }	[-02] =	{ 10 }
Description	Sets the feed constants.			
Note	the values are taken into account in scaling if the setting value "Metres" is selected in„*DS402 Position unit*" (608A).			

P058	DS402 Homing mode		S
Setting range	0 … 35		
Factory setting	{ 0 }		
Description	“*6098 Ref.pt. for* mode“		
Setting values	**Value**	**Function**	**Description**
	0	No reference run	No reference run
	1	DS402 Method 1	
	2	DS402 Method 2	
	3	DS402 Method 3	
	4	DS402 Method 4	
	5	DS402 Method 5	
	6	DS402 Method 6	
	7	DS402 Method 7	
	8	DS402 Method 8	
	9	DS402 Method 9	
	10	DS402 Method 10	
	11	DS402 Method 11	
	12	DS402 Method 12	
	13	DS402 Method 13	
	14	DS402 Method 14	
	15	Reserved	
	16	Reserved	
	17	DS402 Method 17	
	18	DS402 Method 18	
	19	DS402 Method 19	
	20	DS402 Method 20	
	21	DS402 Method 21	
	22	DS402 Method 22	
	23	DS402 Method 23	
	24	DS402 Method 24	
	25	DS402 Method 25	
	26	DS402 Method 26	
	27	DS402 Method 27	
	28	DS402 Method 28	
	29	DS402 Method 29	
	30	DS402 Method 30	
	31	Reserved	
	32	Reserved	
	33	DS402 Method 33	
	34	DS402 Method 34	
	35	DS402 Method 35	

P059	DS402 Homing speed			S
Setting range	0 … 24000 rpm			
Arrays	[-01] =	6099 Ref. Pt. for speed [1]	[-02] =	6099 Ref. Pt. for speed [1]
Factory setting	All { 30 }			
Description	“*6099 Ref. Pt. for speed*” Reference point for speed setting.			

P060	DS402 Homing speed	S
Setting range	0 … 2147483647 rpm/s	
Factory setting	{ 750 }	
Description	“*609A Ref. Pt.for acceleration*“ Reference point run acceleration setting.	

P061	DS402 Homing offset				S
Setting range	-2147483,648 … 2147483,647 rev				
Factory setting	{ 0 }				
Description	„*609A Reference point for offset*“ Sets the reference run offsets.				

P062	DS402 Actual speed				S
Display range	-2147483.648 … 2147483647 rpm				
Arrays	[-01] =	606B Actual speed after ramp	[-02] =	606C Actual speed	
	[-03] =	6069 Actual encoder speed.			
Factory setting	{ 0 }				
Description	Displays the actual speed, speed after the ramp and the encoder speed.				

P063	DS402 Speed target window				S
Setting range	[-01] =	0 … 24000 rpm	[-02] =	0 … 32767 ms	
Arrays	[-01] =	606D Speed window	[-02] =	606E Speed window time	
Factory setting	[-01] =	{ 100 }	[-02] =	{ 200 }	
Description	Sets time window for speed and time				

P064	DS402 Speed threshold value				S
Setting range	[-01] =	0 … 24000 rpm	[-02] =	0 … 32767 ms	
Arrays	[-01] =	606F Speed threshold value	[-02] =	6070 Speed threshold value	
Factory setting	[-01] =	{ 100 }	[-02] =	{ 200 }	
Description	Sets threshold value for speed and time				

P065	DS402 Acceleration profile	S
Setting range	0 ... 2147483647 rpm/s	
Factory setting	{ 750 }	
Description	“*6083 Acceleration profile.*“ Sets the acceleration profile.	

P066	DS402 Delay profile	S
Setting range	0 ... 2147483647 rpm/s	
Factory setting	{ 750 }	
Description	“*6084 Delay profile.*“ Sets the delay profile.	

P067	DS402 Quick stop delay	S
Setting range	0 ... 2147483647 rpm/s	
Factory setting	{ 15000 }	
Description	“*6084 Quick stop delay*“ Sets the quick stop delay.	

P072	DS402 Speed profile	S
Setting range	-24000 ... 24000 rpm	
Factory setting	{ 0 }	
Description	*“60FF Speed profile*“. Sets the speed profile	

P073	DS402 Actual torque	S
Display range	-400 ... 400 %	
Factory setting	{ 0 }	
Description	“*6077 Actual torque*“. Displays the actual torque.	

P074	DS402 Actual current		S	
Display range	-300 ... 300 %			
Factory setting	{ 0 }			
Description	“*6078 Actual current*“. Displays the actual current.			

P075	DS402 Actual DC voltage		S	
Display range	0 ... 1200 %			
Factory setting	{ 0 }			
Description	“*6079 Actual DC voltage*“. Displays the actual DC voltage.			

P076	DS402 Torque ramp		S	
Setting range	0 ... 1000000 %/s			
Factory setting	{ 10000 }			
Description	„*6087 Torque ramp*“. 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. 4 parameter sets are available. The parameters to which different values can also be assigned in the 4 parameter sets are known as "parameter set-dependent" and are 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, the operating parameter set corresponds to the settings in P100.	

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

Setting values

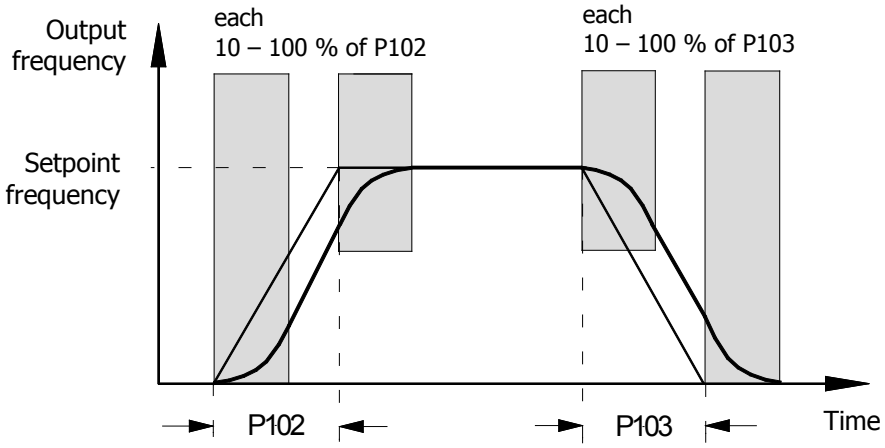
Value		Meaning
0	Do not copy	No copy process triggered.
1	Copy actual to P1	Copies the active parameter set to parameter set 1
2	Copy actual to P2	Copies the active parameter set to parameter set 2
3	Copy actual to P3	Copies the active parameter set to parameter set 3
4	Copy actual to P4	Copies the active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

P102	Acceleration time	P
Setting range	0.00 … 320.00 s	
Factory setting	{ 2.00 }	
Description	The acceleration time is the time which corresponds to the linear frequency increase from 0 Hz to the set maximum frequency P105. If an actual setpoint of <100 % is being used, the acceleration time is reduced linearly according to the setpoint which has been set. The acceleration time can be extended by certain circumstances, e.g. FI overload, setpoint delay, ramp smoothing, or if the current limit is reached.	
Note	Care must be taken that the parameter values are realistic. A setting of P102 = 0 is not permissible for drive units! **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 this may cause damage to the frequency inverter.	

P103	Deceleration time	P
Setting range	0.00 … 320.00 s	
Factory setting	{ 2.00 }	
Description	The deceleration time is the time corresponding to the linear frequency reduction from the set maximum frequency P105 to 0 Hz. If an actual setpoint <100 % is being used, the deceleration time reduces accordingly. The deceleration time can be extended by certain circumstances, e.g. by the selected "Switch-off mode" P108 or "Ramp smoothing" P106.	
Note	Care must be taken that the parameter values are realistic. A setting of P103 = 0 is not permissible for drive units! **Notes 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 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 frequency" (Digital input function = 9) is executed during acceleration or deceleration.	

P105	Maximum frequency	P
Setting range	0.1 … 400.0 Hz	
Factory setting	{ 50.0 }	
Description	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 overshot by the slip compensation P212, the function "Maintain frequency" (Digital input function = 9) or a change to another parameter set with lower maximum frequency. Maximum frequencies are subject to certain restrictions, e.g. • Restrictions in weak field operation, • Compliance with mechanically permissible speeds, • PMSM: Restriction of the maximum frequency to a value which is slightly above the rated 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: $t_{ges\ ACCELERATION\ TIME} = t_{P102} + t_{P102} \cdot \frac{P106[\%]}{100\%}$ $t_{ges\ BRAKING\ TIME} = t_{P103} + t_{P103} \cdot \frac{P106[\%]}{100\%}$ 		

P107	Brake response time			P
Setting range	0 … 2.50 s			
Factory setting	{ 0.00 }			
Description	Electromagnetic brakes have a physically-dependent delayed response time when actuated. This can result in dropping of the load in lifting equipment applications. The brake takes up the load after a delay. The application time must be taken into consideration by setting parameter P107. Within the adjustable application time, the FI supplies the set absolute minimum frequency P505 and so prevents movement against the brake and load drop when stopping. If a time > 0 is set in P107 or P114, at the moment the FI is switched on, the level of the excitation current (field current) is checked. If no excitation current is present, the FI remains in excitation mode and the motor brake is not released.			
Note	In order to achieve a shut-down and an error message (E016) in the event of excitation current, P539 must be set to 2 or 3.			
	For control of an electromagnetic brake (especially for lifting equipment) an internal relay should be used, (P434 [-01] or. [-02], function "1", "External brake"). The minimum absolute frequency (P505) should never be less than 2.0 Hz.			

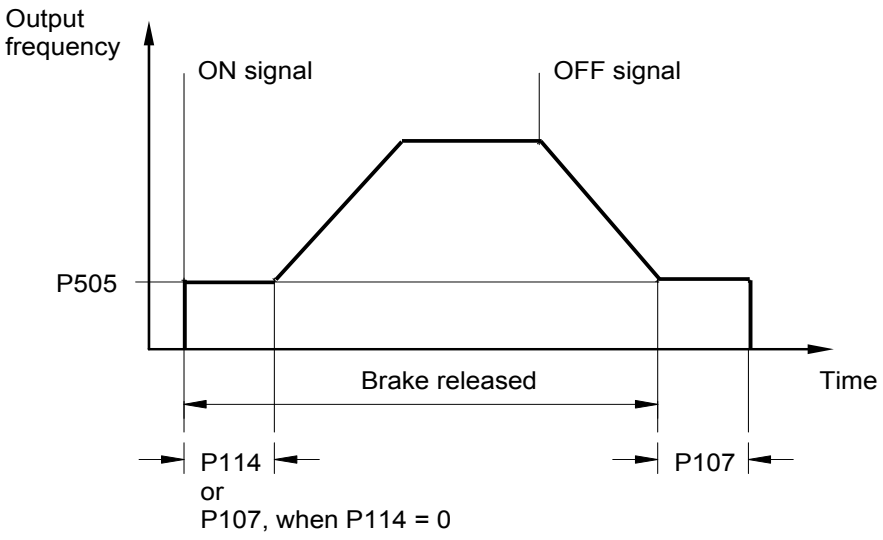
Recommendation for applications:
Lifting equipment with brake, without speed feedback Lifting equipment with brake

P114 = 0.02...0.4 s *
P107 = 0.02...0.4 s *
P201…P208 = Motor data
P434 = 1 (ext. brake)
P505 = 2...4 Hz

for safe start-up
P112 = 401 (off)
P536 = 2.1 (off)
P537 = 150 %
P539 = 2/3 (I_{SD} monitoring)

to prevent load drops
P214 = 50...100 % (precontrol)

* Settings (P107/114) depending on brake type and motor size. At low power levels (< 1.5 kW) lower values apply for higher power ratings (> 4.0 kW) are larger values.



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

Setting values

Value		Meaning
0	Disable voltage	The output signal is switched off immediately. The FI no longer supplies an output frequency. The motor is only braked by mechanical friction. Switching the FI on again immediately can cause an error message.
1	Ramp	The actual 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	Ramp with delay	As with 1 "*Ramp*, however for generational operation the brake ramp is extended, or for static operation the output frequency is increased. Under certain conditions, this function can prevent overvoltage switch-off or reduce braking resistor power dissipation. **NOTE**: This function must not be programmed if defined deceleration is required, e.g. for lifting equipment.
3	Immediate DC braking	The FI switches immediately to the preselected DC current **P109**. This DC current is supplied for the remaining proportion of the "*DC brake time*" **P110.** Depending on the relationship of the actual output frequency to the max. frequency **P105**, the "*DC brake time*" 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 which is 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. Braking distance	"*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 actual frequencies. **Note:** This function cannot be used as a positioning function. This function should not be combined with ramp smoothing (**P106**).
5	Combined Braking	*"Combined braking"*: Depending on the actual link circuit voltage (UZW), a high frequency voltage is switched to the basic frequency (only for linear characteristic curves **P211 = 0** and **P212 = 0**). The braking time **P103** is complied with if possible. → Additional heating in the motor! **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 2 and 6.
8	Quad. comb. braking	"*Quadratic combined braking*": Combination of 5 and 6. **NOTE**: **This function is not suitable for PMSM motors**
9	Const. Accel. Power	*"Constant acceleration power"*: Only applies in field weakening range. The drive is accelerated or braked with constant electrical power. The course of the ramps depends on the load.
10	Distance calculator	Constant distance between actual frequency / speed and the set minimum output frequency **P104**. as for "*Const. braking distance*". However, function [10] only becomes active if the setpoint frequency undershoots the set minimum frequency. In this case, enabling must be retained.
11	Const. Accel. Power with Delay	*"Constant acceleration power with delay"*: Combination of 2 and 9.
12	Const. acceln. power Mode 3	*"Constant acceleration power mode 3"* as for 11, however with additional relief of the brake chopper.
13	Switch-off delay	*"Ramp with disconnection delay!*" as for 1 **"Ramp"**, however, before the brake is applied, the drive unit remains at the absolute minimum frequency set in parameter **P505** for the time specified in parameter **P110.** Application Example: Re-positioning for crane control

P109	DC brake current	S	P
Setting range	0 … 250 %		
Factory setting	{ 100 }		
Description	Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5). The correct setting value depends on the mechanical load and the required deceleration time. A higher setting brings large loads to a standstill more quickly. The 100 % setting corresponds to a current value as stored in the "Nominal motor current" parameter P203.		
Note	The DC current (0 Hz) which the FI can supply is limited. For this value, please refer to the table in Section 8.4.3 "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 during which current selected in parameter P109 is applied to the motor for the function "DC braking" selected in parameter P108 (P108 = 3). Depending on the relationship of the actual output frequency to the max. frequency P105, the "DC brake time" is shortened. The time starts running with the removal of the enable and can be interrupted by 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 must be provided. The torque current limit can also be set over a continuous range of settings using an analogue input. The maximum setpoint (see compare adjustment 100 %, P403/P408) then corresponds to the value set in P112. The limit value 20 % of current torque cannot be undershot by a smaller analogue setpoint (P400 = 2). In contrast, with the control method "CFC closed-loop (Servo Mode) P300 setting "1", a limit value of 0% is possible.		
Note	A torque limit is not permissible for lifting equipment applications!		
Setting values	**Value** / **Meaning** 401 / OFF / The torque current is not limited.		

P113	Jog frequency	S	P
Setting range	-400.0 … 400.0		
Factory setting	{ 0.0 }		
Description	When using the ParameterBox to control the FI, the jog frequency is the starting value after enabling. Alternatively, if control is via the control terminals, the jog frequency can be activated via one of the digital inputs. Setting of the jog frequency can be performed directly via this parameter or, if the FI is enabled via the keyboard, by pressing the OK key. In this case, the actual output frequency is set in parameter P113 and is then available for the next start.		
Note	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 setpoint values which are processed via the functions "Frequency addition" or "Frequency subtraction.		

P114	Brake release time	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 inverter to switch off with an overcurrent report. During the adjustable release time, the FI supplies the set absolute minimum frequency (P505) thus preventing movement against the brake. See also parameter P107 "Brake response time" (setting example).		
Note	If the brake response time P114 is set to "0", then P107 is the brake release and response time.		

P120	Option monitoring	S	P
Setting range	0 … 2		
Arrays	[-01] = Bus TB (Ext. 1)	[-03] = 1st IOE (Ext. 3)	
	[-02] = 2nd IOE (Ext. 2)		
Factory setting	{ 1 }		
Scope of Application	**SK 530P, SK 550P**		
Description	Monitoring of communication at system bus level (in case of fault: error message E10.9)		
Note	If fault messages which are detected by the optional module (e.g. faults at field bus level) are not to result in shut-down of the drive electronics, parameter P513 must also be set to the value -0.1.		

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 … 114	
Factory setting	{ 0 }	
Description	The factory settings for the motor data can be edited with this parameter. The factory setting for parameters P201 ... P209 is a 4-pole IE3 asynchronous motor which corresponds to the rated power of the FI. By selecting one of the possible digits and press the OK key to set all of the motor parameters P201 .... P209 are matched to the selected standard power. The motor data for NORD IE4 motors can be found in the final section of the list.	
Note	After confirmation of the selection, "0" is displayed again in P200. 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 adapted 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 230 V 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 400 V 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 230 V 71LP	14	0,75 kW 230 V 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 400 V 71LP	16	0,75 kW 400 V 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 230 V 100MP	36	5.5 kW 230 V 132SP	46	15,0 kW 400 V 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 400 V 100MP	38	5.5 kW 400 V 132SP	48	18,5 kW 400 V 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 230 V 100AP	40	7.5 kW 230 V 132MP	50	22,0 kW 400 V 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 230 V 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 400 V 112MP	44	11,0 kW 400 V 160MP	54	37.0 kW 400 V 225SP
35	5.0 PS 460 V 112MP	45	15.0 PS 460 V 160MP	55	50.0 PS 460 V
56	45.0 kW 400 V 225MP	66	132,0 kW 400 V 315MP	76	15,0 kW 230 V 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 400 V 315RP	78	18,5 kW 230 V 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	200.0 kW 400 V	80	22,0 kW 230 V 180LP
61	100.0 PS 460 V 280SP	71	270.0 PS 460 V	81	30.0 PS 230 V 180LP
62	90.0 kW 400 V 280MP	72	250.0 kW 400 V	82	30,0 kW 230 V 225RP
63	120.0 PS 460 V 280MP	73	340.0 PS 460 V	83	40.0 PS 230 V 225RP
64	110,0 kW 400 V 315SP	74	11,0 kW 230 V 160MP	84	37,0 kW 230 V 225SP
65	150.0 PS 460 V 315SP	75	15.0 PS 230 V 160MP	85	50.0 PS 230 V

86	0.12 kW 115 V	96	1.10 kW 230 V 90T1/4	106	2.20 kW 400 V 90T1/4
87	0.18 kW 115 V	97	1.10 kW 230 V 80T1/4	107	3.00 kW 230 V 100T5/4
88	0.25 kW 115 V	98	1.10 kW 400 V 80T1/4	108	3.00 kW 230 V 100T2/4
89	0.37 kW 115 V	99	1.50 kW 230 V 90T3/4	109	3.00 kW 400 V 100T2/4
90	0.55 kW 115 V	100	1.50 kW 230 V 90T1/4	110	3.00 kW 400 V 90T3/4
91	0.75 kW 115 V	101	1.50 kW 400 V 90T1/4	111	4.00 kW 230 V 100T5/4
92	1.1 kW 115 V	102	1.50 kW 400 V 80T1/4	112	4.00 kW 400 V 100T5/4
93	4.0 PS 230 V	103	2.20 kW 230 V 100T2/4	113	4.00 kW 400 V 100T2/4
94	4.0 PS 460 V	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		

P201	Nominal motor frequency	S	P
Setting range	10.0 … 399.9 Hz		
Factory setting	{See Note}		
Description	The motor frequency determines the V/f break point at which the FI supplies the nominal voltage P204 at the output.		
Note	The default setting depends on the nominal power of the FI and the setting in P200.		

P202	Nominal motor speed	S	P
Setting range	100 … 24000 rpm		
Factory setting	{See Note}		
Description	The nominal motor speed is important for correct calculation and control of the motor slip and the speed display (P001 = 1).		
Note	The default setting depends on the FI nominal power and the setting in P200.		

P203	Nominal motor current	S	P
Setting range	0.1 … 1000.0 A		
Factory setting	{See Note}		
Description	The nominal motor current is a decisive parameter for current vector control.		
Note	The default setting depends on the nominal power of the FI and the setting in P200.		

P204	Nominal motor voltage	S	P
Setting range	100 … 800 V		
Factory setting	{See Note}		
Description	The nominal motor voltage matches the mains voltage to the motor voltage. In combination with the nominal frequency, the voltage/frequency characteristic curve is produced.		
Note	The default setting depends on the FI nominal power and the setting in P200.		

P205	Nominal motor power			P
Setting range	0.00 … 250.00 kW			
Factory setting	{See Note}			
Description	The motor nominal power controls the motor set via P200.			
Note	The default setting depends on the nominal power of the FI and the setting in P200.			

P206	Motor cos phi		S	P
Setting range	0.50 … 0.95			
Factory setting	{See Note}			
Description	The motor cos φ is a decisive parameter for current vector control.			
Note	The default setting depends on the nominal power of the FI and the setting in P200.			

P207	Motor circuit		S	P
Setting range	0 ... 1			
Factory setting	{See Note}			
Description	The motor circuit is decisive for stator resistance measurement (P220) and therefore for current vector control.			
Note	The default setting depends on the nominal power of the FI and the setting in P200.			
Setting values	**Value**	**Meaning**		
	0	Star		
	1	Delta		

P208	Stator resistance		S	P
Setting range	0.00 … 300.00 Ω			
Factory setting	{See Note}			
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. The default setting depends on the nominal power of the FI and the setting in P200.			

P209	No-load current	S	P
Setting range	0.0 … 1000.0 A		
Factory setting	{See Note}		
Description	This value is always calculated automatically from the motor data if there is a change in the parameter P206 "Motor cos φ" and P203 "Nominal motor 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. The default setting depends on the nominal power of the FI and the setting in P200.		

P210	Static boost	S	P
Setting range	0 ... 400 %		
Factory setting	{ 100 }		
Description	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. For permanent magnet synchronous motors (PMSM) the level of the current which is used for identification can be modified as a percentage.		

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 P210 and P211 must each be set to 0 %.		

P212	Slip compensation	S	P
Setting range	0 ... 150 %		
Factory setting	{ 100 }		
Description	Slip compensation increases the output frequency depending on the load, in order to keep the 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 must be set to 0 %. This also applies for synchronous motors which do not have slip due to their design.		
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 P210 and P211 must each be set to 0 %.		

P213	Amplification ISD control	S	P
Setting range	25 ... 400 %		
Factory setting	{ 100 }		
Description	"*ISD control amplification*". This parameter influences the control dynamics of the FI current vector control (ISD control). Higher settings make the controller faster, lower settings slower. Dependent on 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 lead time	S	P
Setting range	0 ... 200 %		
Factory setting	{ 0 }		
Description	Only advisable with linear characteristic curve (P211 = 0 % and P212 = 0 %). For drives that require a high starting torque, this parameter provides an option for switching in an additional current during the start phase. The application time is limited and can be selected in parameter "Boost lead time P216. All current and torque current limits that may have been set (P112 and P536, P537) are deactivated during the boost lead time.		
Note	With active ISD control (P211 and / or P212 ≠ 0 %), parameterisation of P215 ≠ 0 results in incorrect control.		

P216	Boost lead time.	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 lead time**: Application time for the increased starting current. Only with linear characteristic curve (P211 = 0 % and P212 = 0 %). 2. **Time limit** for **suppression of** pulse **switch-off P537**: enables start-up under heavy load. 3. **Time limit** for **suppression** of **switch-off on error** in parameter P401, setting { 05 } "0 ... 10V with switch-off on error 2"		

P217	Oscillation damping	S	
Setting range	0 ... 400 %		
Factory setting	{ 10 }		
Description	Parameter P217 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 This function is not active in control mode "CFC closed-loop" (Servo Mode) P300, setting "1".		

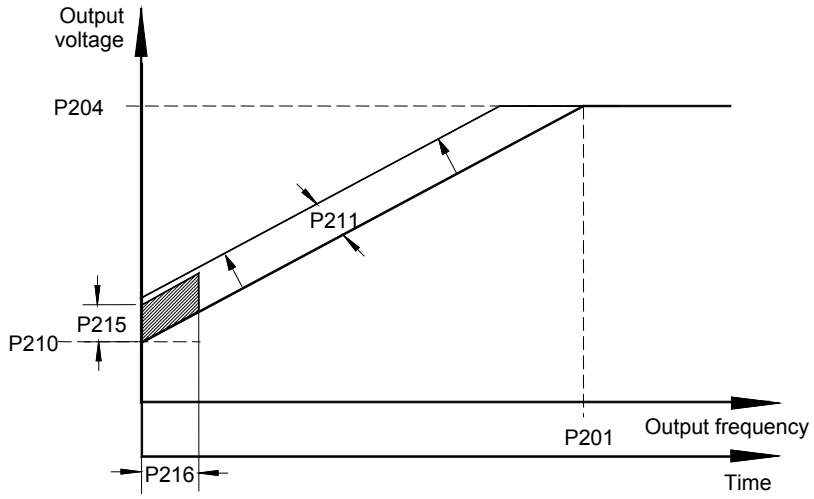
P218	Modulation depth	S	
Setting range	50 ... 110 %		
Factory setting	{ 100 }		
Description	This setting influences the maximum possible output voltage of the FI in relation to the mains voltage. Values <100% reduce the voltage to values which are less than the mains voltage. Values >100 % increase the 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. flux adjustment	S
Setting range	25 ... 100 % / 101	
Factory setting	{ 100 }	
Description	"*Automatic flux adjustment*". 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 limiting value, to which the field in the motor can be reduced. Reduction of the field is carried out 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 curve, as it adapts the voltage to the load.	
Note	For applications with rapid torque fluctuations (e.g. lifting equipment) this parameter should be left at the factory setting (100%). Otherwise, rapid load changes could cause shut-down due to overcurrent or "breakdown".	
	This parameter does not function with synchronous motors (IE4 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)

P220	Par. identification	P
Setting range	0 … 2	
Factory setting	{ 0 }	
Description	"*Parameter identification*". For FIs with output up to 5.5 KW (230 V ⩽ 2.2 kW) the motor data is determined automatically by the FI via these parameters. In many cases, better drive behaviour is achieved with measured motor data. Identification of all parameters takes some time. **Do not switch off the mains voltage** during this time. If there is unfavourable operating behaviour after identification, select a suitable motor in **P200** or set parameters **P201 … P208** manually.	
Note	• Before starting parameter identification, the motor data must be pre-set according to the rating plate or **P200**: – Nominal frequency **P201** – Nominal speed **P202** – Voltage **P204** – Power **P205** – Motor circuit **P207** • Parameter identification should only be carried when the motor is cold (15 … 25 °C) Warming up of the motor during operation is taken into account. • The FI must be in “Ready for operation” condition. For Bus operation, the Bus must be operating without error. • The motor power may only be one power level greater or 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. • Care must be taken that the connection to the motor is not interrupted during the entire measuring process. • If a PMSM is used, the current value for identification can be adjusted as a percentage via the parameter **P210** “*Static Boost*“. • If the identification cannot be completed successfully, error message **E019** is generated. • After parameter identification, P220 is again = 0.	

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

P240	EMF voltage PMSM	S	P
Setting range	0 … 800 V		
Factory setting	{ 0 }		
Description	The EMF voltage PMSM describes the self induction voltage of the motor. The value to be set can be found on the data sheet for the motor or on the type plate and is scaled to 1000 rpm. As the rated speed of the motor is not usually 1000 rpm, these details must be converted accordingly: ***Example:*** E (EMF - constant, type plate): 89 V Nn (rated speed of motor): 2100 rpm Value in P240: P240 = E * Nn/1000 P240 = 89 V * 2100 rpm / 1000 rpm P240 = 187 V		
Setting values	**Value** / **Meaning** 0 / ASM is used / "*Asynchronous motor used*" No compensation		

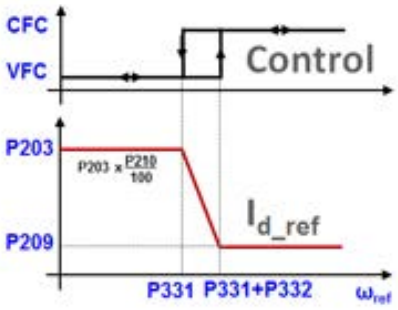
P241	PMSM inductance		S	P
Setting range	0.1 … 200.0 mH			
Arrays	[-01] = d-axis (Ld)	[-02] = q-axis (Lq)		
Factory setting	all { 20.0 }			
Description	The typical asymmetric reluctances of the PMSM are compensated with this parameter. The stator inductances can be measured by the frequency inverter (P220).			

P243	Reluct. angle IPMSM	S	P
Setting range	0 … 30°		
Factory setting	{ 0 }		
Description	*"Reluctance angle IPMSM"* In addition to the synchronous torque, synchronous motors with embedded magnets also have a reluctance torque. The reason for this is due to the anisotropy 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, which can be assumed to be 10° for NORD motors, can be taken into account with this parameter. The smaller the angle, the smaller the reluctance component. The specific reluctance angle for the motor can be determined as follows: • Allow drives with constant load (> 0.5 M_N) to run in CFC mode (P300 ≥ 1) • Gradually increase the reluctance angle P243 until the current P719 reaches a minimum		

P244	Peak current PMSM	S	P
Setting range	0.1 … 1000.0 A		
Factory setting	{ 5.0 }		
Description	This parameter contains the peak current of a synchronous motor. The value must be obtained from the motor data sheet.		

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	Moment of inertia	S	P
Setting range	0.0 … 1000.0 kg*cm²		
Factory setting	{ 5.0 }		
Description	The mass inertia of the drive system can be entered in this parameter. For most applications the default setting is sufficient. However, for highly dynamic systems the actual value should ideally be entered. The values for the motors can be obtained from the technical data. The portion of the external centrifugal mass (gear unit, machine) must be calculated or determined experimentally.		

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

5.1.5 Control parameters

P300	Control method			P
Setting range	0 … 2			
Factory setting	{ 0 }			
Description	The control method for the motor is defined with this parameter. The following constraints must be observed: In comparison with setting "0", setting "2" enables higher dynamics and control precision, however it requires greater effort for parameterisation. Setting "1" operates with speed feedback from an encoder and therefore enables the highest possible quality of speed control and dynamics.			
Note	Commissioning information: (📖 Section 4.2 "Selecting the operating mode for motor control").			
Setting values	**Value**	**Meaning**		
	0	VFC open-loop	Speed control without encoder feedback	
	1	CFC closed-loop	Speed control with encoder feedback	
	2	CFC open-loop	Speed control without encoder feedback	

P301	Encoder resolution		
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 compensated 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

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 controller I			P
Setting range	0 … 800 % / ms			
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 ms. Values that are too small cause the controller to slow down (reset time is too long).			

P312	Torque current controller 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. Excessively high values in P312 generally lead to high-frequency oscillations at low speeds; on the other hand, excessively high values in P313 generally produce low frequency oscillations across the whole speed range. If the value "Zero" is set in P312 and P313, the torque current control is switched off. In this case, only the motor model lead time is used.			

P313	Torque current controller I		S	P
Setting range	0 … 800 % / ms			
Factory setting	{ 50 }			
Description	I component of the torque current controller (see P312 "Torque current controler P").			

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

P315	Field 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. Excessively high values for P315 generally lead to high frequency vibrations at low speeds. On the other hand, excessively high values in P316 generally produce low frequency vibrations across the whole speed range If the value "Zero" is entered in P315 and P316, then the field current controller is switched off. In this case, only the lead time for the motor model is used.		

P316	Field curr. ctrl. I	S	P
Setting range	0 … 800 % / ms		
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 current controller 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 reduction range (see P320). The values for P314 and P317 should always be set roughly the same, so that the field and torque current controllers are balanced.		

P318	Field weakening controller P	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	Field weakening controller I	S	P
Setting range	0 … 800 % / ms		
Factory setting	{ 20 }		
Description	Only affects the field weakening range, see P318 "Field weakening controller P"		

P320	Field weakening limit	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	Speedctr. I brake release	S	P
Setting range	0 … 4		
Factory setting	{ 0 }		
Description	"*Speed control I brake release time*". 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	Encoder function		S	P
Setting range	0 … 5			
Arrays	[-01] = TTL	[-02] = HTL	[-03] = Sin/Cos	
Factory setting (SK 500P/ SK 510 P)	{ 0 }	{ 1 }	{ 0 }	
Factory setting (SK 530P/ SK 550 P)	{ 1 }	{ 0 }	{ 0 }	
Description	The speed list value supplied by an incremental encoder to the FI 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	Frequency 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	Encoder speed ratio			S
Setting range	0.01 … 100.00			
Arrays	[-01] = TTL	[-02] = HTL	[-03] = Sin/Cos	
Factory setting	{ 1.00 }			
Description	"*Encoder speed ratio*". 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	Only when P325 = 1, 2, 3 or 4, therefore not in "Servo mode speed measurement".			

P327	Speed slip error		P
Setting range	0 … 3000 rpm		
Factory setting	{ 0 }		
Description	"*Slip error speed control*. The limit value for a permitted maximum slip error can be set. If this value is reached, the FI switches off and indicates error E013.1. Slip error monitoring functions with all control methods (P300). *Relevant settings*		
	Encoder type	**Electrical connection**	**Parameters**
	TTL encoder	Encoder Interface (Terminal X13)	P325 = 0
	HTL encoder	DIN3 (Terminal X11:23) …	P420 [-02] = 43
		DIN4 (Terminal X11:24) …	P420 [-04] = 44
Setting values	0 = OFF		

P328	Slip error delay		P
Setting range	0.0 ... 10.0 s		
Factory setting	{ 0.0 }		
Description	"*Slip error delay*". If the permissible slip error defined in P327 is exceeded the error message E013.1 is suppressed within the time limits which are set here.		
Setting values	0 = Off		

P330	Rotor starting position detection	S
Setting range	0 … 3 { 1 }	
Factory setting	{ 1 }	
Description	"*Rotor starting position detection* ". Selection of the method for determination of the starting position of the rotor (initial value of the rotor position) of a PMSM (Permanent Magnet Synchronous Motor). The parameter is only relevant for the control method "CFC closed-loop" (P300, setting "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 determination of the 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 determining the position of the rotor is very precise (<1° electrical). This method is unsuitable for lifting equipment applications, as there is always a counter-torque. For operation without encoders: Up to the switchover frequency **P331** the motor (with the nominal current memorised) is operated under voltage control. Once the switchover frequency has been reached, the method for determining the rotor position is switched over to the EMF method. If, taking hysteresis (**P332**) into account, the frequency falls below the value in **P331**, the frequency inverter switches back from the EMF method to voltage controlled operation.
1	**Test signal method**: The starting position of the rotor is determined with a test signal. This method also functions at a standstill with the brake applied, however it requires a PMSM with sufficient anisotropy between the inductance of the d and q axes. 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 changed with parameter **P213**. For motors which are suitable for use with the test signal method, a rotor position accuracy of 5°…10° electrical can be achieved (depending on the motor and the anisotropy).
2	**Value from universal encoder,** "*Value from universal encoder*": With this method the starting position of the rotor is determined from the absolute position of a universal encoder (Hiperface, EnDat with Sin/Cos track, BISS with Sin/Cos track or SSI with Sin/Cos track) The universal encoder type is set in the 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 start 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 settings "0" and "1" of parameter **P330**. For this the drive unit is started with the setting "0" or "1". After the first start, the 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 EEEPROM, 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 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 "0" cannot be achieved, as the synchronous motor has a slight load due to the fan wheel at high speeds. The universal encoder should be located on the motor shaft.
3	**Value from CANopen encoder,** "*Value from CANopen encoder*": As for "2", however a CANopen absolute encoder is used to determine the starting position of the rotor.
4	**Voltage Zero track** The precision of synchronisation of the rotor position via the zero pulse is directly related to the resolution of the encoder. We recommend use of an encoder with a pulse number of at least 512.
5	**Zero track test signal** The precision of synchronisation of the rotor position via the zero pulse is directly related to the resolution of the encoder. We recommend use of an encoder with a pulse number of at least 512.

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

P332	Hyst.switchover.CFC ol	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 the transition of operation without encoder into the control method specified in P330 (and vice versa).		

P333	Flux feedback.CFC ol	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 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 IE4 motors.		

P334	Encoder offset PMSM	S	
Setting range	-0.500 ... 0.500 rev		
Factory setting	{ 0,000 }		
Description	Evaluation of the zero track is necessary for operation of PMSM (Permanent Magnet Synchronous Motors). The zero pulse is then used for synchronisation of the rotor position. Parameter P330 must be set to "0" or "1". The value to be set for parameter P334 (offset between zero pulse and actual rotor position "Zero") must be determined experimentally or included with the motor.		
Note	A sticker on which the setting is specified is typically affixed to motors supplied by NORD. Provided that the details on the motor are specified in °, these must be converted into *rev* (e.g. 90° = 0.250 rev).		

P336	Rotor pos. identification mode	S
Setting range	0 … 3	
Factory setting	{ 0 }	
Description	*"Rotor position identification mode"* The exact position of the rotor must be known in order to operate a PMSM. This can be determined by various methods.	
Note	Use of the parameter is only advisable if the test signal method is set (P330).	

Setting values

Value		Meaning
0	First enable	Identification of the PMSM rotor position is performed the first time that the drive enabled.
1	Supply voltage	Identification of the PMSM rotor position is performed the first time that the supply voltage is applied.
2	Digital input/Bus input Bit	Identification of the PMSM rotor position is triggered with an external order by means of a binary bit (digital input (P420) or Bus-in bit (P480), setting "79", "rotor position identification"). Identification of the rotor position is only performed if the FI is in the “ready to switch-on” state and the rotor position is not known (see P434, P481 function 28).
3	Every enable	Identification of the PMSM rotor position is performed on each enable.

P350	PLC functionality
Setting range	0 … 1
Factory setting	{ 0 }
Description	Activation of the integrated PLC

Setting values

Value		Meaning
0	Off	The PLC is not active, control of the device is via IOs.
1	On	The PLC is active, device is actuated via the PLC, depending on P351.

P351	PLC setpoint selection
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 "1", the main setpoints are defined via P553, but the definition of the auxiliary setpoints remains unchanged via P546. This parameter is only taken over if the frequency inverter is in "Ready to start" status.
Setting values	

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

P353	Bus status via PLC
Setting range	0 … 3
Factory setting	{ 0 }
Description	This parameter decides whether the control word for the master function and the status word of the frequency inverter are further processed by the PLC.
Setting values	

Value		Meaning
0	Off	Control word for the master function 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	Status word (STW) for the 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 setting 1 and 2

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

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

P360	PLC display value
Display range	- 2 147 483.648 … 2 147 483.647
Arrays	[-01] … [-05]
Description	Display of PLC data. By means of the relevant process variables, the parameter arrays can be written by the PLC. The values are not saved!

P370	PLC status	
Display range	0000 … FFFF (hex)	0000 0000 … 1111 1111 (bin)
Description	Display of the actual PLC status.	

Display values

Value (Bit)		Meaning
0	P350=1	Parameter P350 was set in the "Activate internal PLC" function
1	PLC active	The internal PLC is active.
2	Stop active	The PLC program is in "Stop" status.
3	Debug active	The error checking of the PLC program runs.
4	PLC error	The PLC has an error However, PLC User Errors 23.xx are not displayed.
5	PLC halted	The PLC program has been halted (Single Step or Breakpoint).
6	Scope Memory used	A function block uses the memory area for the oscilloscope function of the NORDCON software Because of this, the oscilloscope function cannot be used.

5.1.6 Control terminals

P400	Analog input function		P
Setting range	0 … 58		
Arrays	[-01] = Analog input 1	Analog input 1 (AI1) integrated into the FI	
	[-02] = Analog input 2	Analog input 2 (AI2) integrated into the FI	
	[-03] = Ext. analog input 1	*"External analog input 1".* Analog input 1 of the first IO extension	
	[-04] = Ext. analog input 2	*"External analog input 2".* Analog input 2 of the first IO extension	
	[-05] = Ext. A. in.1 2.IOE	*"External analog input 1 of the 2nd IOE".* Analog input 1 of the second I/O extension	
	[-06] = Ext. A. in.1 2.IOE	*"External analog input 2 of the 2nd IOE".* Analog input 2 of the second I/O extension	
	[-07] = Reserved		
	[-08] = Reserved		
	[-09] = Clock input 1		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-09] SK 530P and higher		
Factory setting	[-01] = { 1 } All other { 0 }		
Description	"*analog 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 (analog inputs 1 and 2) can alternatively be parameterised to digital functions (see P420 [-13] or [-14]). To avoid misinterpretation of the signals, the analogue functions can then be connected to the relevant inputs (P400 [-01] or [-02])		

Setting values

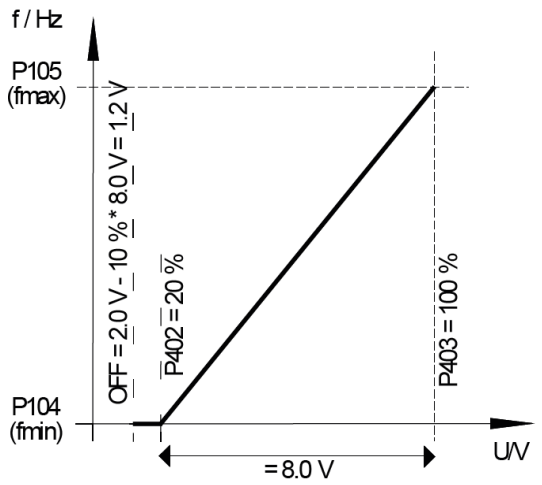
Value		Description
00	Off	The analogue input has no function. After the FI has been enabled via the control terminals, it supplies the set minimum frequency P104.
01	Setpoint frequency	The specified analogue range (matching of analogue input) varies the output frequency between the set minimum and maximum frequencies P104/P105.
02	Torque current limit	Based on the set torque current limit P112, this can be changed by means of an analogue value. 100 % setpoint here corresponds to the set torque current limit P112.
03	Actual PID frequency [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).
04	Frequency addition [2)]	The supplied frequency value is added to the setpoint.
05	Frequency subtraction [2)]	The frequency value provided is subtracted from the setpoint.

06	Current limit	Based on the set current limit P536, this can be changed via the analogue input.
07	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 exceeded/undershot.
08	Actual PID frequency limited [1)]	As for Function 3, Actual frequency PID, however the output frequency cannot fall below the programmed "minimum frequency" value in Parameter P104 (no reversal of direction of rotation).
09	Actual frequency PID monitored [1)]	As for Function 3, actual frequency PID, however the FI switches the output frequency off 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 or limited with this function. Here the speed regulation is switched off and a torque control is activated. The analogue input is then the source of the setpoint. In the open-loop method (P300 ≠ 1) this function can be used with reduced quality of control.
11	Torque lead	Function which enables a value for the anticipated torque requirement to be entered in the controller (interference factor switching). This function can be used to improve the load take-up of lifting equipment with separate load detection.
12	Reserved	
13	Multiplication	The setpoint is multiplied by the analogue value supplied. The analogue value adjusted to 100 % then corresponds to a multiplication factor of 1.
14	Actual value process controller [1)]	Activates the process controller. Activates the process controller, analogue input 1 is connected to the actual value sensor (compensator, air can, flow volume meter, etc.). The mode (0-10 V or 0/4-20 mA) is set in P401.
15	Process controller setpoint [1)]	As for Function 14, however the setpoint is specified (e.g. by a potentiometer). The actual value must be specified using another input.
16	Process controller lead [1)]	Adds an adjustable additional setpoint after the process controller
17	Reserved	
18	Curve travel calculator	The slave communicates the actual speed to the master. From its own speed, the speed of the slave and the specified speed, the master calculates the actual setpoint speed. Therefore neither of the two drives moves faster than the specified speed in the curve.
19	Reserved	
20	Set analog output	Value from P542
21	... 45 Reserved	
46	Setpoint Torque Position control	Process controller torque setpoint
47	Gear ratio factor	Sets the speed ratio between master and slave
48	Motor temperature	Motor temperature measurement with temperature sensor (e.g. KTY-84), see🕮 Section 4.4for details.
49	Ramp time	Acceleration and deceleration
53	d-correction, F process	"Diameter correction, PID process controller frequency"
54	d-correction torque	"Diameter correction, torque"
55	d-correction, F+torque	"Diameter correction, PID process controller frequency and torque"
56	Acceleration time	Adaptation of the time for the acceleration process. 0% corresponds to the shortest possible time, 100% corresponds to P102
57	Deceleration time	Adaptation of the time for the deceleration process. 0% corresponds to the shortest possible time, 100% corresponds to P103
58	Reserved for POSICON	
[1)] Process controller details: P400 and 🕮 Section 8.2.		
[2)] The limits of these values are set by the parameter P410 "Minimum frequency auxiliary setpoints" and parameter P411 "Maximum frequency auxiliary setpoints".		
NOTE: Overview of scaling in 🕮 Section 8.8.		

P401	Analogue input mode		S
Setting range	0 … 5		
Arrays	[-01] = Analogue input 1	Analogue input 1 (AI1) integrated into the FI	
	[-02] = Analogue input 2	Analogue input 2 (AI2) integrated into the FI	
	[-03] = Ext. analogue input 1	*"External analogue input 1".* Analogue input 1 of the first IO extension	
	[-04] = Ext. analogue input 2	*"External analogue input 2".* Analogue input 2 of the first IO extension	
	[-05] = Ext. A. in.1 2.IOE	*"External analogue input 1 of the 2nd IOE".* Analogue input 1 of the second I/O extension	
	[-06] = Ext. A. in.1 2.IOE	*"External analogue input 2 of the 2nd IOE".* Analogue input 2 of the second I/O extension	
	[-07] = Reserved		
	[-08] = Reserved		
	[-09] = Clock input 1		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-09] SK 530P and higher		
Factory setting	All { 0 }		
Description	"*Analogue input mode*". This parameter determines how the frequency inverter responds to an analogue signal which is less than the 0 % adjustment (P402).		

Setting values

Value	Function	Description
0	Limited to 0-10V:	An analogue setpoint smaller than the programmed adjustment 0 % (P402) does not lead to undershooting of the programmed minimum frequency P104, i.e. it does not result in a change of the direction of rotation.
1	0 – 100 %	If a setpoint smaller than the programmed adjustment 0 % (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer. E.g. internal setpoint with reversal of direction of rotation: P402 = 50 %, P104 = 0 Hz, Potentiometer 0 – 10 V → Rotation direction change at 5 V in mid-range setting of the potentiometer. At the moment of reversal (hysteresis = ± P505), the drive stands still if the minimum frequency P104 is smaller than the absolute minimum frequency P505. A brake that is controlled by the FI will be applied in the hysteresis range. If the minimum frequency P104 is greater than the absolute minimum frequency P505, the drive reverses when the minimum frequency is reached. In the hysteresis range ± P104, the FI supplies the minimum frequency P104; the brake controlled by the FI is not applied.

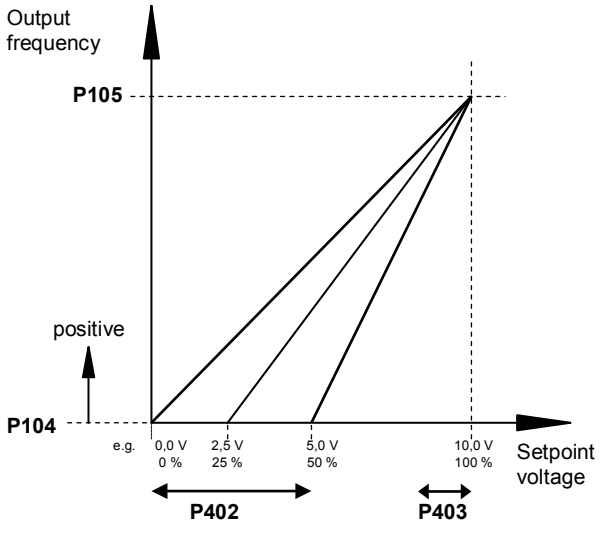
2	0 – 10V monitored:	If the minimum adjusted setpoint P402 is undershot by 10 % of the difference value from P403 and P402, the FI output switches off. Once the setpoint is greater than P402 - (10 % * (P403 … P402)), it will deliver an output signal. Note: A function for the relevant input must be assigned in P400.
		
		E.g. Setpoint 4 - 20 mA: P402: Adjustment 0 % = Setting 10 %; P403: "Adjustment 100 %“ = Setting 50 %; -10 % of the difference between P403 and P402 corresponds to -0.4 V; i.e. 1...5 V (4 ... 20 mA) normal working range, 0.6 ... 1 V = Minimum frequency setpoint less than 0.6 V (2.4 mA) causes the output to switch off.
3	- 100 % – 100 %	If a setpoint smaller than the programmed adjustment 0 % (P402) is present, this can cause a change in direction rotation. This allows rotation direction reversal using a simple voltage source and potentiometer. E.g. internal setpoint with reversal of direction of rotation: P402 = 50 %, P104 = 0 Hz, Potentiometer 0 – 10 V; Rotation direction change at 5 V in mid-range setting of the potentiometer. At the moment of reversing (hysteresis = ± P505), the drive is at a standstill if the minimum frequency P104 is smaller than the absolute minimum frequency P505. A brake which is controlled by the FI has not been applied in the hysteresis range. If the minimum frequency P104 is greater than the absolute minimum frequency P505, the drive reverses when the minimum frequency is reached. In the hysteresis range ± P104, the FI supplies the minimum frequency P104; the brake controlled by the FI is not applied. **NOTE**: The function -10V – 10V is a description of the method of function and not a reference to a physical bipolar signal (see example above).
4	0 – 100 % with error 1	"*0 – 100 % with shutdown on error 1*“. If the value of the 0 % adjustment in P402 is undershot, the error message 12.8 "*Undershoot of Analogue In Min*" is activated. If the value of the 100 % adjustment in P403 is exceeded, the error message 12.9 *Analogue In Max exceeded* is activated. Even if the analogue value is outside the limits defined in P402 and P403, the setpoint value is limited to 0 - 100 %. The monitoring function only becomes active if an enable signal is present and the analogue value has reached the valid range (≥P402 or ≤P403) for the first time (e.g. pressure build-up after switching on a pump). *Once the function has been activated, it also operates if actuation takes place via a field bus, for example, and the analogue input is not actuated.*
5	0 – 100 % with error 2	"*0 – 100 % with shutdown on error 2*“: See setting 4 ("0 - 10% with error switch off 1“), however: In this setting the monitoring function only becomes active if an enable signal is present and the time during which the error monitoring is suppressed has elapsed. This suppression time is set in parameter P216.

P402	Analog input matching 0%		S
Setting range	-500.0 ... 500.0 %		
Arrays	[-01] = Analog input 1	Analogue input 1 (AI1) integrated into the FI	
	[-02] = Analog input 2	Analogue input 2 (AI2) integrated into the FI	
	[-03] = Ext. analog input 1	*"External analog input 1".* Analogue input 1 of the first IO extension	
	[-04] = Ext. analog input 2	*"External analog input 2".* Analogue input 2 of the first IO extension	
	[-05] = Ext. A. in.1 2.IOE	*"External analog input 1 of the 2nd IOE".* Analogue input 1 of the second I/O extension	
	[-06] = Ext. A. in.1 2.IOE	*"External analog input 2 of the 2nd IOE".* Analogue input 2 of the second I/O extension	
	[-07] = Reserved		
	[-08] = Reserved		
	[-09] = Clock input 1		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-09] SK 530P and higher		
Factory setting	All { 0.0 }		
Description	"*Analog input adjustment: 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 function 0 – 100 % monitored) 0 – 20 mA 0.0 % (internal resistance approx. 250Ω) 4 – 20 mA 20.0 % (internal resistance approx. 250Ω)		

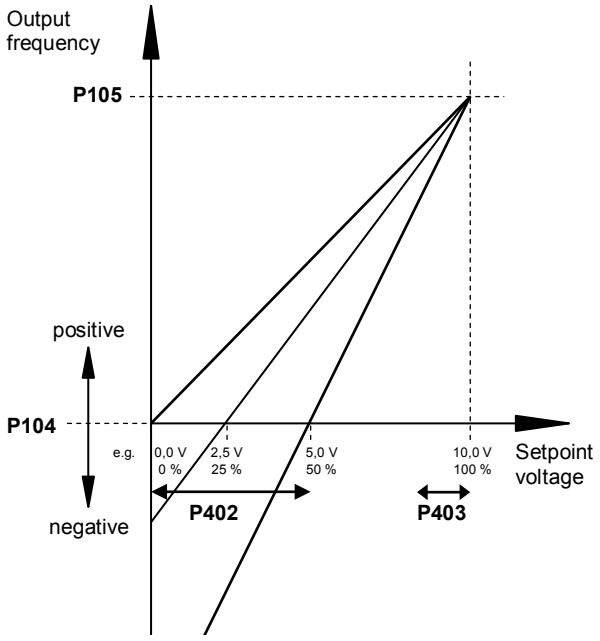
P403	Analog input adjustment 100%		S
Setting range	-500.0 ... 500.0 %		
Arrays	[-01] = Analog input 1	Analog input 1 (AI1) integrated into the FI	
	[-02] = Analog input 2	Analog input 2 (AI2) integrated into the FI	
	[-03] = Ext. analog input 1	*"External analog input 1"*. Analogue input 1 of the first IO extension	
	[-04] = Ext. analog input 2	*"External analog input 2"*. Analogue input 2 of the first IO extension	
	[-05] = Ext. A. in.1 2.IOE	*"External analog input 1 of the 2nd IOE"*. Analogue input 1 of the second I/O extension	
	[-06] = Ext. A. in.1 2.IOE	*"External analog input 2 of the 2nd IOE"*. Analogue input 2 of the second I/O extension	
	[-07] = Reserved		
	[-08] = Reserved		
	[-09] = Clock input 1		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-09] SK 530P and higher		
Factory setting	All { 100.0 }		
Description	"*Analog input adjustment: 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 function 0 – 100 % monitored) 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	Analogue input filter		S
Setting range	1 ... 400 ms		
Arrays	[-01] = Analogue input 1	Analogue input 1 (AI1) integrated into the FI	
	[-02] = Analogue input 2	Analogue input 2 (AI2) integrated into the FI	
	[-03] = Reserved		
	[-04] = Reserved		
	[-05] = Clock input 1		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-05] SK 530P and higher		
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/I Analogue		S
Setting range	0 … 1		
Arrays	[-01] = Analogue input 1	Analogue input 1 (AI1) integrated into the FI	
	[-02] = Analogue input 2	Analogue input 2 (AI2) integrated into the FI	
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. aux. setpoint			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 • Min. frequency via analogue setpoint (potentiometer)			

P412	Setpoint process controller		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), 🕮 Section 8.2 "Process controller".			

P413	P-component PID controller		S	P
Setting range	0.0 ... 400.0 %			
Factory setting	{ 10.0 }			
Description	This parameter is only effective when 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 standard deviation of 50 %, 5 % is added to the actual setpoint.			

P414	I-component PID controller		S	P
Setting range	0.0 ... 3000.0 % / s			
Factory setting	{ 10.0 }			
Description	This parameter is only effective when the function "PID actual frequency" is selected. The I-component of the PID controller determines the frequency change depending on time.			

P415	D-comp. PID controller		S	P
Setting range	0 ... 400.0 % / ms			
Factory setting	{ 1.0 }			
Description	This parameter is only effective when the function "PID actual frequency" is selected. The D-component of the PID controller determines the frequency change depending on time. If a function of the analogue inputs is set to the function "Actual value process controller", this parameter determines the controller limitation (%) after the PI controller. For further details see 🕮 Section 8.2 "Process controller".			

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

P417	Analogue output offset		S	P
Setting range	-100 ... 100 %			
Arrays	[-01] = Analogue output	Analogue output (AO) integrated into the FI		
	[-02] = Reserved			
	[-03] = First IOE	*"External analogue output of first IOE"*. Analogue input of the first IO extension		
	[-04] = Second IOE	*"External analogue output of second IOE":* Analogue output of the first IO extension		
Scope of Application	**[-01] SK 500P and higher**			
	[-03] … [-04] SK 530P and higher			
Factory setting	all { 0 }			
Description	In the "Analogue output" function an offset can be set in order to simplify processing of the analogue signal in further devices. If the analogue output has been programmed with a digital function, then the difference between the switch-on point and the switch-off point can be set in this parameter (hysteresis).			

P418	Analog output function		P
Setting range	0 ... 60		
Arrays	[-01] = Analog output 1	Analogue output (AO) integrated into the FI	
	[-02] = Reserved		
	[-03] = First IOE	*"External analog output of first IOE".* Analogue output of the first IO extension	
	[-04] = Second IOE	*"External analog output of second 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	"*Analog output function*".(max. load: 5 mA analogue, 20 mA digital)**:** An analogue voltage (0 ... +10 Volt) can be obtained at the control terminals (max. 5 mA). Various functions are available, whereby: 0 Volt analogue voltage always corresponds to 0 % of the selected value. 10 V analogue voltage always corresponds to the nominal values for the motor (unless otherwise stated) multiplied by the P419 scaling factor, e.g.: $\Rightarrow 10\,\mathrm{V} = \frac{\text{Motor rating value} \cdot \text{P419}}{100\,\%}$		

Setting values	**Value**		**Description**
Analogue functions	0	No function	No output signal at terminals.
	01	Actual frequency	The analogue voltage is proportional to the FI output frequency.
	02	Actual speed	This is the synchronous speed calculated by the FI 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.
	03	Current	The effective value of the output current supplied by the FI.
	04	Torque current	Displays the motor load torque calculated by the FI (100 % = P112).
	05	Voltage	The output voltage supplied by the FI.
	06	Link voltage	"*Link voltage*". The DC voltage in the FI. This is not based on the motor rated data. 10 V with 100 % standardisation, corresponds to 450 V DC (230 V mains) or 850 Volt DC (480 V mains)!
	07	Value of P542	The analogue output can be set using parameter P542 independently of the actual operating status of the FI. With bus control, e.g. an analogue value from the controller can be directly tunnelled to the analogue output of the FI.
	08	Apparent power	The actual apparent power calculated by the FI.
	09	Effective power	The actual effective power calculated by the FI.

10	Torque [%]	The actual torque calculated by the FI.
11	Field [%]	The actual field in the motor calculated by the FI.
12	Actual frequency ±	The analogue voltage is proportional to the output frequency of the FI, whereby the zero point is shifted to 5 V. For CW direction of rotation, values from 5V to 10 V are output and for CCW rotation values from 5 V to 0 V.
13	Actual speed ±	This is the synchronous rotation speed calculated by the FI, based on the present setpoint, where the zero point has been shifted to 5 V. Values of 5 V to 10 V are output with CW rotation, and values of 5 V to 0 V with left-hand rotation. The measured speed is output via this function if servo mode is used.
14	Torque [%] ±	Is the actual torque calculated by the FI, whereby the zero point is shifted to 5 V. For motor torques, values between 5 V and 10 V are output, and for generator torque, values between 5 V and 0 V.
15	… 28	See digital functions.
29		Reserved POSICON.
30	Setpoint freq. before 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 stage after it has been adjusted by the start-up or braking ramp P102, P103.
31	Output via BUS PZD	The analogue output is controlled via a bus system. The process data are transferred directly (P546, P547, P548 = 20).
32		See digital functions.
33	Freq. of setpt. source,	"*Frequency of setpoint source*".
34	… 40	Reserved POSICON.
41	… 52	See digital functions.
53	… 59	Reserved
60	Value from PLC	The analogue output is set by the integrated PLC, independently of the current operating status of the FI.

Digital functions

All relay functions described in Parameter P434 can also be used with the analogue output. If a condition has been fulfilled, then there will be 10 V at the output terminals. A negation of a function can be specified in parameter P419.

Value	Function	Value	Function
15	External brake	27	Generator torque current limit
16	Inverter working	28	Reserved
17	Current limit	32	FI ready
18	Torque current limit	41	... 43 reserved
19	Frequency limit	44	BusIO In Bit 0
20	Setpoint reached	45	BusIO In Bit 1
21	Fault	46	BusIO In Bit 2
22	Warning	47	BusIO In Bit 3
23	Overcurrent warning	48	BusIO In Bit 4
24	Motor overtemp. warning	49	BusIO In Bit 5
25	Torque current limit active	50	BusIO In Bit 6
26	Value of P541	51	BusIO In Bit 7
		52	Value from Bus setpoint Output via Bus (if P546, P547 or P548 = 19), BUS Bit 4 then controls the analogue output.

P419	Standard Analogue output		S	P
Setting range	-500 ... 500 %			
Arrays	[-01] = Analogue output 1	Analogue output (AO) integrated in the FI		
	[-02] = Reserved			
	[-03] = First IOE	*"External analogue output of first IOE".* Analogue input of the first IO extension		
	[-04] = Second IOE	*"External analogue output of second IOE":* Analogue output of the first 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 working range. The maximum analogue output (10 V) corresponds to the scaled value of the appropriate selection. Therefore, if this parameter is raised from 100 % to 200 % at a constant operating point, the analogue output voltage is halved. 10 V output signal then corresponds to twice the nominal value. For negative values the logic is reversed. An actual value of 0 % will then produce 10 V at the output and -100 % will produce 0 V. Digital functions P418 (= 15 ... 28, 34 ... 52) The switching threshold can be set using this parameter for the functions "Current limit" (= 17), "Torque current limit" (= 18) and "Frequency limit" (= 19). A value of 100 % refers to the corresponding nominal motor value (see P435). With a negative value, the output function is output negated (0/1 → 1/0).			

P420	Digital inputs				
Setting range	0 … 84				
Arrays	[-01] = Digital input 1	Digital input 1 (DI1) integrated into the FI			
	[-02] = Digital input 2	Digital input 2 (DI2) integrated into the FI			
	[-03] = Digital input 3	Digital input 3 (DI3) integrated into the FI			
	[-04] = Digital input 4	Digital input 4 (DI4) integrated into the FI			
	[-05] = Digital input 5	Digital input 5 (DI5) integrated into the FI			
	[-06] = Digital input 6	Digital input 6 (DI6) integrated into the FI			
	[-07] = Digital input 7	Digital input 1 (DIO1) integrated into SK CU5			
	[-08] = Digital input 8	Digital input 2 (DIO2) integrated into SK CU5			
	[-09] = Digital input 9	Digital input 3 (DIO3) integrated into SK CU5			
	[-10] = Digital input 10	Digital input 4 (DIO4) integrated into SK CU5			
	[-11] = Reserved				
	[-12] = Reserved				
	[-13] = Digital function analog1	Analogue input 1 (AI1) (digital function) integrated into the FI			
	[-14] = Digital function analog2	Analogue input 2 (AI2) (digital function) integrated into the FI			
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 other { 0 }
Description	"*Digital input functions*". Up to 14 inputs which can be freely programmed with digital functions are available.				
Note	Analogue inputs 1 and 2 of the FI do not comply with EN61131-2 (Type 1 digital inputs)				
	Alternatively, digital inputs 7… 10 can also be used as digital outputs 3… 6 (see P434). 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 "flag".				

Setting values

Value		Description	Signal
00	No function	Input switched off.	---
01	Enable right	The FI delivers an output signal with the rotation field "right" if a positive setpoint is present. 0 → 1 Flank (P428 = 0)	High
02	Enable left	The FI delivers an output signal with the rotation field "left" if a positive setpoint is present. 0 → 1 Flank (P428 = 0)	High
If the drive is to start up automatically when the mains is switched on (P428 = 1) a permanent High level for enabling must be provided (bridge between DIN1 and the control voltage output). If the functions "Enable right" and "Enable left" are actuated simultaneously, the FI is blocked. If the frequency controller is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a 1 → 0 flank.			
03	Change of rotation direction	Causes the rotation field to change direction (combined with Enable right or left).	High

04	Fixed frequency 1 [1]	The frequency from P429 is added to the actual setpoint value.	High
05	Fixed frequency 2 [1]	The frequency from P430 is added to the actual setpoint value.	High
06	Fixed frequency 3 [1]	The frequency from P431 is added to the actual setpoint value.	High
07	Fixed frequency 4 [1]	The frequency from P432 is added to the actual setpoint value.	High
If several fixed frequencies are actuated simultaneously, they are added with the correct sign. In addition, the analogue setpoint (P400) and if necessary the minimum frequency (P104) are added.			
08	Par. set changeover	First Bit of the parameter set switch over, selection of the active parameter set 1…4 (P100).	High
09	Hold frequency	During the acceleration or deceleration phase, a Low level will cause the actual output frequency to be "Held". A High level allows the ramp to continue.	Low
10	Block voltage [2]	The FI output voltage is switched off; the motor runs down freely.	Low
11	Quick stop [2]	The FI reduces the frequency according to the quick stop time from P426.	Low
12	Error acknowledgement [2]	Fault acknowledgement with an external signal. If this function is not programmed, a fault can also be acknowledged by a Low enable setting (P506).	0→1 Flank
13	PTC input [2]	Analogue evaluation of signal which is present. Switching threshold approx. 2.5 V, Switch-off delay = 2 sec, warning after 1 sec. NOTE: function 13 can only be used via DIN 5 up to SK 535E, sizes 1 - 4! For SK 54xE and sizes above Size 5, there is a separate connection which cannot be deactivated. If the motor is not equipped with a thermistor, both terminals must be bridged in for these FIs in order to deactivate the function (status as delivered).	level
14	Remote control [2, 3]	With Bus system control, Low level switches the control to control via the control terminals.	High
15	Jog frequency [1]	The fixed frequency value can be adjusted using the HIGHER/LOWER and ENTER keys (P113), if control is via the ControlBox or ParameterBox.	High
16	Motor potentiometer	As in setting 09, however, 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 switch over; selection of the active parameter set 1…4 (P100).	High
18	Watchdog [2]	Input must see a High flank cyclically (P460), otherwise a shutdown will occur with error E012. Function starts with the 1st High flank.	0→1 Flank
19	Setpoint 1 On/Off	Analogue input switch-on and switch-off 1/2 (High = ON) The low signal sets the analogue input to 0 % which does not lead to shutdown when the minimum frequency P104 > than the absolute minimum frequency P505.	High
20	Setpoint 2 On/Off		
21	Fixed frequency 5 [1]	The frequency from P433 is added to the actual setpoint value.	High
22	… 25	Reserved POSICON.	
26	… 29	Reserved	
30	Disable PID	Switches the PID controller / process controller function on and off (High = PID ON)	Low
31	Disable right running [2]	Blocks the "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	Disable left running [2]		Low
33	… 40	Reserved	
41	TTL encoder Z track	Evaluation of the zero track of a TTL encoder. Only connection to digital input 5 (DI5))	
42	HTL encoder Z track	Evaluation of the zero track of an HTL encoder.	
43	HTL encoder A track 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.	Pulsed
44	HTL encoder B track 3/ 4		Pulsed

45	3-W-Ctrl.Start-Right (closing switch for enable right)	"*3-Wire-Control*". This control function provides an alternative to enable R/L (01, 02), in which a permanently applied level is required. Here, only a control pulse is required to trigger the function. Control of the FI can therefore be performed entirely with keys. A pulse on the function "Reverse direction of rotation" (see Function 65) inverts the present direction of rotation. This function is reset with a "Stop signal" or by activating a key for the functions 45, 46, 49.	0→1 Flank
46	3-W-Ctrl.Start-Left (closing key for enable left)		0→1 Flank
49	3-Wire-Ctrl.Stop (opening key for Stop)		0→1 Flank
47	Motorpot.Freq.+	In combination with enable R/L the output frequency can be continuously varied. To save a current value in P113, both inputs must be at a High voltage for 0.5 s. This value then applies as the next starting value for the same direction of rotation (Enable R/L) 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	Bit 0 Fixed. freq.Array	Fixed frequency array, binary coded digital inputs to generate up to 32 fixed frequencies. **P465 [-01] ... [-31]**	High
51	Bit 1 Fixed. freq.Array		High
52	Bit 2 Fixed. freq.Array		High
53	Bit 3 Fixed. freq.Array		High
54	Bit 4 Fixed. freq.Array		High
55	… 64	Reserved POSICON.	
65	3-wire direction (closing switch to reverse direction of rotation)	See functions 45, 46, 49	0→1 Flank
66	… 70	Reserved	
71	Motorpot.F+ and Save	"*Motor potentiometer function frequency +/- with automatic saving*". With this motor potentiometer function a setpoint value (sum) is set via the digital inputs and is simultaneously stored. With control enabling R/L this is then started up in the correspondingly enabled direction. The frequency is retained if the direction is changed. Simultaneous activation of the +/- function causes the frequency setpoint value to be set to zero. The frequency setpoint value can also be displayed or set in the operating value display (**P001 = 30**, actual setpoint MP-S) or in **P718** and can be preset in the "Ready to switch-on" operating mode. A minimum frequency which is set **P104** is still effective. Other setpoint values, e.g. analogue or fixed frequencies can be added or subtracted. Adjustment of the frequency setpoint value is performed with the ramps from **P102 / 103**.	High
72	Motorpot.F- and Save		High
73[2]	Right disable +fast	As for setting 31, however coupled to the function "Quick Stop[2]"	Low
74[2]	Left disable+fast	As for setting 32, however coupled to the function "Quick Stop"	Low
75	… 76	Reserved	
77	… 78	Reserved POSICON.	
79	Rotor pos. ident.	Precise knowledge of the rotor position is essential for PMSM operation. Rotor position identification is performed if the following conditions are met: • The frequency inverter is in the status “ready to switch-on”, • The rotor position is not known (see P434, P481, function “28”), • Function “2” is selected in P336.	0→1 Flank
80	PLC stop	The program execution of the internal PLC is stopped for as long as the signal is present.	High
81	Frequency measurement Input 3	The frequency measured via the analogue input (P400 [-09]) is used as the setpoint (2 kHz to 22 kHz)	Pulses
82	Duty measurement Input 3	The duty cycle (20 % … 80 % at 2 kHz) measured via the analogue input (P400 [-09]) is used as the setpoint.	Pulses

1 If neither of the digital inputs is programmed for left or right enable, actuation of a fixed frequency or jog frequency enables the frequency inverter. The direction of rotation depends on the prefix of the setpoint.

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

3. Function cannot be selected via BUS IO In Bits

P423	Safety SS1 max. time [s]			
Setting range	0.01 … 320.00			
Factory setting	{ 0.10 }			
Scope of Application	**SK 510P**, **SK 530P and higher** with **SK CU5-MLT** or **SK CU5-STO**			
Description	Trigger time for SS1 function. If the inverter does not switch off the output pulse within this time, STO is triggered.			
Note	Changes to the parameter setting are only adopted after a restart of the frequency inverter (Power Off → 60 s → Power On). In case of a separate 24 V DC supply of the control board, this must also be switched off.			

P424	Safety digital input.		S	P
Setting range	0 … 2			
Factory setting	{ 0 }			
Validity range	**SK 510P, SK 540P** **SK 530P** and higher with **SK CU5-MLT** or **SK CU5 STO**			
Description	Assignment of a fail-safe stop function for the safe digital input of the frequency inverter.			
Note	The parameter is only saved after entry and confirmation of parameter **P499** (Safety CRC). Changes to the parameter setting are only adopted after a restart of the frequency inverter (Power Off → 60 s → Power On). In case of a separate 24 V DC supply of the control board, this must also be switched off.			
	If the safety functions are used, the parameter must be provided with password protection **P004**.			
	Parameter **P424** is not changed with the command **P523** "*Load factory setting*". If parameter **P424** is to be changed to a default value, this must be carried out manually.			
Setting values	**Value**	**Meaning**		
	0	No function		
	1	Disable voltage	The FI output voltage is switched off; the motor runs down freely.	
	2	Quick stop	The FI reduces the frequency according to the programmed fast stop time from P426.	

P425	PTC input function			
Setting range	0 … 1			
Factory setting	{ 1 }			
Scope of Application	**SK 530P, SK 550P**			
Description	A connected thermistor is evaluated by the device This function must be disabled if no thermistor is connected. Otherwise the device will enter a fault state with an overtemperature message (E2.0).			
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. An quick stop can be triggered by error E2.x, E7.0, E10.x, E12.8, E12.9 and E19.0.			
Setting values	**Value**	**Meaning**		
	0	Off	Automatic quick stop in case of fault is deactivated	
	1	In case of mains supply failure	Automatic quick stop in case of mains supply failure.	
	2	In case of faults	Automatic quick stop in case of fault	
	3	Fault or mains failure	Automatic quick stop in case of fault or mains failure	

P428	Automatic start	S
Setting range	0 … 1	
Factory setting	{ 0 }	
Description	**Danger!** Switch-on in case of an earth fault / short circuit. Do not parameterise **P428** to "On" if automatic fault acknowledgement **P506 = 6** ("always") has been parameterised. Parameter **P428** defines how the FI responds to a static enabling signal when the mains voltage is applied (mains voltage On). In the standard setting **P428 = 0** Off the FI requires a flank to enable (signal change from "Low → High") at the relevant digital input. If the FI has to start immediately when the mains voltage is switched on, **P428 = 1** "On" can be set. If the enable signal is permanently switched on, or equipped with a cable jumper, the FI starts up immediately.	
Note	The Automatic Start function can only be activated if the frequency inverter has been parameterised to local control (**P509** setting "0" or "1").	

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 block).
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! Danger 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 FI (right or left), the fixed frequency is used as a setpoint. A negative setting value will cause a direction change (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}, 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".			

P434	Digital output function		P
Setting range	0 … 59		
Arrays	[-01] = Binary output.1 / MFR1	Multi-function relay 1 (K1) integrated into the FI	
	[-02] = Binary output.2 / MFR2	Multi-function relay 2 (K2) integrated into the FI	
	[-03] = Digital output 1	Digital output 1 (DO1) integrated into the FI	
	[-04] = Digital output 2	Digital output 2 (DO2) integrated into the FI	
	[-05] = Digital output 3	Digital output 1 (DIO1) integrated into SK CU5	
	[-06] = Digital output 4	Digital output 2 (DIO2) integrated into SK CU5	
	[-07] = Digital output 5	Digital output 3 (DIO3) integrated into SK CU5	
	[-08] = Digital output 6	Digital output 4 (DIO4) integrated into SK CU5	
	[-09] = Digital function analog1	Digital output 1 (AO1) (digital function) integrated into the FI	
	[-10] = Reserved		
Scope of Application	**[-01] … [-02] SK 500P and higher**		
	[-03] … [-08] SK 530P and higher		
	[-09] … [-10] SK 500P and higher		
Factory setting	[-01] = { 1 } [-02] = { 7 } All other { 0 }		
Description	"*Digital output function*". Up to 10 outputs (2 of which are relays) are available. These 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 limiting 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 "flag".		

Setting values

Value		Description	Signal
00	No function	Input switched off.	Low
01	External brake	For control of a mechanical brake on the motor. The relay switches at a programmed absolute minimum frequency P505. For typical brakes a setpoint delay of 0.2 ... 0.3 s (see P107) should be programmed. A mechanical brake can be directly switched with AC. (Note the technical specification of the relay contact!)	High
02	Inverter working	The closed relay contact indicates voltage at the inverter output (U - V - W) (as well as DC run-on P559).	High
03	Current limit	Based on the nominal motor current setting in P203. This value can be adjusted with scaling P435.	High

04	Torque current limit	Based on motor data settings in P203 and P206. Signals a corresponding torque load on the motor. This value can be adjusted with scaling P435.	High
05	Frequency limit	Based on nominal motor frequency setting in P201. This value can be adjusted with scaling P435.	High
06	Setpoint reached	Indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = actual frequency! From a difference of 1 Hz → Setpoint not reached - contact opens.	High
07	Fault	General fault message, fault is active or not yet acknowledged. Fault: Contact opens, ready for operation: Contact closes.	Low
08	Warning	General warning - a limit value was reached that could result in a later shutdown of the FI.	Low
09	Overcurrent warning	At least 130 % of the nominal FI current was supplied for 30 seconds.	Low
10	Motor overtemp. warning *	"*Motor overtemperature (Warning)*". The motor temperature is evaluated via the thermistor input or a digital input. →Motor is too hot. The warning is given immediately, overheating switch-off after 2 seconds.	Low
11	Torque current limit active*	"*Torque current limit/Current limit active (Warning)*". The limit value in P112 or P536 has been reached. A negative value in P435 inverts the response. Hysteresis = 10 %	Low
12	Value of P541	The output can be set using parameter P541 independently of the actual operating status of the FI.	High
13	Generator torque current limit *	Limit value in P112 was reached in the generator range. Hysteresis = 10 %	High
14	Effective power limit	Ratio of the stated mechanical power to the nominal power of the motor.	
15	Freq.+ current limit		
16	Quick stop Active	A quick stop (P427) has been triggered.	High
17	Quick stop + STO active	A quick stop (P427) is triggered if STO "*Block voltage*" or "*Quick stop*" are enabled.	High
18	FI ready	The FI is ready for operation. After being enabled it delivers an output signal.	High
19	Generator. torque limit	As for 13, however a limit value can be set via P435.	High
20	… 27	Reserved POSICON.	
28	PMSM rotor position 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 from Bus setpoint	Value from Bus setpoint (P546 ...)	High
39	STO inactive	The relay / bit deactivates if STO or Safe Stop are active.	High
40	Output via PLC	The output is set by the integrated PLC	High
41	Comparison value AIN1,	Comparison of AIN 1 with the value which can be set in the adjustment value P435.	
42	Comparison value AIN2,	Comparison of AIN 2 with the value which can be set in the adjustment value P435.	
43	STO or OUT2/3 inactive	Neither safe stop, disable voltage nor quick stop are active.	High
50	Digital-In 1 status	A signal is present at digital input 1.	High
51	Digital-In 2 status	A signal is present at digital input 2.	High
52	Digital-In 3 status	A signal is present at digital input 3.	High
53	Digital-In 4 status	A signal is present at digital input 4.	High
54	Digital-In 5 status	A signal is present at digital input 5.	High
55	Digital-In 6 status	A signal is present at digital input 6.	High
56	Digital-In 7 status	A signal is present at digital input 7.	High
57	Digital-In 8 status	A signal is present at digital input 8.	High
58	Digital-In 9 status	A signal is present at digital input 9.	High
59	Digital-In 10 status	A signal is present at digital input 10.	High
Note: For relay contacts (High = "Contact closed", Low = "Contact open")			

P435	**Dig. out scaling**		**P**
Setting range	-400 … 400 %		
Arrays	[-01] = Binary output 1 / MFR1	Multi-function relay 1 (K1) integrated into the FI	
	[-02] = Binary output 2 / MFR2	Multi-function relay 2 (K2) integrated into the FI	
	[-03] = Digital output 1	Digital output 1 (DO1) integrated into the FI	
	[-04] = Digital output 2	Digital output 2 (DO2) integrated into the FI	
	[-05] = Digital output 3	Digital output 3 (DO3) integrated into SK CU5	
	[-06] = Digital output 4	Digital output 4 (DO4) integrated into SK CU5	
	[-07] = Digital output 5	Digital output 5 (DO5) integrated into SK CU5	
	[-08] = Digital output 6	Digital output 6 (DO6) integrated into SK CU5	
	[-09] = Digital function Analogue1	Digital output 1 (AO1) (digital function) integrated into the FI	
	[-10] = Reserved		
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 limiting values of the digital functions. For a negative value, the output function will be output negative. Reference to the following values: Current limit (P434 = 3) = x [%] · P203 "Rated motor current" Torque current limit (P434 = 4) = x [%] · P203 · P206 (calculated rated motor torque) Frequency limit (P434 = 5) = x [%] · P201 "Rated motor current"		

P436	Dig. out. hysteresis		S	P
Setting range	1 … 100 %			
Arrays	[-01] = Binary output 1 / MFR1	Multi-function relay 1 (K1) integrated into the FI		
	[-02] = Binary output 2 / MFR2	Multi-function relay 2 (K2) integrated into the FI		
	[-03] = Digital output 1	Digital output 1 (DO1) integrated into the FI		
	[-04] = Digital output 2	Digital output 2 (DO2) integrated into the FI		
	[-05] = Digital output 3	Digital output 3 (DO3) integrated into SK CU5		
	[-06] = Digital output 4	Digital output 4 (DO4) integrated into SK CU5		
	[-07] = Digital output 5	Digital output 5 (DO5) integrated into SK CU5		
	[-08] = Digital output 6	Digital output 6 (DO6) integrated into SK CU5		
	[-09] = Digital function Analogue1	Digital output 1 (AO1) (digital function) integrated into the FI		
	[-10] = Reserved			
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 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 8), 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	Addition to main setpoint:	Fixed frequencies and the fixed frequency array are added to each other. I.e. they are added together, or added to an analogue setpoint to which limits are assigned according to P104 and P105.
1	As main setpoint	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 with an customer unit input value or a bus setpoint is still possible and valid, as is the addition of a motor potentiometer function to the setpoint (function of digital inputs: 71/72). If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (E.g.: **20** > 10 or **20** > -30).

P465	Fixed freq. Array			
Setting range	-400.0 … 400.0 Hz			
Arrays	[-01] = Fixed frequency array 1			
	[-02] = Fixed frequency array 2			
	…			
	[-04] = Fixed frequency array 31			
Factory setting	{ 0.0 }			
Description	In the array levels, up to 31 different fixed frequencies can be set, which in turn can be encoded for the functions 50… 54 in binary code for the digital inputs.			

P466	Minimum freq. process control	S	P
Setting range	0.0 … 400.0 Hz		
Factory setting	{ 0.0 }		
Description	"*Minimum process controller frequency*". 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 in P400 and 🕮 Section 8.2 "Process controller".		

P475	On/off switching delay		S
Setting range	-30,000 ... 30,000 s		
Arrays	[-01] = Digital input 1	Digital input 1 (DI1) integrated into the FI	
	[-02] = Digital input 2	Digital input 2 (DI2) integrated into the FI	
	[-03] = Digital input 3	Digital input 3 (DI3) integrated into the FI	
	[-04] = Digital input 4	Digital input 4 (DI4) integrated into the FI	
	[-05] = Digital input 5	Digital input 5 (DI5) integrated into the FI	
	[-06] = Digital input 6	Digital input 6 (DI6) integrated into the FI	
	[-07] = Digital input 7	Digital input 7 (DI7) integrated into SK CU5	
	[-08] = Digital input 8	Digital input 8 (DI8) integrated into SK CU5	
	[-09] = Digital input 9	Digital input 9 (DI9) integrated into SK CU5	
	[-10] = Digital input 10	Digital input 10 (DI10) integrated into SK CU5	
	[-11] = Reserved		
	[-12] = Reserved		
	[-13] = Reserved		
	[-14] = Digital function Analogue1	Analogue input 1 (AI1) (digital function) integrated into the FI	
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/off delay*". Adjustable switch-on/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	

P480	**Bus IO In Bits function**				**S**
Setting range	0 … 82				
Arrays	[-01] = Bus / 2nd IOE Dig In1	In Bit 0 … 3 via Bus or digital input 1 … 4 of the 2nd IO extension			
	[-02] = Bus / 2nd IOE Dig In2				
	[-03] = Bus / 2nd IOE Dig In3				
	[-04] = Bus / 2nd IOE Dig In4				
	[-05] = Bus / 1st IOE Dig In1	In Bit 4 … 7 via Bus or digital output 1 … 4 of the 1st IO extension			
	[-06] = Bus / 1st IOE Dig In2				
	[-07] = Bus / 1st IOE Dig In3				
	[-08] = Bus / 1st IOE Dig In4				
	[-09] = Flag 1	See "Use of flags" at the end of the description of parameter P481			
	[-10] = Flag 2				
	[-11] = Bit 8 Bus control word	Assignment of a function for Bit 8 or 9 of the control word			
	[-12] = Bit 9 Bus control word				
Factory setting	[-01] = { 1 }	[-02] = { 2 }	[-03] = { 4 }	[-04] = { 5 }	All other { 0 }
Description	"*Bus IO In Bits function* ". The Bus I/O In Bits are perceived as 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 "Bus I/O In Bits 0-7". The required function must then be assigned to the relevant bit.				
Note	For the possible functions of the Bus In Bits, please refer to the table of digital input functions. Function 14 "Remote control" is not possible.				

P481	BusIO Out Bits function		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 Out 1	Out Bit 4 … 5 via Bus or digital output 1 … 2 of the 1st IO extension.	
	[-06] = Bus / 1.IOE Dig Out 2		
	[-07] = Bus / 2.IOE Dig Out 1	Out Bit 6 … 7 via Bus or digital output 1 … 2 of the 2nd IO extension.	
	[-08] = Bus / 2.IOE Dig Out 2		
	[-09] = Flag 1	See "Use of flags" at the end of the description of parameter P481.	
	[-10] = Flag 2		
	[-11] = Bit10 Bus status word	Assignment of a function for Bit 10 or 13 of the status word.	
	[-12] = Bit13 Bus status word		
	[-13]… [-18]	Reserved	
Factory setting	All { 0 }		
Description	"*Bus IO Out Bits function* ". The bus I/O Out bits are perceived as 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 "Bus I/O In 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.		

P480 … P481 Use of the marker

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

Example:

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

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

Depending on the function selected in (P481) the function must be inverted by adjusting the scaling (P482).

P482	Standard 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 / 1st IOE Dig Out1	Out Bit 4 … 5 via Bus or digital output 1 … 2 of the 1st IO extension.	
	[-06] = Bus / 1st IOE Dig Out2		
	[-07] = Bus / 2nd IOE Dig Out1	Out Bit 6 … 7 via Bus or digital output 1 … 2 of the 2nd IO extension.	
	[-08] = Bus / 2nd IOE Dig Out2		
	[-09] = Flag 1	See "Use of flags" at the end of the description of parameter P481.	
	[-10] = Flag 2		
	[-11] = Bit 10 Bus status word	Bit 10 or 13 of the status word.	
	[-12] = Bit 13 Bus status word		
	[-13] = Reserved		
	[-14] = Reserved		
	[-15] = Reserved		
	[-16] = Reserved		
	[-17] = Reserved		
	[-18] = Reserved		
Factory setting	all { 100 }		
Description	*"Scaling of Bus IO Out Bits".* Adjustment of the limit values of the bus Out bits. For a negative value, the output function will be output negative. Reference to the following values: Current limit (P481 = 3) = x [%] · P203 "Rated motor current" Torque current limit (P481 = 4) = x [%] · P203 · P206 (calculated rated motor torque) Frequency limit (P481 = 5) = x [%] · P201 "Rated motor current"		

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 / 1st IOE Dig Out1	Out Bit 4 … 5 via Bus or digital output 1 … 2 of the 1st IO extension.	
	[-06] = Bus / 1st IOE Dig Out2		
	[-07] = Bus / 2nd IOE Dig Out1	Out Bit 6 … 7 via Bus or digital output 1 … 2 of the 2nd IO extension.	
	[-08] = Bus / 2nd IOE Dig Out2		
	[-09] = Flag 1	See "Use of flags" at the end of the description of parameter P481.	
	[-10] = Flag 2		
	[-11] = Bit 10 Bus status word	Bit 10 or 13 of the status word.	
	[-12] = Bit 13 Bus status word		
	[-13] = Reserved		
	[-14] = Reserved		
	[-15] = Reserved		
	[-16] = Reserved		
	[-17] = Reserved		
	[-18] = Reserved		
Factory setting	all { 10 }		
Description	"*Hysteresis Bus IO Out Bits*". Difference between switch-on and switch-off point to prevent oscillation of the output signal.		

P499	Safety CRC
Setting range	-32768 ... 32767
Factory setting	{ -9525 }
Description	A CRC is necessary for saving the parameter which is relevant for the functional safety. NORDCON calculates the CRC automatically when parameter **P499** is saved If the CRC is input by any other method, it must be calculated manually. After input of the CRC an error is triggered, in order to force a restart of the frequency inverter with adoption of the parameter. A false CRC results in an error when the frequency inverter is started. Typical values for manual input:
Note	If the safety functions are used, the parameter must be provided with password protection **P004**. Parameter **P499** is not changed with the command **P523** "*Load factory setting*". If parameter **P499** is to changed to a default value, this must be carried out manually.

Safety digital input	Max. Safety SS1 time	Safety CRC	Inverse Safety CRC
0	0.1	56011	-9525
1	0.1	38686	-26850
2	0.1	16737	–
2	0.2	24727	–
2	0.3	47708	-17828
2	0.5	62797	-2739
2	0.7	9342	–
2	1	18020	–
2	2	28317	–
2	3	13459	–
2	5	52569	-12967
2	7	12629	–
2	10	6580	–

5.1.7 Additional parameters

P500	Language	S	P
Setting range	0 … 5		
Factory setting	{ 0 }		
Description	Selection of the display language		

Setting values	Value	Meaning	Value	Meaning	Value	Meaning
	0 =	German	1 =	English	2 =	French
	3 =	Spanish	4 =	Swedish	5 =	Netherlands

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	Master function value	S	P
Setting range	0 … 57		
Arrays	[-01] = Master value 1	[-02] = Master value 2	[-02] = 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	For details regarding the processing of setpoints and actual values, please refer to 🕮 Section 8.8.		

Setting values	Value	Meaning	Value	Meaning	Value	Meaning
	00 =	Off	10 =	Reserved POSICON	21 =	**A**ctual frequency without slip master value
	01 =	Actual frequency	11 =			
	02 =	Actual speed	12 =	BusIO Out Bits0-7	22 =	Speed encoder
	03 =	Current	13 =	Reserved POSICON	23 =	Actual frequency with slip
	04 =	Torque current	…		24 =	Master value actual frequency with slip
	05 =	Digital IO status	16 =		53 =	Actual value 1 PLC
	06 =	Reserved POSICON	17 =	Value analogue input 1	…	…
	07 =		18 =	Value analogue input 2	57 =	Actual value 5 PLC
	08 =	Setpoint frequency	19 =	Setpoint frequency master value	58 =	Clock input 1
	09 =	Error number	20 =	Setpoint frequency after master value ramp		

P503	Master function 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	Output of control word and master values on CAN open via the ParameterBox or NORDCON, 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 ... 16.4 kHz	
Factory setting	{ 6.0 }	
Description	The internal pulse frequency for controlling the power unit can be changed with this parameter. A higher setting reduces motor noise, but leads to increased EMC emissions and reduction of the possible motor nominal torque.	
Note	The best possible degree of interference suppression for the device is 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 curve). When the temperature warning limit C001 is reached, the pulse frequency is gradually lowered to the default value (see also P537). If the inverter temperature drops by a sufficient amount, the pulse frequency is increased to the original value.	
	The pulse frequency must not change if a sine filter is used. Otherwise "Module error" (E4.0) can be triggered. See setting 16.2 and 16.3	

Setting values

Value		Meaning
4.0 … 16.0	Pulse frequency 4.0… 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 % to the rated power, the high pulse frequency is set.

P505	Absolute minimum frequency	S	P
Setting range	0.0 … 10.0 Hz		
Factory setting	{ 2 }		
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 the setpoint delay P107 are executed. If a setting value of "Zero" is selected, the brake relay does not switch during reversing. When controlling lift equipment without speed feedback, this value should be set to a minimum of 2 Hz. From 2 Hz, 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 (📖 Section 8.4 "Reduced output power").		

P506	Auto. fault acknowledgement	S	
Setting range	0 … 7		
Factory setting	{ 0 }		
Description	*"Automatic fault acknowledgement"* In addition to the manual error acknowledgement, an automatic one can also be selected.		
Note	**NOTICE!** If P428 is parameterised to "On", P506 "Automatic error acknowledgement" must not be parameterised to the setting 6 "Always" as otherwise the FI would always switch on again in case of an active error (e.g.: earth fault / short circuit). This would probably destroy the FI and cause damage to the system.		

Setting values

Value	Meaning
0	**No automatic** error acknowledgement
1 … 5	**Number** of permissible automatic malfunction acknowledgements within one mains-on cycle. After mains off and switch on again, the full amount is again available.
6	**Always**, a fault message will always be acknowledged automatically if the cause of the error is no longer present. See **Note**.
7	**Via enable deactivation**, 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	Control terminals or keyboard control [1]	Control is via the optional control display (SK TU5-CTR) (if P510 = 0) or via the digital and analogue inputs or via BUS I/O Bits.
1	Only control terminals [2]	Control is via the digital and analogue input signals or via the Bus I/O 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: If a communication error occurs (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	Setpoint source	S
Setting range	0 … 10	
Arrays	Selection of the setpoint source. [-01] = Main setpoint [-02] = Auxiliary setpoint	
Factory setting	all { 0 }	
Description	Selection of the interface via which the FI receives its setpoint.	

Setting values

Value	Meaning
0	Auto (= P509) — The setpoint source corresponds to the control word (P509).
1	Only control terminals — Digital and analogue inputs control the frequency, including fixed frequencies.
2	USS / Modbus — The setpoint is expected via the RS485 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 … 8	
Factory setting	{ 3 }	
Description	Setting of the transfer rate (transfer speed) via the RS485 interface. The same baud rate must be set for all bus participants.	
Note	For communication via Modbus RTU (available for SK 540E and higher) a transfer rate 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	187750 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 timeout**				**S**
Setting range	-0.1 ... 100.0 sec				
Arrays	[-01] =	USS / Modbus	[-02] =	USB	
	[-03] =	CANopen / CAN	[-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	{ 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 an fault and switches off with the error message E010 "Bus Timeout". 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 concerning which channel to monitor is made by the setting in parameters P509 or P510. For example, in this way it is possible to register the interruption of a CAN Broadcast communication, although the FI is still communicating with a Master via CAN.				
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	… 100.0	Setting of telegram downtime		

P514	CAN baud rate						S	P
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.							
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 * (for test purposes only)		
	2	50 kBaud	5	250 kBaud				
	*) Reliable operation cannot be guaranteed							

P515	CAN address		S	P
Setting range	0 … 255			
Arrays	[-01] = Slave address	Receipt address for CAN and CANopen system bus		
	[-02] = Broadcast slave address	Broadcast receipt address for CANopen system bus (slave)		
	[-03] = Master address	Broadcast transmission address for CANopen system bus (Master)		
Factory setting	All { 50 }			
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: FI 1 = 32, FI 2 = 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 shown. 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 range 1	S	P
Setting range	0.0 … 50.0 Hz		
Factory setting	{ 2.0 }		
Description	Skip range for "Skip frequency 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 frequency in the range between +P519 and -P519 set here is not shown. 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 and subtracted from the skip frequency. Skip frequency 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 connect the FI to motors which are already rotating, e.g. for fan drives.		
Note	For physical reasons, flying start only operates above 1/10 of the nominal motor frequency (P201), however not below 10 Hz.		
	Motor frequencies >100 Hz are only picked up in speed controlled mode (Servo mode P300 = 1).		

	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 functions above f_{Fang}=10Hz.	The flying start functions above f_{Fang}=20Hz.

	PMSM: The catch function automatically determines the direction of rotation. With the setting for function 2 the FI therefore behaves in an identical way to function 1. With the setting for function 4 the FI behaves in an identical way to function 3.
	PMSM: In CFC closed loop operation, the catch circuit can only be executed if the rotor position is known in relation to the incremental encoder. For this purpose, the motor cannot initially rotate when it is switched on for the first time after a "mains on" of the FI. This restriction does not apply if the zero track of the incremental encoder is used.
	PMSM: The flying restart does not function if fixed pulse frequencies (setting 16.2 and 16.3) are used in P504.

Setting values	**Value**	**Meaning**
	0	Switched off	No flying start
	1	Both directions	The FI searches for a speed in both directions.
	2	In the setpoint direction	Searches only in the direction of the present setpoint value.
	3	Both directions after failure	As for 1, however only after mains failure or fault.
	4	Setpoint direction after failure	As for 2, however only after 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.		

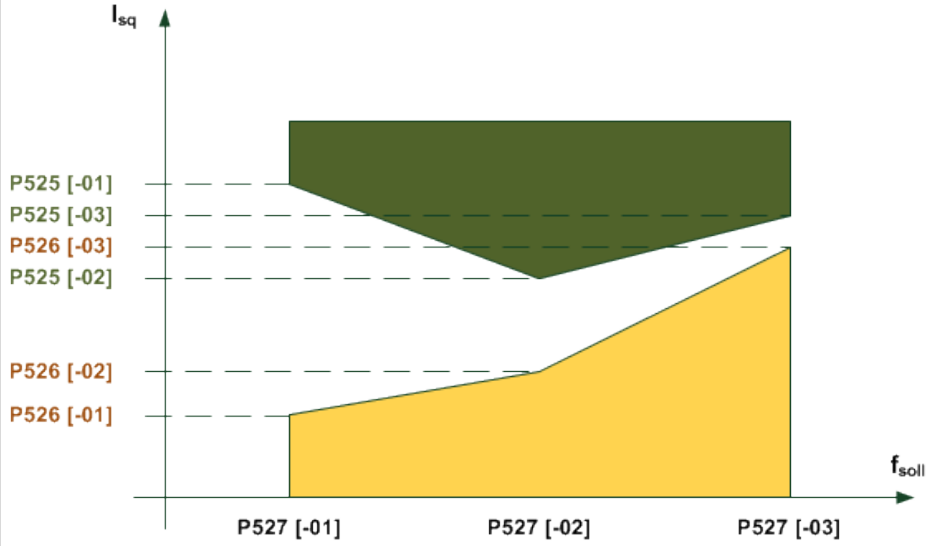
P523	Factory setting
Setting range	0 … 3
Factory setting	{ 0 }
Description	With the selection and activation of the relevant value, the selected parameter range is set to the factory setting. Once this setting is made, the parameter value automatically changes back to 0.
Note	With setting 1 “Load factory settings” the safety-relevant parameters **P423**, **P424**, **P499** are not reset. These must be reset manually.
Setting values	

Value		Meaning
0	No change	Does not change the parameterisation.
1	Load factory setting	The entire parameterisation of the FI is reset to the factory setting. All originally parameterised data are lost.
2	Factory settings without Bus	*"Factory settings without bus"* All parameters of the frequency inverter, with the *exception* of the bus parameters, are reset to the factory setting.
3	Factory only Ethernet	*“Factory settings only Ethernet”.* 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** → Mo monitoring is performed.

P525 … P529	Load monitoring
	With load monitoring, a range can be specified within which the load torque may change depending on the output frequency. There are three auxiliary values for the maximum permissible torque and three auxiliary values for the minimum permissible torque. A frequency is assigned to each of these auxiliary values. No monitoring is carried out below the first and above the third frequency. In addition, monitoring can be deactivated for minimum and maximum values. As standard, monitoring is deactivated.
	
	The time after which a fault is triggered can be set with parameter (P528). If the permissible range is exceeded *(Example diagram: Infringement of the area marked in yellow or green*), the error message E12.5 is generated if parameter P529 does not suppress triggering of an error.
	A warning C12.5 is always given after the elapse of half of the set error triggering time P528. This also applies if a mode is selected for which no fault message is generated. If only a maximum or minimum value is to be monitored, the other limit must be deactivated or must remain deactivated. The torque current and not the calculated torque is used as the reference value. This has the advantage that monitoring outside of the "field weakened range" without servo mode is usually more accurate. Naturally however, it cannot display more than the physical torque in the weakened field range.
	All parameters depend on parameter sets. No differentiation is made between motor and generator torque, therefore the value of the torque is considered. As well as this, there is no differentiation between "left" and "right" running. The monitoring is therefore independent of the prefix of the frequency. There are four different load monitoring modes P529.
	The frequencies and the minimum and maximum values belong together within the various array elements. The frequencies do not need to be sorted according to their magnitude in 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** → Mo monitoring is performed.							

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

P528	Load monitoring delay	S	P
Setting range	0.10 ... 320.00		
Factory setting	{ 2.00 }		
Description	"*Load monitoring delay*". Parameter P528 defines the delay time for which an error message "E12.5" is suppressed on infringement of the defined monitoring range P525 … P527. A warning "C12.5" is triggered after half of this time has elapsed. According to the selected monitoring mode P529 an error message can also be generally suppressed.		

P529	Load monitoring mode		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 and warning	Infringement of the monitoring range produces a warning "E12.5" after the elapse of the time defined in parameter P528. A warning C12.5 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 monitoring range produces a warning C12.5.		
	2 Error and warning, constant travel	"*Fault and warning during constant travel*". As for setting "0" however monitoring is inactive during acceleration phases.		
	3 Warning during constant travel	"*Warning only during constant travel*". As for setting "1" however monitoring is inactive during acceleration phases		

P533	I^2t motor factor	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 switch-off limit		S	P
Setting range	0 ... 400 % / 401			
Arrays	[-01] = Motor switch-off limit	[-02] = Generator switch-off limit		
Factory setting	all { 401 }			
Description	"*Torque switch-off limit*". Setting for a maximum permissible torque limit. A warning (C12.1 or C12.2) is given above 80% of the set limit. The drive shuts down at 100% of the set limit value. An error message (E12.1 or E12.2) is given.			
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 then switch off occurs with error message E002. Possible positive or negative ambient conditions are not taken into account. The I^2t motor function can be set in a differentiated manner. Eight characteristic curves with three different triggering times (<5 s, <10 s and <20 s) are available for selection. The trigger times are based on classes 5, 10 and 20 for semiconductor switching devices. The recommended setting for standard applications is P535 = 5. All curves run from 0 Hz to half of the nominal frequency P201. The full nominal current is available from above half of the nominal frequency.

Switch-off class 5, 60s at 1.5x I_N		Switch-off class 10, 120s at 1.5x I_N		Switch-off class 20, 240s at 1.5x I_N	
I_N at 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	Shut-off classes 10 and 20 are provided for applications with heavy starting. When using these shut-off classes, it must be ensured that the FI has a sufficiently high overload capacity.
	With multi-motor operation the monitoring must be disabled.
	Setting **0 = Off** → Mo monitoring is performed.

P536	Current limit	S
Setting range	0.1 ... 2.0 / 2.1	
Factory setting	{ 1.5 }	
Description	The output current is limited to the rated current 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	Setting **2.1 = Off** → the parameter is disabled.	

P537	Pulse disconnection	S
Setting range	10 ... 200 % / 201	
Factory setting	{ 150 }	
Description	This function prevents rapid shutdown of the FI according to the load. With the pulse switch-off enabled, the output current is limited to the set value. This limitation is implemented by brief switching off of individual output stage transistors, the actual output frequency remains unchanged.	
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 (📖 Section 8.4 "Reduced output power") can be undershot.	
	If the function is disabled and a high pulse frequency is selected in parameter P504, the FI automatically reduces the pulse frequency when the power limit is reached. If the load on the FI is reduced again, the pulse frequency increases back to the original value.	
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 Switched 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	Output monitoring	S	P
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	The output current at the U-V-W terminals is 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	Switched off	Monitoring is not performed.
1	Motor phases only	The output current is measured and checked for symmetry. If an imbalance 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 phase + Magnet.	Monitoring according to settings 1 and 2.

P540	Direction of rotation mode	S	P
Setting range	0 ... 7		
Factory setting	{ 0 }		
Description	For safety reasons this parameter can be used to prevent a rotation direction reversal and therefore prevent an incorrect rotation direction.		
Note	This function does not operate with active position control.		

Setting values

Value		Meaning
0	No restriction	No restriction of direction of rotation
1	Direction key disabled	The rotation direction key on the ControlBox SK TU5-CTR is blocked.
2	CW only [1)]	Only the "right" field of rotation is possible. The selection of the "incorrect" rotation direction leads to the output of the minimum frequency P104 with the field of rotation R.
3	Left running only [1)]	Only the left direction is possible. Selection of the "incorrect" rotation direction results in the output of the minimum frequency P104 with the field of rotation L.
4	Only enable direction	Rotation direction is only possible according to the enable signal, otherwise 0 Hz is output.
5	Only right direction monitored [1)]	*"Only right direction monitored"* Only right direction is possible. Selection of the "incorrect" rotation direction leads to the FI switching off (control block). If necessary, an adequately large setpoint value (>fmin) must be observed.
6	Only left running monitored [1)]	*"Only Cleft running monitored"*. Only left direction is possible. Selection of the "incorrect" rotation direction leads to the FI switching off (control block). If necessary, an adequately large setpoint value (>fmin) must be observed.
7	Only CW monitored	*"Only enable direction monitored"* Rotation direction is only possible according to the enable signal, otherwise the FI is switched off.
1)	Applies for control via control terminals and keyboard (SK TU5-CTR). In addition the direction key of the ControlBox is disabled.	

P541	Set Digital Out		S
Setting range	0000 … 3FFF (hex)		
Arrays	[-01] = Internal (Set relays)	[-02] = Set Bus / IOE Out	
Factory setting	{ 0000 }		
Description	"*Set relays and digital outputs*". This function provides the option of controlling the relay and the digital outputs independently of the frequency inverter status. For this, the corresponding output (e.g. multi-function relay 1: P434 [-01]) must be set to Function 12, "Value of P541". This function can either be used manually or in combination with a bus control.		
Note	The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off!		
Setting values	**[-01]= Internal (Set relays)**	**[-02] = Set Bus / IOE Out**	

Bit 0	Binary output.1 / MFR1	Bit 0	Bus/IOE – Dig-Out1
Bit 1	Binary output.2 / MFR2	Bit 1	Bus/IOE – Dig-Out2
Bit 2	Binary output 3/ Digital output 1 [1]	Bit 2	Bus/IOE – Dig-Out3
Bit 3	Binary output4/ Digital output 2 [1]	Bit 3	Bus/IOE – Dig-Out4
Bit 4	Binary output 5/ Digital output 3 (CU5) [1)]	Bit 4	Bus/IOE – Dig-Out5
Bit 5	Binary output 6/ Digital output 4 (CU5) [1)]	Bit 5	Bus/IOE – Dig-Out6
Bit 6	Binary output 7/ Digital output 5 (CU5) [1)]	Bit 6	Bus/IOE – Dig-Out7
Bit 7	Binary output 8/ Digital output 6 (CU5) [1)]	Bit 7	Bus/IOE – Dig-Out8
Bit 8	Digital function analog1		
Bit 9	Reserved		

1 SK 530P and higher

P542	Set analogue output		S
Setting range	0 … 100 %		
Arrays	[-01] = Analogue output	Analogue output (AO) integrated into the FI	
	[-02] = Reserved		
	[-03] = First IOE	Analogue input of the first IO extension	
	[-04] = Second IOE	Analogue output of the first 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 module regardless of the actual operating statuses. For this, the relevant analogue output must be set to the function "External control" (e.g.: P418 = 7). This function can either be used manually or in combination with a bus control. After confirmation the value set here is output to the analogue output.		
Note	The setting is not saved in the EEPROM and is lost when the frequency inverter is switched off!		

P543	**Bus actual value**								**S**	**P**
Setting range	0 … 57									
Arrays	[-01] = Actual bus value 1		[-02] = Actual bus value 2		[-03] = Actual bus value 3					
	[-04] = Actual bus value 4		[-05] = Actual bus value 5							
Factory setting	[-01] = { 1 }		[-02] = { 4 }		[-03] = { 9 }		[-04] = { 0 }		[-05] = { 0 }	
Description	Setting of the return values for bus control.									
Setting values	**Value / Meaning**									

0	Off	18	Value analog input 2
1	Actual frequency	19	Setpoint frequency master value P503
2	Actual speed	20	Setpoint frequency master value after ramp "Setpoint frequency master value after ramp"
3	Current		
4	Torque current (100 % = P112)	21	Act. freq. without slip master value "Actual frequency without slip master value"
5	Digital- IO status [1]		
6, 7	Reserved POSICON	22	Speed encoder
8	Setpoint frequency	23	Actual frequency with slip, *"Actual frequency with slip"*
9	Error number	24	Master value, actual freq. with slip, "Master value, actual freq. with slip"
10, 11	Reserved POSICON	53	Actual value 1 PLC
12	BusIO Out Bits 0-7	…	…
13	Reserved POSICON	57	Actual value 5 PLC
…		58	Clock input 1
16			
17	Value analog input 1		

[1] Digital input assignments::

Bit 0 (FI):	DIN	Bit 4 (FI):	DIN	Bit 8 (FI):	AIN2	Bit 12 (FI):	Mfr1
Bit 1 (FI):	DIN	Bit 5 (FI):	DIN	Bit 9 (CU5):	DIN2	Bit 13 (FI):	Mfr2
Bit 2 (FI):	DIN	Bit 6 (CU5):	DIN1	Bit 10 (CU5):	DIN3	Bit 14 (FI):	DOUT1
Bit 3 (FI):	DIN	Bit 7 (FI):	AIN1	Bit 11 (CU5):	DIN4	Bit 15 (FI):	DOUT2

P546	Function Bus setpoint			S	P
Setting range	0 … 57				
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 other { 0 }			
Description	Assignment of a function to a bus setpoint value.				

Setting values

Value		Value	
0	Off	18	Curve travel calculator
1	Setpoint frequency	19	Set relay "Output status" (as for P541)
2	Torque current limit P112		
3	Actual frequency PID	20	Set analogue output (as for P542)
4	Frequency addition	21	Reserved POSICON
5	Frequency subtraction	…	
6	Current limit P536	24	
7	Maximum frequency P105	46	Setpoint Setval.torque p.reg., "Setpoint torque process controller"
8	Actual PID frequency limited		
9	Actual PID frequency monitored	47	Reserved POSICON
10	Torque servo mode P300	48	Motor temperature
11	Torque lead P214	49	Ramp time (acceleration / deceleration)
12	Reserved	53	d-correction, F process
13	Multiplication	54	d-correction torque
14	Process controller actual value	55	d-correction, F+ Torque
15	Process controller setpoint	56	Acceleration time
16	Process controller lead	57	Deceleration time
17	Bus I/O In Bits 0-7	58	Reserved POSICON

P549	PotentiometerBox function		S	
Setting range	0 … 16			
Factory setting	{ 0 }			
Description	This parameter provides the option of adding a correction value (fixed frequency, analogue value, bus) to the actual setpoint value by means of the ControlBox keyboard. An explanation can be found in the description of P400.			
Setting values	**Value**	**Meaning**	**Value**	**Meaning**
	0	Off	8	Actual PID frequency limited
	1	Setpoint frequency	9	Actual PID frequency monitored
	2	Torque current limit	10	Servo mode torque
	3	Actual frequency PID	11	Torque lead
	4	Frequency addition	12	Reserved
	5	Frequency subtraction	13	Multiplication
	6	Current limit	14	Process controller actual value
	7	Maximum frequency	15	Process controller setpoint
			16	Process controller lead

P550	µSD orders	
Setting range	0 … 10	
Factory setting	{ 0 }	
Scope of Application	**SK 530P, SK 550P**	
Description	If a Micro SD card is present in slot X18, entire parameter sets (each consisting of the parameter sets 1 – 4) can be exchanged between the MicroSD card and the frequency inverter.	
Note	5 storage areas are available on the MicroSD card. Therefore data sets from a total of 5 different frequency inverters can be archived on the card.	
	NB: 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 storage area 1 of the MicroSD card.
	2	FI → µSD 2	As for 1, however to storage area 2.
	3	FI → µSD 3	As for 1, however to storage area 3.
	4	FI → µSD 4	As for 1, however to storage area 4.
	5	FI → µSD 5	As for 1, however to storage area 5.
	6	µSD 1 → FI	The data set is copied from storage area 1 of the MicroSD card to the frequency inverter.
	7	µSD 2 → FI	As for 6, however to storage area 2.
	8	µSD 3 → FI	As for 6, however to storage area 3.
	9	µSD 4 → FI	As for 6, however to storage area 4.
	10	µSD 5 → FI	As for 6, however to storage area 5.

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	Reserved	
	3	Nord-Custom	Drive profile with freely assignable bits.

P552	CAN master cycle	S
Setting range	0 … 100 ms	
Arrays	[-01] =	CAN master function, CAN master cycle 1
	[-02] =	CANopen absolute encoder, CANopen absolute encoder, CAN master cycle 2
Factory setting	all { 0 }	
Description	In this parameter, the cycle time for the CAN/CANopen master mode and the CANopen encoder is set (see P503/514/515). Depending on the baud rate which is set, there are different minimum values for the actual cycle time:	
Note	The range of values which can be set is between 0 and 100ms. With the setting 0 “Auto” the default value (see table) is used. In this setting the monitoring function for the CANopen absolute encoder is no longer triggered at 50 ms but rather at 150 ms.	

Baud rate	Minimum value t_z	Default CAN Master	Default CANopen Abs.
10 kBaud	10 ms	50 ms	20 ms
20 kBaud	10 ms	25 ms	20 ms
50 kBaud	5 ms	10 ms	10 ms
100 kBaud	2 ms	5 ms	5 ms
125 kBaud	2 ms	5 ms	5 ms
250 kBaud	1 ms	5 ms	2 ms
500 kBaud	1 ms	5 ms	2 ms
1000 kBaud	1 ms	5 ms	2 ms

P553	PLC setpoints		
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	Value	Meaning
0	Off	18	Curve travel calculator
1	Setpoint frequency	19	Set relay "Output status" (as for P541)
2	Torque current limit P112		
3	Actual frequency PID	20	Set analogue output (as for P542)
4	Frequency addition	21	Reserved POSICON
5	Frequency subtraction	…	
6	Current limit P536	24	
7	Maximum frequency P105	46	Setpoint Setval.torque p.reg., "Setpoint torque process controller"
8	Actual PID frequency limited		
9	Actual PID frequency monitored	47	Reserved POSICON
10	Torque servo mode P300	48	Motor temperature
11	Torque lead P214	49	Ramp time (acceleration / deceleration)
12	Reserved	53	d-correction, F process
13	Multiplication	54	d-correction torque
14	Process controller actual value	55	d-correction, F+ Torque
15	Process controller setpoint	56	Acceleration time
16	Process controller lead	57	Deceleration time
17	Bus I/O In Bits 0-7	58	Reserved 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	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.

P555	P chopper limit		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 delay (modulation level) for the chopper can only rise to a certain maximum specified limit. Once this value has been reached, irrespective of the level of the link circuit voltage, the inverter switches off the current to the resistor. The result would be an overvoltage switch-off of the FI.		
	The correct percentage value is calculated as follows: $k[\%] = \frac{R * P_{\max BW}}{U_{\max}^{2}} * 100\%$		
	R =	Resistance of the braking resistor	
	P_{maxBW} =	Momentary peak power of the braking resistor	
	U_{max} =	FI chopper switching threshold	
		1~ 115/230 V	⇒ 440 V =
		3~ 230 V	⇒ 500 V =
		3~ 400 V	⇒ 1000 V =

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 output P557 including overload (200 % for 60 s) is reached, an I^2t limit error E003.1 is triggered. For further details see P737.	

P557	Braking resistor power	S
Setting range	0.00 ... 320.00 kW	
Factory setting	{ 0.00 }	
Description	Continuous power (nominal power) of the resistor, to display the actual utilisation in P737. For a correctly calculated value, the correct value must be entered into P556 and P557.	
Setting values	0.00 Monitoring disabled	

P558	Flux delay	S	P
Setting range	0 / 1 / 2 ... 5000 ms		
Factory setting	{ 1 }		
Description	The ISD control can only function correctly if there is a magnetic field in the motor. For this reason, a DC current is applied before starting the motor to provide the excitation of the stator winding. The duration depends on the size of the motor and is automatically set in the factory setting of the FI. For time-critical applications, the magnetising time can be set or deactivated.		
Note	Setting values that are too low can reduce the dynamics and starting torque.		
Setting values	**Value** / **Meaning**		
	0 – Switched off		
	1 – Automatic calculation		
	2 … 5000 – Time set in [ms]		

P559	DC run-on time	S	P
Setting range	0.00 ... 30.00 sec		
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 should completely stop the drive. Depending on the inertia, the time for which the current is applied can be set in this parameter. The current level depends on the previous braking procedure (current vector control) or the static boost (linear characteristic).		

P560	Parameter, Saving mode	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 no longer saved in 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 EPROM	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 sequence for controlling the motor phases (U – V – W) can be changed with this parameter. This enables the direction of rotation of the motor to be changed without having to change 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	Inverted	*"Invert motor phase sequence"* The direction of rotation of the motor is changed. The counting direction of the encoder for speed detection (if present) remains unchanged.	
	2	Inverted by encoder	As for setting 1, however in addition the counting direction of the encoder is also changed.	

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 error	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 (see Section 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 … 99.9
Arrays	[-01] … [-10]
Description	„*Last fault 1 … 10*“. This parameter stores the last 10 faults (🕮 Section 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 ... 999.9 A	
Arrays	[-01] … [-10]	
Description	"*Current last error 1 … 10*“. This parameter stores the output current that was being delivered at the time the fault occurred. The values of the last 10 errors are stored.	

P704	Volt. last error		S	
Display range	0 ... 600 V AC			
Arrays	[-01] … [-10]			
Description	„*Last voltage error 1 … 10*“. This parameter stores the output voltage that was being delivered at the time the fault 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] = Version number (Vx.x) [-02] = Revision number (Rx) [-03] = Special version of hardware/software (0.0)			
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	Digital input status
Display range	0000 ... 1FFF (hex)
Arrays	[-01] = Status of digital inputs of the frequency inverter
	[-02] = Status of digital inputs of extension modules
Description	"*State of digital inputs*". Displays the status of the digital inputs in hexadecimal code.

	Bits 15-12	Bits 11-8	Bits 7-4	Bits 3-0	
Minimum value	0000 **0**	0000 **0**	0000 **0**	0000 **0**	Binary **hex**
Maximum value	0001 **1**	1111 **F**	1111 **F**	1111 **F**	Binary **hex**

Display values

Array [-01]

Value	Meaning
Bit 0	Bus / 2nd IOE Dig In1
Bit 1	Digital input 2 (DI2)
Bit 2	Digital input 3 (DI3)
Bit 3	Digital input 4 (DI4)
Bit 4	Digital input 5 (DI5)
Bit 5	Digital input 6 (DI6) [1]
Bit 6	Digital input 7 (DI7) [2]
Bit 7	Digital input 8 (DI8) [2]
Bit 8	Digital input 9 (DI9) [2]
Bit 9	Digital input 10 (DI10) [2]
Bit 10	Digital input 11 (DI11) [3]
Bit 11	Digital input 12 (DI12) [4]
Bit 12	Digital function, analog input 1 (AI1)
Bit 13	Digital function, analog input 2 (AI2)

Array [-02]

Value	Meaning
Bit 0	Bus / 1st IOE Dig In1
Bit 1	Bus / 1st IOE Dig In2
Bit 2	Bus / 1st IOE Dig In3
Bit 3	Bus / 1st IOE Dig In4
Bit 4	Bus / 2nd IOE Dig In1
Bit 5	Bus / 2nd IOE Dig In2
Bit 6	Bus / 2nd IOE Dig In3
Bit 7	Bus / 2nd IOE Dig In4

[1] SK 530P and higher

[2] For SK 530P and higher with SK CU5-MLT

[3] For SK 530P and higher with SK CU5-STO

[4] For SK 530P and higher with SK CU5-SLS

P709	**V/I analogue inputs**	
Display range	-100.0 ... 100.0 %	
Arrays	[-01] = Analogue input 1	Analogue input 1 (AI1) integrated into the FI
	[-02] = Analogue input 2	Analogue input 2 (AI2) integrated into the FI
	[-03] = Ext. analogue input 1	*"External analogue input 1".* Analogue input 1 of the first IO extension
	[-04] = Ext. analogue input 2	*"External analogue input 2".* Analogue input 2 of the first IO extension
	[-05] = Ext. A. in.1 2.IOE	*"External analogue input 1 of the 2nd IOE".* Analogue input 1 of the second I/O extension
	[-06] = Ext. A. in.1 2.IOE	*"External analogue input 2 of the 2nd IOE".* Analogue input 2 of the second I/O extension
	[-07] = Reserved	
	[-08] = Reserved	
	[-09] = Clock input 1	
	[-10] = Reserved	
Scope of Application	**[-01] … [-02] SK 500P and higher**	
	[-03] … [-12] SK 530P and higher	
Description	„*Voltage of analogue inputs*“. Displays the measured customer unit input value.	
Note	100 % = 10.0 V or 20.0 mA	

P710	**V/I analogue outputs**	
Display range	0 ... 100 %	
Arrays	[-01] = Analogue output	Analogue output (AO) integrated in the FI
	[-02] = Reserved	
	[-03] = First IOI	*"External analogue output of first IOE“.* Analogue input of the first IO extension
	[-04] = Second IOE	*"External analogue output of second IOE":* Analogue output of the first IO extension
Scope of Application	**[-01] SK 500P and higher**	
	[-02] … [-04] SK 530P and higher	
Description	„*Analogue output voltage*“. Displays the delivered value of analogue output.	
Note	100 % = 10.0 V or 20.0 mA	

P711	Digital output status
Display range	0000 ... 0FFF
Description	"*State of digital outputs*". Displays the status of the digital outputs in hexadecimal code.

	Bits 15-12	Bits 11-8	Bits 7-4	Bits 3-0	
Minimum value	0000 **0**	0000 **0**	0000 **0**	0000 **0**	Binary **hex**
Maximum value	0000 **0**	1111 **F**	1111 **F**	1111 **F**	Binary **hex**

Setting values

Value	Meaning	Value	Meaning
Bit 0	Multi-function relay 1 (K1)	Bit 7	Digital output 6 (DO2) [2]
Bit 1	Multi-function relay 2 (K2)	Bit 8	Analogue output 1 (AO1) - digital function AO1
Bit 2	Digital output 1 (DO1) [1]	Bit 9	Reserved
Bit 3	Digital output 2 (DO2) [1]	Bit 10	Digital output 1/1.IOE
Bit 4	Digital output 3 (DO3) [2]	Bit 11	Digital output 2/1.IOE
Bit 5	Digital output 4 (DO4) [2]	Bit 12	Digital output 1/2.IOE
Bit 6	Digital output 5 (DO5) [2]	Bit 13	Digital output 2/2.IOE

1) SK 530P and higher

2) For SK 530P and higher with SK CU5-MLT

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).

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 ... _____ h
Description	Duration of the ready state of the inverter and availability of mains voltage (cumulative value over the life of the inverter).

P715	Running time
Display range	0.00 ... _____ h
Description	Duration of the time in which the inverter was enabled and delivered power at the output (cumulative value over the life of the inverter).

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

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

P718	Actual setp. 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 (📖 Section 8.1 "Setpoint processing").			

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

P720	Act. torque current			
Display range	-999.9 ... 999.9 A			
Description	Displays the actual calculated torque-developing output current (active current). Basis for calculation is the motor data P203. 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 P203. P209			

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

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

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

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

P726	Apparent power
Display range	0.00 ... 300.00 kVA
Description	Displays the actual calculated apparent power. Basis for calculation is the motor data P203. 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 P203. 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 P203. 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 P203. P209

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

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

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

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

P735	Speed encoder	S
Display range	-9999 … 9999 rpm	
Arrays	[-01] = TTL encoder	[-03] = Sin/Cos encoder
	[-02] = HTL encoder	[-04] = Speed monitor (The speed is determined by alternative measuring methods and by calculation)
Scope of Application	**[-01], [-03] SK 530P and higher**	
	[-02], [-04] SK 500P and higher	
Description	Displays the actual speed supplied by the encoder. P301 / P605 must be set, depending on the encoder which is used.	

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

P737	Usage brake res.
Display range	0 … 100 %
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	Motor usage rate	
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. The basis for the calculation are the motor data P203 and the current which is actually consumed.	

P739	Temperature	
Display range	-40 … 150 °C	
Arrays	[-01] = Heat sink	Actual temperature of the heat sink This value is used for overtemperature switch-off E001.0.
	[-02] = Ambient temperature UZW	Actual temperature of the interior of the power section of the inverter. This value is used for overtemperature switch-off E001.1.
	[-03] = Motor PT/KTY:	Displays the actual motor temperature when monitoring with a temperature sensor(Type: KTY84-130, PT100, PT1000)
	[-04] = Microprocessor	Actual 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 actual temperature values at various measuring points.	

P740	Process data bus In		S
Display range	0000 … FFFF (hex)		
Arrays	[-01] = Control word	Control word, source from P509.	
	[-02] = Setpoint 1 … [-06] = Setpoint 5	Setpoint data from main setpoint P510 [-01].	
	[-07] = Resulting status In Bit 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: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)	
	[-13] = Setpoint 1 … [-17] = Setpoint 5	Setpoint data (P510 [-02]) from the master function value (Broadcast) if P508 = 9/10	
	[-18] = Control word PLC	Control word, source PLC	
	[-19] = PLC setpoint 1 … [-23] = PLC setpoint 5	Setpoint data from the PLC.	
	[-24] = Main setpoint from the PLC	Main setpoint from the PLC.	
	[-25] = Auxiliary control byte 1 PLC	The first byte of the auxiliary control word with defined functionalities for IO control via PLC. 0 x 01 Fixed frequency 1 0 x 02 Fixed frequency 2 0 x 04 Fixed frequency 3 0 x 08 Fixed frequency 4 0 x 10 Fixed frequency 5 0 x 20 Jog frequency 0 x 40 Hold frequency with motor potentiometer 0 x 80 Remove enable via analogue input	
	[-26] = Auxiliary control byte 2 PLC	The second byte of the auxiliary control word with defined functionalities for IO control via PLC. 0 x 01 Fixed frequency array Bit 0 0 x 02 Fixed frequency array Bit 1 0 x 04 Fixed frequency array Bit 2 0 x 08 Fixed frequency array Bit 3 0 x 10 Fixed frequency array Bit 4 0 x 20 Motor potentiometer function activated 0 x 40 Increase motor potentiometer frequency 0 x 80 Reduce motor potentiometer frequency	
	[-27] = Res: Control word 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 actual control word and the setpoints that are transferred via the bus systems.		
Note	For display, a Bus system must be selected in P509 Scaling: 🕮 Section 8.8 "Standardisation of setpoint / target values"		

P741	Process data bus Out		S
Display range	0000 … FFFF (hex)		
Arrays	[-01] = Bus status word	Status word corresponding to selection in P551	
	[-02] = Actual bus value 1 … … [-06] = Actual bus value 5	Actual value according to P543	
	[-07] = Resulting status OutBit P481	The displayed value depicts all Bus OUT Bit sources linked with an "*OR*".	
	[-08] = Parameter data Out 1 … … [-12] = Parameter data Out 5	Data during parameter transfer.	
	[-13] = Master function actual value 1 … … [-17] = Master function actual value 5	Actual value of master function P502 / P503.	
	[-18] = Status word PLC	Status word via PLC	
	[-19] = Actual value 1 PLC … … [-23] = Actual value 5 PLC	Actual value via PLC	
	[-24] = Res: FI status word	*Resulting status word“* – Status word from the frequency inverter.	
Description	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.		
Note	Scaling: 🕮 Section 8.8 "Standardisation of setpoint / target 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	0000 … FFFF (hex)	
Arrays	[-01] = Configuration	Displays the configuration of the FI
	[-02] = Device version	Display of the device version
	[-03] = CU5 extension	Displays customer unit (SK CU5-…)
	[-04] = Additional interfaces	Displays communication interfaces
	[-05] = Functionalities	Displays device functions
Description	Displays the configuration of the device.	

Display values

Value	Meaning
Array [-01] Configuration	
0200	Basic
0201	Advanced
0202	PNT
0203	ECT
0204	EIP
0205	POL
Array [-02] device versions	
0000	No extension
0001	STO
0002	Industrial Ethernet
Array [-03] CU5 extension	
0000	No extension
0001	STO
0002	ENC (Encoder)
0003	MLT = (Multi IO)
0004	RES (Resolver)
0005	SAF (ProfiSafe module)
0006	SS1
Array [-04] Additional 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 24V supply
Bit 5	CAN/CANopen interface
Bit 6	CAN absolute encoder interface (ABS)
Bit 7	MicroSD card Interface
Bit 8	USB port
Bits 9-15	Reserved
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 … 15	Reserved

P745	Module version			
Display range	-3276.8 … 3276.7			
Arrays	[-01] =	TU5 version	[-07] =	XU5 version
	[-02] =	TU5 version	[-08] =	XU5 version
	[-03] =	TU5 special version	[-09] =	XU5 special version
	[-04] =	CU5 version	[-10] =	XU5 Stack 1
	[-05] =	CU5 version	[-11] =	XU5 Stack 2
	[-06] =	CU5 special version		
Scope of Application	**[-01] … [-03]**	**SK 500P and higher**		
	[-04] … [-06]	**SK 530P and higher**		
	[-07] … [-11]	**SK 550P and higher**		
Description	Software version for optional hardware extensions. Have this data available in case of technical queries.			

P746	Option status			S
Display range	0000 … FFFF (hex)			
Arrays	[-01] = TU5	[-02] = CU5	[-03] = XU5	
Scope of Application	**[-01] SK 500P and higher**	**[-02] SK 530P and higher**	**[-03] SK 550P and higher**	
Description	Displays the actual status of the optional hardware extensions. 0 = Not ready 1 = Standby			

P747	Inverter Volt Range		
Display range	0 … 4		
Description	"*Inverter voltage range*". Indicates the mains voltage range for which this device is specified.		
Display values	0 = 100 V .. 200 V	1 = 200 V .. 240 V	2 = 380 V .. 480 V
	3 = 400 V .. 500 V		

P748	CANopen status		S
Display range	0000 … FFFF (hex)		
Arrays	[-01] = CANopen status	[-02] = Reserved	[-03] = Reserved
Description	Shows 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	Fault 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: The number of error messages according to P750 [-01] are displayed in P751 [-01].	

P752	Last extn. fault
Display range	0 ... 65535
Arrays	[-01] … [-10]
Description	This parameter stores the last 10 errors from **P700 [4]**
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.

P780	Inverter ID
Display range	0 … 9 and A … Z (char)
Arrays	[-01] = … [-14]
Description	Display of the serial number (14-digit) of the device.
Note	• Display via NORDCON: as a contiguous serial number of the device • Display via Bus: ASCII code (decimal). Each array must be read out separately.

P799	Op.hrs. last fault
Display range	0.00 … 19 999 999.99 h
Arrays	[-01] … [-10]
Description	"*Operating time, last fault*". If an fault occurs a time stamp is set on the basis of the on-time P714 and saved in P799. Array [-01]. [10] corresponds to the last faults 1 ... 10.

6 Operating status messages

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

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

Start disabled, “Not Ready” → (P700 [-03])

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

Display is only possible with the NORD CON software or the ParameterBox.

Warning messages → (P700 [-02])

Warning messages are generated as soon as a defined limit is reached. However this does not cause the frequency inverter to switch off. These messages can be displayed via the array-element [**-02**] in parameter (**P700**) until either the reason for the warning is no longer present or the frequency inverter has gone into a fault state with an error message.

Error messages → (P700 [-01])

Errors cause the device to switch off, in order to prevent a device fault.

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

- Switching the mains off and on again,
- By an appropriately programmed digital input (**P420**),
- By switching off the “enable” on the device (if no digital input is programmed for acknowledgement),
- By Bus acknowledgement
- By (**P506**), automatic error acknowledgement.

6.1 Display of messages

LED indicators

The frequency inverter is equipped with several dual colour LEDs (red and green) for diagnostic purposes.

- The device-specific LEDs **(1)** are labelled as "DEV" and "BUS" and "USB").
- The two status LEDs **A** and **B (2)**, which are significant for communication in Industrial Ethernet are not directly labelled and are only present in the SK 550P version (📖 BU 0620).

Explanations for the individual LEDS are described below.

Figure 9: LEDs – status displays on the device

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 and red alternately (4 Hz)	• Warning
Flashing red (2 Hz/ 1 Hz)	• Output of the error number (e.g. Error 3: flashes three times and then pauses)
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
Green off	• USB driver in PC not correctly initialised
Lights up green	• 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.

6.2 Messages

Error messages

Display in the SimpleBox / ControlBox		Fault Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-01] / P701**		
E001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring measurements are outside of the permissible temperature range, i.e. the error is triggered if the permissible lower limit is undershot or the permissible upper temperature limit is exceeded. • Depending on the cause: Reduce or increase the ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
	1.1	**Overtemp. FI internal** *"Internal FI overtemperature"* (interior of FI)	
E002	**2.0**	**Motor overtemp. PTC** *“Motor overtemp. PTC“* With SK530P and above, PTC monitoring can be disabled via Parameter P425.	Motor temperature sensor (thermistor) has triggered • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Motor overtemp. I²t** *“Motor overtemperature I²t“* Only if I^2t motor (P535) is programmed.	Motor I^2t has triggered (calculated motor overtemperature) • Reduce motor load • Increase motor speed • Repeat stator resistance measurement, see 5.1.4 "Motor data / characteristic curve parameters"
	2.2	**External braking resistor overtemperature** *“External braking resistor overtemperature”* Overtemperature via digital input (P420 […])={13}	Temperature sensor (e.g. braking resistor) has triggered • Digital input is low • Check connections and temperature sensor

E003	**3.0**	**I^2t overcurrent limit**	a.c. inverter: I^2t limit has triggered, e.g. > 1.5 x I_n for 60s (see P504) • Continuous overload at FI output • Possible encoder fault (resolution, defect, connection)
	3.1	**Chopper overtemperature I^2t**	Brake chopper: I^2t limit has activated, 1.5 times value reached for 60s (see to P554 if present, as well as P555, P556, P557) • Avoid overcurrent in braking resistor
	3.2	**IGBT overcurrent** 125 % monitoring	De-rating (power reduction) • 125 % overcurrent for 50 ms • for fan drives: enable flying start circuit (P520)
	3.3	**IGBT overcurrent fast** 150 % monitoring	De-rating (power reduction) • 150 % overcurrent
	3.4	**Chopper overcurrent**	• Brake chopper current too high • Avoid overcurrent in braking resistor
	3.7	**Power limit**	Input current too high. Continuous overload at FI Input. Shutdown for 150% overload within 60 s. • Reduce load Note: Higher loads or frequent overloads result in shortening of the shutdown time. An overload at the FI input may occur e.g. if the mains voltage is in the lower tolerance range.
E004	**4.0**	**Overcurrent module**	Error signal from module (short duration) • Short-circuit or earthing fault at FI output • Motor cable is too long • Use external output choke • Brake resistor faulty or resistance too low **→ Do not switch off P537!** **The occurrence of a fault can significantly shorten the service life of the device, or even destroy it.**
	4.1	**Overcurrent measurement** *"Overcurrent measurement"*	P537 (pulse current switch-off) was reached 3x within 50 ms (only possible if P112 and P536 are disabled) • FI is overloaded • Drive sluggish, insufficiently sized, • Ramps (P102/P103) too steep → Increase ramp time • Check motor data (P201 … P209)
	4.5	**Overcurrent / short circuit in the brake rectifier** *Overcurrent / short circuit in the brake rectifier*	• Electromechanical brake defective • Electromechanical brake connected with impermissible electrical data → Check the connection data

E005	**5.0**	**Overvoltage Ud**	Link circuit voltage too high • Increase deceleration time (P103) • Possibly set shutdown mode (P108) with delay (not for lifting equipment) • Extend the quick stop time (P426) • Speed fluctuation (for example due to high inertia loads) → if necessary set the <U/f characteristic curve (P211, P212) FIs with brake chopper: • Dissipate energy feedback with a braking resistor • Check the function of the braking resistor (cable break) • Resistance of connected braking resistor too high
	5.1	**Mains high voltage**	Mains voltage too high • See Technical Data (📖 Section 7)
E006	**6.0**	**Charging fault**	Link circuit voltage too low • Mains voltage too low • See Technical Data (📖 Section 7)
	6.1	**Mains low voltage**	Mains voltage too low • See Technical Data (📖 Section 7)
E007	**7.0**	**Mains phase error**	Error at terminal connection side • A mains phase is not connected • Mains asymmetrical
	7.1	**UZW phase error**	Mains phase error
E008	**8.0**	**Parameter loss** (maximum EEPROM value exceeded)	Error in EEPROM data • Software version of the stored data set not compatible with the software version of the FI. **NOTE**: Faulty parameters are automatically reloaded (factory setting). • EMC interferences (see also E020)
	8.1	**Inverter type incorrect**	• EEPROM faulty
	8.2	**External copy error** (ControlBox)	• Check ControlBox for correct position • ControlBox EEPROM defective (**P550 = 1**)
	8.4	**Internal EEPROM error** (Database version incorrect)	The configuration of the frequency inverter was not correctly identified. • Switch mains voltage off and on again.
	8.7	**EEPR copy not the same**	

E010	**10.0**	**Bus Time-Out** (for Can, Canopen, USS)	Telegram time-out / BUS Off int. CANbus • Data transfer defective. Check P513. • Check the physical bus connections. • Check the program sequence of the bus protocol. • Check the bus master. • Check the 24 V supply of the internal CAN/CANopen Bus. • Nodeguarding error (internal CANopen) • Bus-Off error (internal CANbus)
	10.1	Reserved	
	10.2	**Bus Timeout XU5**	Bus module 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.
	10.3	**Bus Time-Out XU5**	Bus module telegram time-out by **P513** • Timeout triggered by parameter **P513**.
	10.4	**Option init-error**	Bus module initialisation failure • Restart the frequency inverter (switch the power supply off and on again). • DIP switch of a connected I/O extension defective.
	10.5	**Option system error**	• External bus module • netX & control system controller software not compatible • Error when changing the XU5 field bus protocol • Package length to XU5 too long • Condition for changing the XU5 of field bus protocol not present
	10.6	**Ethernet cable**	• Ethernet cable not connected or connection defective.
	10.7	Reserved	
	10.8	**System bus error**	• Error between bus interface and frequency inverter.
	10.9	**Module missingP120**	The module stated in parameter **P120** is not present. • Check connections
E011	**11.0**	**Customer interface**	Error in analog-digital converter • Internal customer unit (internal data bus) faulty or damaged by radio radiation (EMC) • Check control connections for short-circuit. • Minimize EMC interference by laying control and power cables separately. • Earth the devices and shields well.

E012	**12.0**	**External watchdog**	The Watchdog function is selected at a digital input and the impulse at the corresponding digital input is not present for longer than the time set in parameter P460 >Watchdog time<. • Check connections • Check setting P460
	12.1	**Limit moto./Customer** *"Drive switch-off limit"*	The drive switch-off limit (P534 [-01]) has triggered. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Limit gen.** *"Generator switch-off limit"*	The generator switch-off limit (P534 [-02]) has triggered. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.3	**Torque limit**	Limit from potentiometer or setpoint source has switched off. P400 = 12
	12.4	**Current limit**	Limit from potentiometer or setpoint source has switched off. P400 = 14
	12.5	**Load monitor**	Switch-off due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528). • Change monitoring mode (P529).
	12.8	**AI minimum** *„Analogue In minimum“*	Switch-off due to undershooting of the 0% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2"
	12.9	**AI maximum** *„Analogue In maximum“*	Switch-off due to overshooting of the 100% adjustment value (P402) with setting (P401) "0-10V with switch-off on error 1" or "....2"

E013	**13.0**	**Encoder error**	No signal from encoder • Check 5V sensor if present. • Check supply voltage of encoder.
	13.1	**Speed slip error** *"Speed slip error"*	The slip speed error limit was reached. • Increase value in P327
	13.2	**Shut-down monitoring**	The slip error switch-off monitoring has triggered. The motor could not follow the setpoint • Check motor data P201 ... P209! (important for current controllers) • Check motor circuit • Check encoder settings P300 and following in servo mode • Increase value for torque limit in P112 • Increase value for current limit in P536 • Check deceleration time P103 and extend if necessary
	13.3	**Slip error**	Incorrect direction of rotation • Check connections
	13.5	**Reserved**	Error message for POSICON → see supplementary instructions
	13.6	**Reserved**	Error message for POSICON → see supplementary instructions
	13.8	**Right hand limit switch reached**	Error message for POSICON → see supplementary instructions
	13.9	**Left hand limit switch reached**	Error message for POSICON → see supplementary instructions
E014	**---**	**Reserved**	Error message for POSICON → see supplementary instructions
E015	**---**	**Reserved**	
E016	**16.0**	**Motor phase error**	A motor phase is not connected. • Check P539 • Check motor connection
	16.1	**Magnetisation current monitoring** *"Magnetisation current monitoring"*	Required exciting current not achieved at moment of switch-on. • Check P539 • Check motor connection
	16.2	**Phase sequence changed during operation**	Parameter P583 has been changed during enabling.
E017	**17.0**	**Customer interface fault**	• EMC fault • Defective component
E018	**18.0**	**Safety circuit (SafetyCirc)**	While the frequency inverter was enabled, the “Safe Pulse Block” safety circuit has triggered.
	18.5	**Safety SS1**	The monitoring time has expired before control of the drive has been terminated. This error cannot be acknowledged. The frequency inverter must be restarted.
	18.6	**Safety System**	Safety function error: These errors cannot be acknowledged.

E019	**19.0**	**Parameter ident.** "Parameter identification".	Automatic identification of the connected motor has failed • Check motor connection • Check pre-set motor data (P201…P209)
	19.1	**Rotor position**	PMSM– PMSM - closed-loop mode: Rotor position in relation to the incremental encoder not correct. • Perform determination of rotor position (first enable after a “mains on” only if the motor is at a standstill) (P330)
E022	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E023	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E024	**---**	**Reserved**	Error message for PLC → see supplementary instructions BU 0550
E025	**---**	**Reserved**	Error message for POSICON → see supplementary instructions
E026	**---**	**µSD card error**	• µSD card inserted incorrectly • µSD card defective
E099	**---**	**System error**	Restart the frequency inverter

Warning messages

Display in the SimpleBox / ControlBox		Warning Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-02]**		
C001	**1.0**	**Overtemp. Inverter** *"Inverter overtemperature"* (inverter heat sink)	Inverter temperature monitoring Warning: permissible temperature limit reached. • Reduce ambient temperature • Check the FI fan / control cabinet ventilation • Check the FI for dirt
C002	**2.0**	**Motor overtemp. PTC** *"Motor overtemp. PTC"*	Warning from the motor temperature sensor (trigger limit reached) • Reduce motor load • Increase motor speed • Use external motor fan
	2.1	**Motor overtemp. I^2t** *"Motor overtemperature I^2t"* Only if I^2t motor (P535) is programmed.	Warning: I^2t motor monitoring (1.3x the rated current reached for the time period set in (P535)) • Reduce motor load • Increase motor speed
	2.2	**External braking resistor overtemperature** *"External braking resistor overtemperature"* Overtemperature via digital input (P420 […])={13}	Warning: Temperature sensor (e.g. braking resistor) has triggererd • Digital input is low
C003	**3.0**	**I^2t overcurrent limit**	Warning: AC inverter: I^2t limit has triggered, e.g. > 1.3 x I_n for 60s (see P504) • Continuous overload at FI output
	3.1	**Chopper overtemperature I^2t**	Warning: I^2t limit for brake chopper has triggered, 1.3 times value reached for 60s (see P554 if present, as well as P555, P556, P557) • Avoid overcurrent in braking resistor
	3.5	**Torque current limit**	Warning: Torque current limit reached • Check P112
	3.6	**Current limit**	Warning: Current limit reached • Check P536
	3.7	**Effective power limit**	Input current too high • Reduce load

C004	**4.1**	**Overcurrent measurement** *"Overcurrent measurement"*	Warning: pulse switch off is active The limit for activation of pulse switch off (P537) has been reached (only possible if P112 and P536 are switched off) • FI is overloaded • Drive sluggish, insufficiently sized • Ramps (P102/P103) too steep -> Increase ramp time • Check motor data (P201 … P209) • Switch off slip compensation (P212)
C008	**8.0**	**Parameter loss**	Warning: One of the cyclically saved messages such as *operating hours* or *enabling time* could not be saved successfully. The warning disappears as soon as saving can be successfully performed.
C012	**12.1**	**Motor Limit / Customer** *"Motor switch-off limit"*	Warning: 80 % of the drive switch-off limit (P534 [-01]) has been exceeded. • Reduce load on motor • Set higher value in (P534 [-01]).
	12.2	**Generator limit** *"Generator switch-off limit"*	Warning: 80 % of the generator switch-off limit (P534 [-02]) has been reached. • Reduce load on motor • Set higher value in (P534 [-02]).
	12.5	**Load monitor**	Warning due to overshooting or undershooting of permissible load torques ((P525) … (P529)) for the time set in (P528). • Adjust load. • Change limit values ((P525) ... (P527)). • Increase delay time (P528).
C025		**reserved**	Error message for POSICON → see supplementary instructions BU 0610
C026	**26.0**	**SD card not inserted**	• µSD card inserted incorrectly • µSD card defective
	26.1	**Incompatible data set**	
	26.2	**SD card writing error**	
	26.3	**SD card not recognised**	

Switch-on block messages

Display in the SimpleBox / ControlBox		Reason: Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 [-03]**		
I000	**0.1**	**Disable voltage from IO**	If the function "disable voltage"is parameterised, input (P420 / P480) is at Low • Set "input High" • Check signal cable (broken cable)
	0.2	**IO fast stop**	If the function "fast stop"is parameterised, input (P420 / P480) is at Low • Set "input High" • Check signal cable (broken cable)
	0.3	**Block voltage from bus**	• For bus operation (P509): control word Bit 1 is "Low"
	0.4	**Bus fast stop**	• For bus operation (P509): control word Bit 2 is "Low"
	0.5	**Enable on start**	Enable signal (control word, Dig I/O or Bus I/O) was already applied during the initialisation phase (after mains "ON", or control voltage "ON"). Or electrical phase is missing. • Only issue enable signal after completion of initialisation (i.e. when the FI is ready) • Activation of "Automatic Start" (P428)
	0.6 – 0.7	**Reserved**	Information message for PLC → see supplementary instructions
	0.8	**Right direction blocked**	Switch-on block with inverter shut-off activated by: **P540** or by "Enable right block" **(P420** = 31, 73) or "Enable left block" (**P420** = 32, 74), The frequency inverter switches to "Ready for switching on" status
	0.9	**Left direction blocked**	
I006 [1]	**6.0**	**Charging error**	Charging relay not energised, because: • Mains / link voltage too low • Mains failure
I011	**11.0**	**Analog Stop**	If an analog input of the frequency inverter or a connected IO extension is configured to detect cable breaks (2-10V signal or 4-20mA signal), the frequency inverter switches to the status "ready for switch-on" if the analog signal undershoots the value **1 V** or **2 mA** This also occurs if the relevant analog input is parameterised to function "0" ("no function"). • Check connections
I014 [1]	**14.4**	**Reserved**	Error message for POSICON → see supplementary instructions
I018 [1]	**18.0**	**Reserved**	Information message for "Safe Stop" function → see supplementary instructions

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

7 Technical data

7.1 General Data

Function	Specification
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
Efficiency	> 95 %
Insulation resistance	> 5 MΩ
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 (📖 Section 9.1 "Maintenance Instructions")
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 under-voltage • 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 / Bi-metal 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 customer unit inputs)
Connection terminals	For details and terminal screw tightening torques: 📖 Section 2.6.3and 2.6.4.
External supply voltage	18 … 30 V DC, ≥ 800 mA
Analog setpoint input / PID input	2 x 0 … 10 V, 0/4...20 mA, scalable, digital 7.5 ... 30 V
Analog 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	0 ... 10 V scalable

7.2 Electrical data

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

Details of the UL/CSA approval conditions can be found in Section 1.7.1. Use of mains fuses which are faster than those stated is permissible.

By the use of a mains choke, the input current is reduced to approximately that of the output current (📖 Section 2.4.1.1 "Mains choke SK CI5").

7.2.1 Electrical data 230 V

Frequency inverter 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		Fan, temperature controlled Switching thresholds:[1] ON = 57 °C, OFF = 47 °C		
Max.	weight [kg]	1.2				
		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	410 V	480 V	715 V	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

Frequency inverter 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		Fan, temperature controlled Switching thresholds:[1] ON = 57 °C, OFF = 47 °C				
Max.	weight [kg]	1.6				
		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	480 V	410 V	715 V	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

7.2.2 Electrical data 400 V

Frequency inverter 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	0.35 kW	0.55 kW	0.75 kW	1.1 kW
	480 V	1/3 hp	½ hp	¾ hp	1 hp	1½ hp
Mains voltage	400 V	3 AC 380 … 480 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		Fan, temperature controlled Switching thresholds:[1] ON = 57 °C, OFF = 47 °C		
Max.	weight [kg]	1.2				1.6
		General fuses (AC) (recommended)				
	slow-blowing	6 A	6 A	6 A	6 A	10 A

						Fuse Type		I_{sc} kA [2]		UL fuses (AC) UL approved				
240 V	480 V	410 V	715 V	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

Frequency inverter 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
Mains voltage	400 V	3 AC 380 … 480 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		Fan, temperature controlled Switching thresholds:[1]; ON = 57 °C, OFF = 47 °				
Approx.	weight [kg]	1.6		2.6		
		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	480 V	410 V	715 V	Class	CB	SIBA 50 215 26	SIBA 20 028 20	5	20					
	x			J					x	10 A	15 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

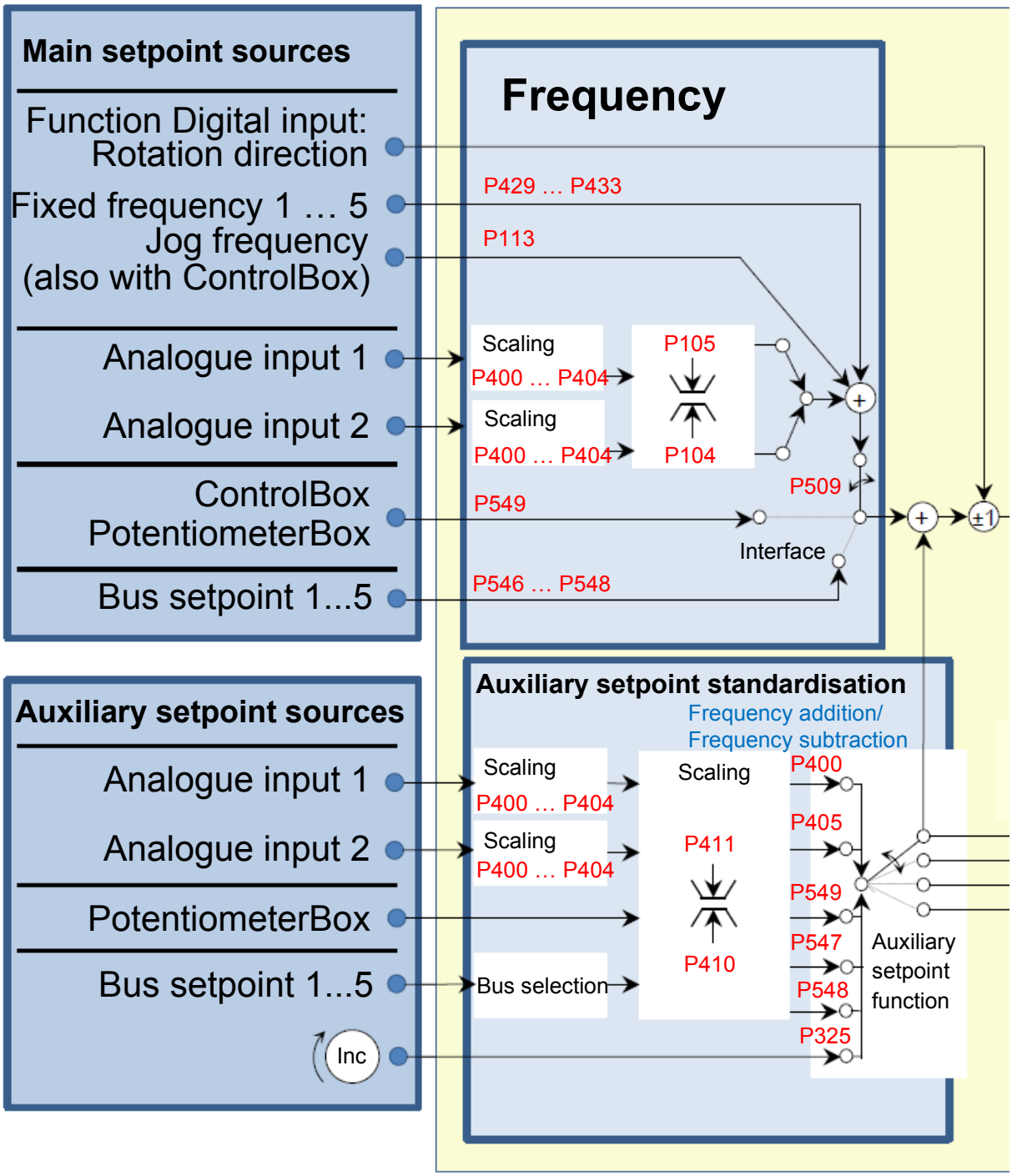
[1] Short test run after connection of the mains voltage

[2] Maximum permissible mains short circuit current with mains

8 Additional information

8.1 Setpoint processing

Illustration of setpoint processing.



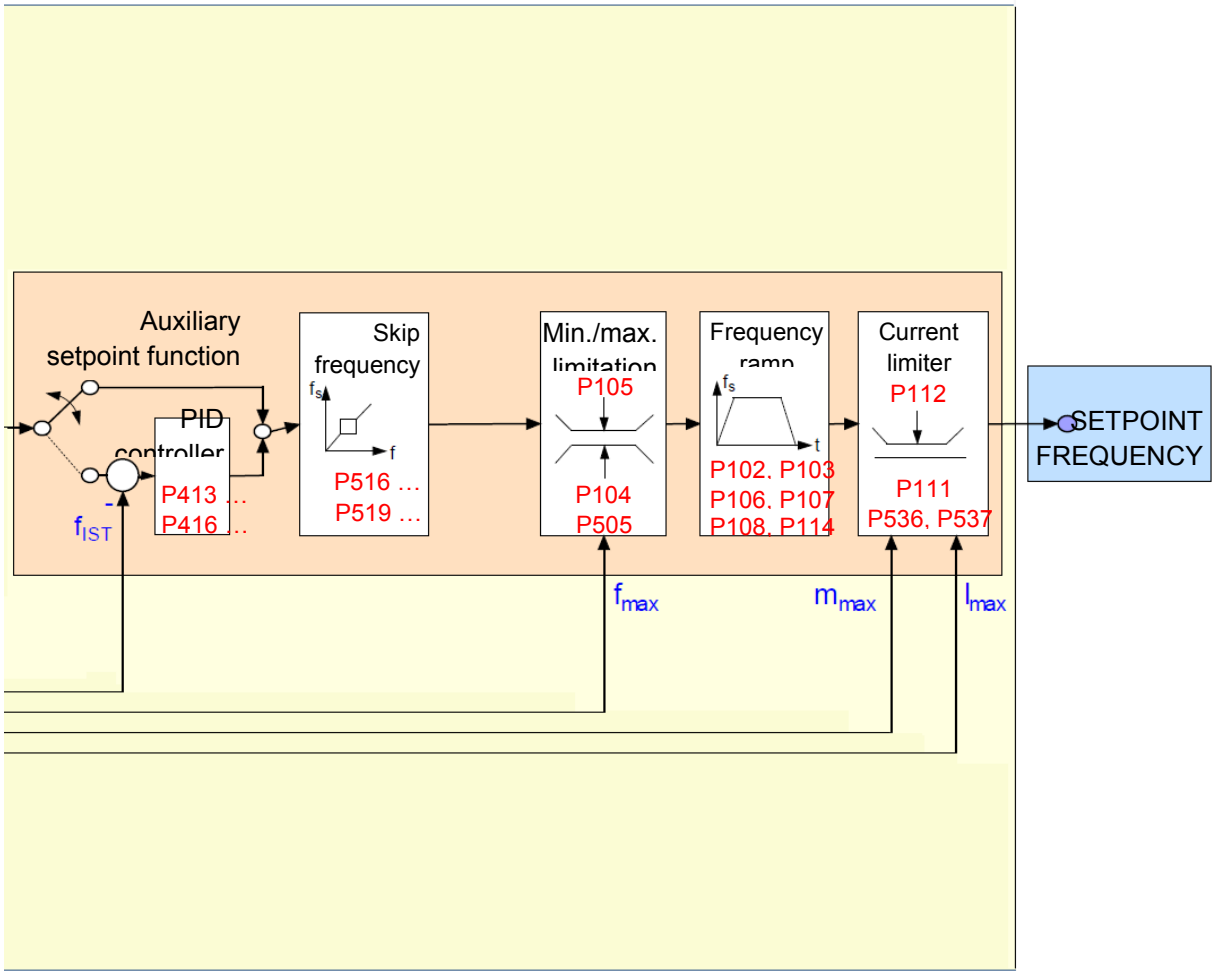


Figure 10: Setpoint processing

8.2 Process controller

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

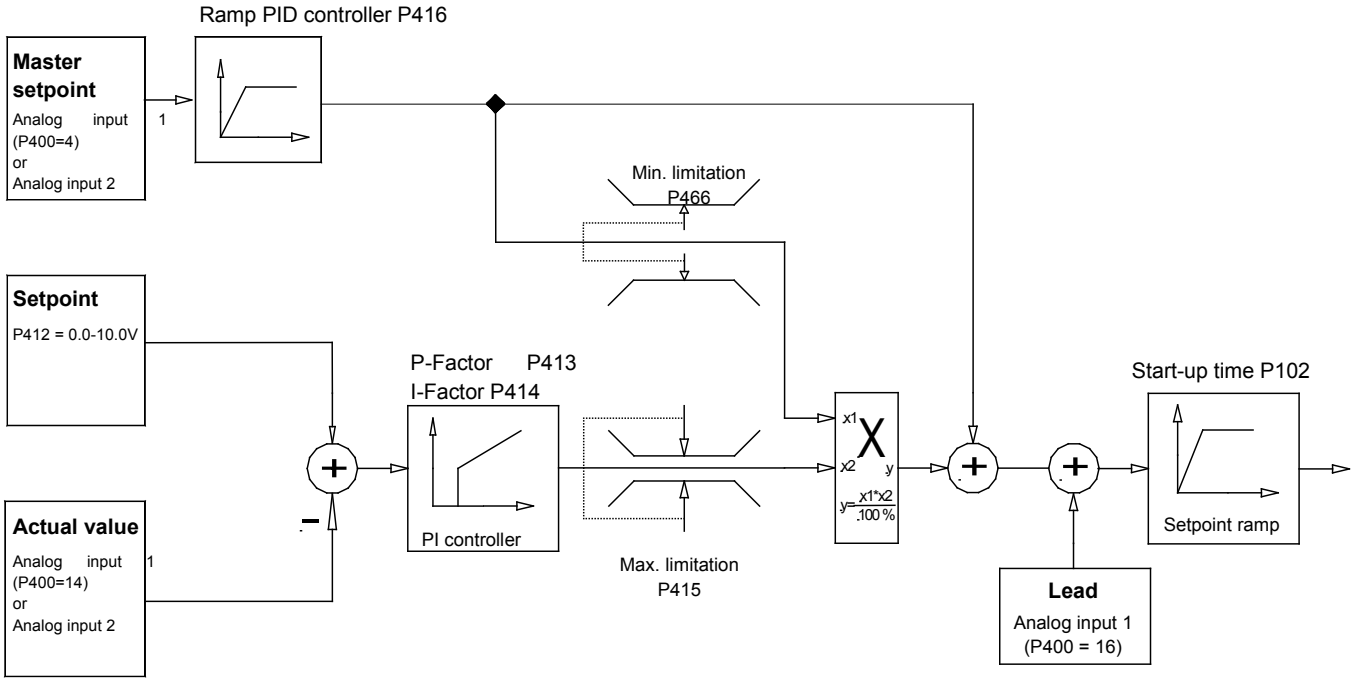
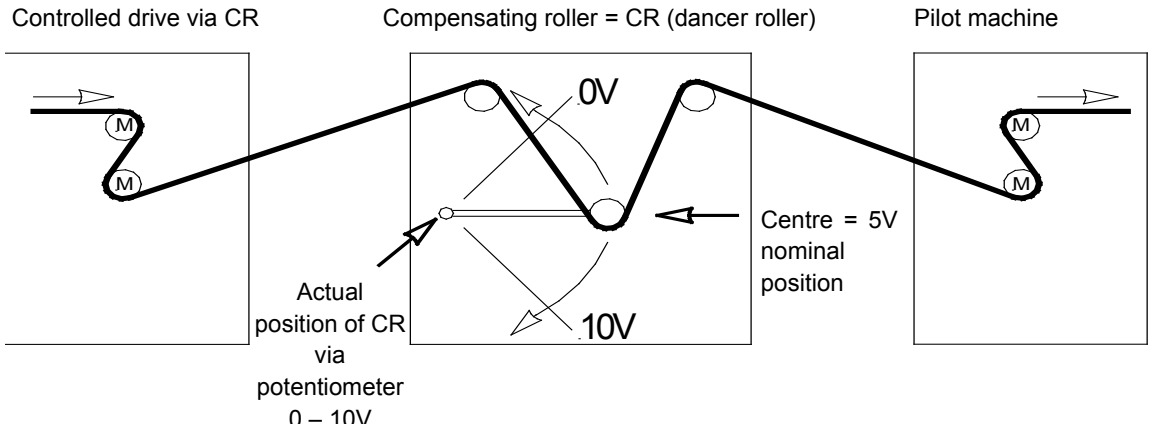
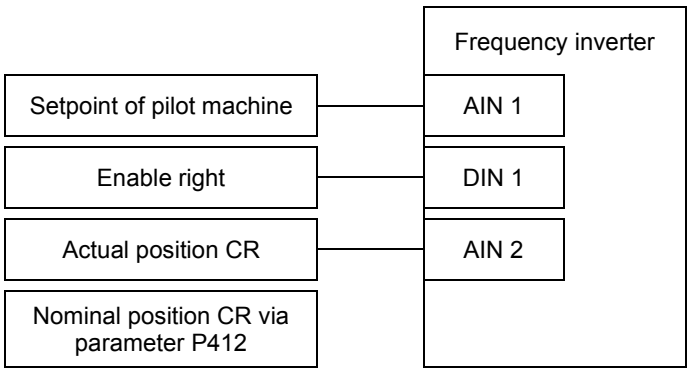
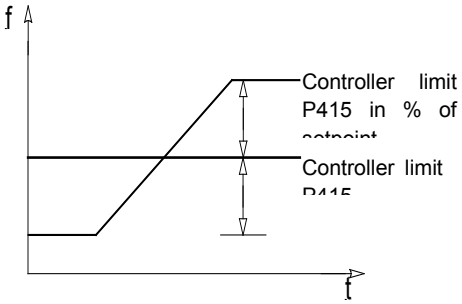


Figure 11: Process controller flow diagram

8.2.1 Process controller application example







8.2.2 Process controller parameter settings

Example: SK 500P, setpoint frequency: 50 Hz, control limits: +/- 25%,

P105 (maximum frequency) [Hz]	$\geq \text{Setpoint freq.}\,[Hz] + \left(\frac{\text{Setpoint freq.}\,[Hz] \times P415[\%]}{100\%}\right)$ Example: $\geq 50Hz + \frac{50Hz \times 25\%}{100\%} =$ **62.5Hz**
P400 [-01] (Function analogue input):	**"4"** (frequency addition)
P411 (setpoint frequency) [Hz]	Set frequency with 10 V at analogue input 1 Example: **50 Hz**
P412 (Process controller setpoint):	CR middle position / Default setting **5 V** (adjust if necessary)
P413 (P-controller) [%]:	Factory setting **10 %** (adjust if necessary)
P414 (I-controller) [% / ms]:	recommended **100**%/s
P415 (limitation +/-) [%]	Controller limitation (see above) **Note:** In the function process controller, parameter P415 is used as a controller limiter downstream from the PI controller. This parameter therefore has a double function. Example: **25 %** of setpoint
P416 (ramp before controller) [s]:	Factory setting **2s** (if necessary, adjust to match control behaviour)
P420 (Function digital input 1):	**"1"** Enable right
P400 [-02] (Function analogue input 2):	**"14"** actual value PID process controller

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 55011-1 (environmental standard)***

   The limits are defined in dependence on the basic environment in which the product is operated in this standard. A distinction is made between 2 environments, whereby the **1st environment** describes the non-industrial **living and business area** without its own high-voltage or medium-voltage distribution transformers. The **2nd environment**, on the other hand, defines **industrial areas** which are not connected to the public low-voltage network, but have their own high-voltage or medium-voltage distribution transformers. The limits are subdivided into **classes A1, A2 and B**.

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

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

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

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

Category as per EN 61800-3	C1	C2	C3
Limit class in accordance with EN 55011	B	A1	A2
Operation permissible in 1. Environment (living environment)	X	X 1)	-
2. Environment (industrial environment)	X	X 1)	X 1)
Note required in accordance with EN-61800-3	-	2)	3)
Sales channel	Generally available	Limited availability	
EMC situation	No requirements	Installation and start-up by EMC expert	

1) Device used neither as a plug-in device nor in moving equipment
2) "The drive system can cause high-frequency interference in a living environment that may make interference suppression measures necessary".
3) "The drive system is not intended for use in a public low-voltage network that feeds residential areas".

Table 13: EMC comparison between EN 61800-3 and EN 55011

8.3.3 EMC of device

NOTICE!

EMC Interference to the environment

This device produces high frequency interference, which may make additional suppression measures necessary in domestic environments (📖 Section 8.3.2 "EMC evaluation").

- Use of shielded motor cables is essential in order to comply with the specified radio interference suppression level.

The device is exclusively intended for commercial use. It is therefore not subject to the requirements of the standard EN 61000-3-2 for radiation of harmonics.

The limit value classes are only achieved if

- the wiring is EMC-compliant
- the length of shielded motor cable does not exceed the permissible limits

The motor cable shielding must be connected to both sides (frequency inverter shield angle and the metal motor terminal box). Depending on the inverter 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

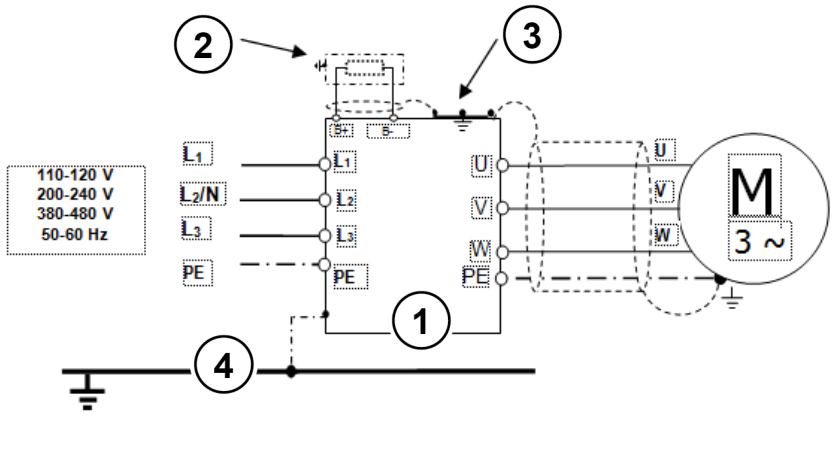
For connection of shielded motor cables with a length > 30 m, in particular with low power frequency inverters the current monitoring may trigger, so that use of an output choke (SK CO5…) is also necessary.

Frequency inverter type	Conducted emissions 1 150 kHz – 30 MHz	
	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

Table 14: 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 (size 1-4)
Radiated emission (interference field strength)	EN 55011	C2
		-
Interference immunity EN 61000-6-1, EN 61000-6-2		
ESD, discharge of static electricity	EN 61000-4-2	6 kV (CD), 8 kV (AD)
EMF, high frequency electro-magnetic fields	EN 61000-4-3	10 V/m; 80 – 1000 MHz
Burst on control cables	EN 61000-4-4	1 kV
Burst on mains and motor cables	EN 61000-4-4	2 kV
Surge (phase-phase / phase-ground)	EN 61000-4-5	1 kV / 2 kV
Cable-led interference due to high frequency fields	EN 61000-4-6	10 V, 0.15 – 80 MHz
Voltage fluctuations and drops	EN 61000-2-1	+10 %, -15 %; 90 %
Voltage asymmetries and frequency changes	EN 61000-2-4	3 %; 2 %

Table 15: Overview according to product standard EN 61800-3



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

Figure 12: Wiring recommendation

8.3.4 EU Declaration of Conformity

GETRIEBEBAU NORD
Member of the NORD DRIVESYSTEMS Group

DRIVESYSTEMS

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

C310601_1319

EU Declaration of Conformity

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

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

- **SK 500P-xxx-123-.-.. , SK 500P-xxx-340-.-..**
  (xxx= 250, 370, 550, 750, 111, 151, 221, 301, 401, 551, 751)
  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
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 61800-3:2004+A1:2012+AC:2014	EN 61800-9-1:2017
EN 60529:1991+A1:2000+A2:2013+AC:2016	EN 50581:2012	EN 61800-9-2:2017

It is necessary to notice the data in the operating manual to meet the regulations of the EMC-Directive. Specially take care about correct EMC installation and cabling, differences in the field of applications and if necessary original accessories.

First marking was carried out in 2019.

Bargteheide, 28.03.2019

U. Küchenmeister
Managing Director

pp F. Wiedemann
Head of Inverter Division

8.4 Reduced output power

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

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

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

8.4.1 Increased heat dissipation due to pulse frequency

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

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

The diagram shows the possible current load capacity for continuous operation.

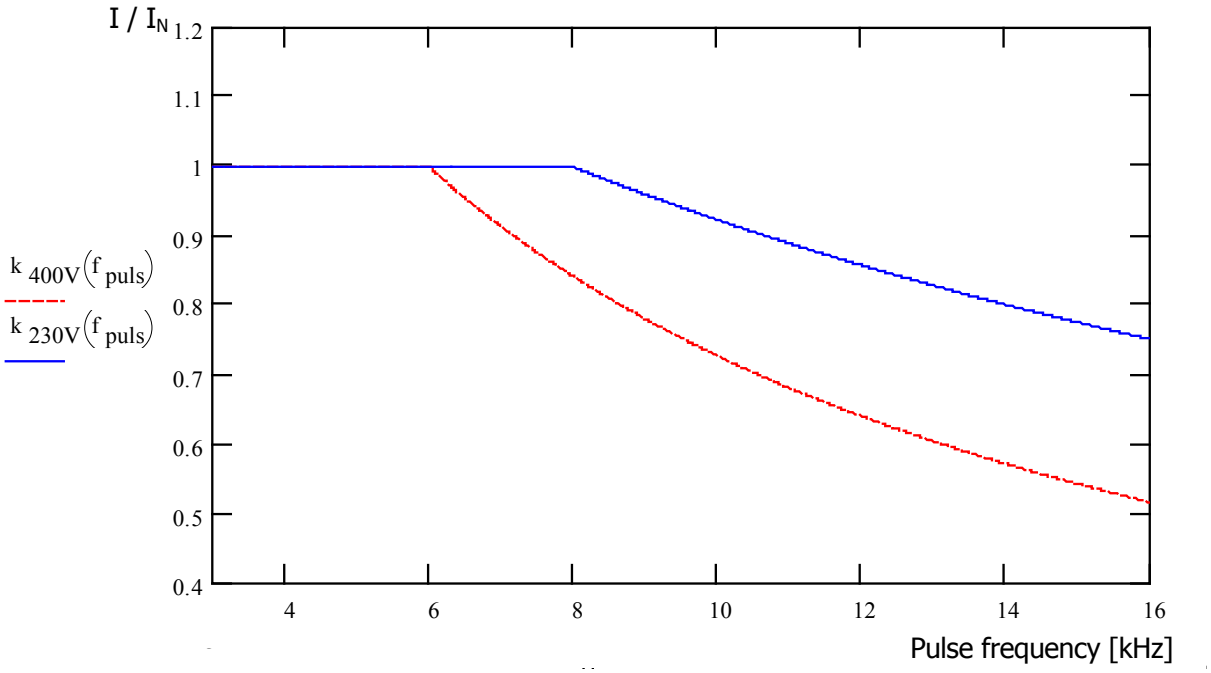


Figure 13: Heat losses due to pulse frequency

8.4.2 Reduced overcurrent due to time

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

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

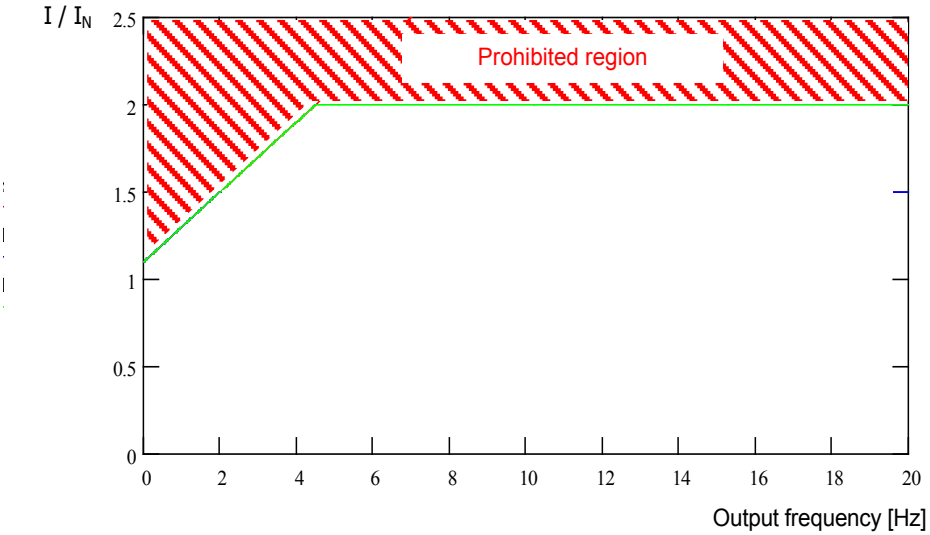
230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...8	110%	150%	170%	180%	180%	200%
10	103%	140%	155%	165%	165%	180%
12	96%	130%	145%	155%	155%	160%
14	90%	120%	135%	145%	145%	150%
16	82%	110%	125%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

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

Table 16: Overcurrent relative to time

8.4.3 Reduced overcurrent due to output frequency

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



The upper limiting values for the various pulse frequencies can be obtained from the following tables. In all cases, the value (10 … 201) which can be set in parameter P537, is limited to the value stated in the tables according to the pulse frequency. Values below the limit can be set as required.

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

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

Table 17: Overcurrent relative to pulse and output frequency

8.4.4 Reduced output current due to 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.

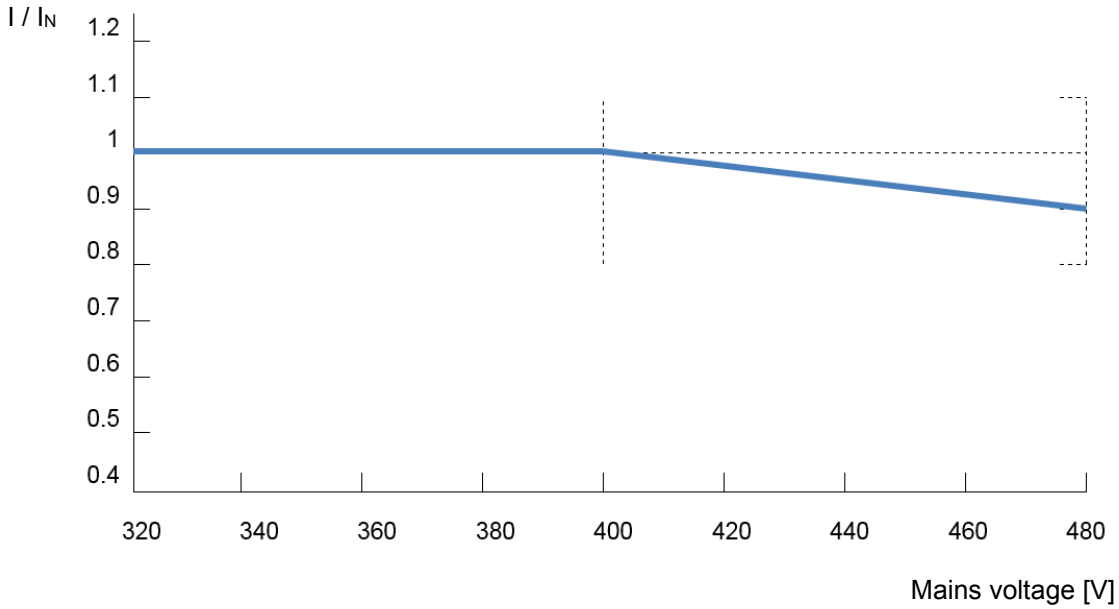


Figure 14: Reduced output current due to low voltage

8.4.5 Reduced output current due to the heat sink temperature

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

8.5 Operation on the FI circuit breaker

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

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

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

(📖 Section 2.6.3.2 "Mains connection (PE, L1, L2/N, L3)")

(📖 See also document TI 800_000000003.)

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.

If a frequency inverter with a 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.

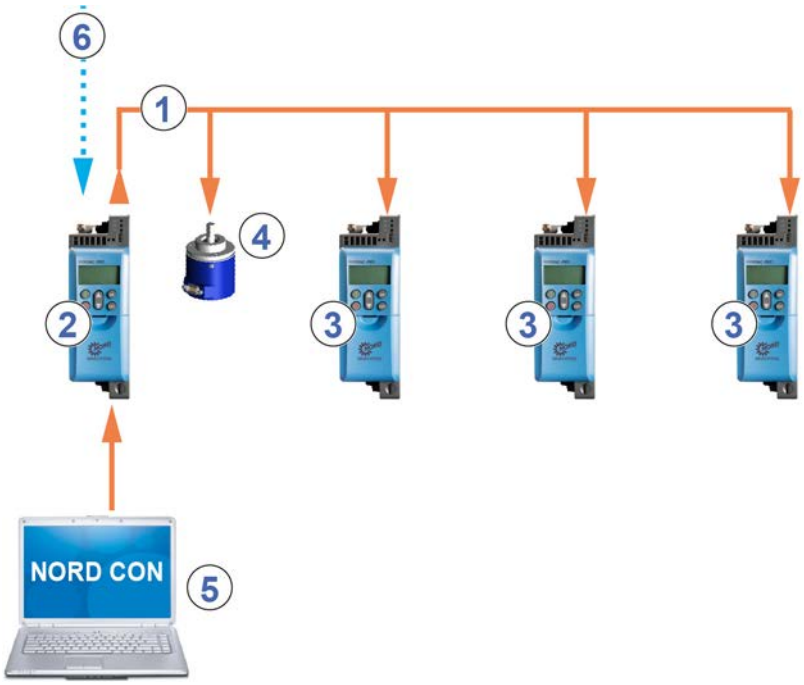


Figure 15: Example of the structure of a NORD system bus

Item	Description
1	NORD system bus (CAN field bus)
2	SK 550P frequency inverter with field bus interface
3	Frequency inverter SK 5x0P
4	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 8 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 a unique address (CAN ID). The addresses of the frequency inverters are set with parameter **P515 CAN Address**.

The addresses of connected absolute encoders are 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 ID of the frequency inverter + 1

This results in the following matrix:

Device	FI 1 (SP 550P)	AG 1	FI 2	AG 2	…
CAN ID	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 Baud Rate**) This also applies to any absolute encoders which are connected.

8.7 Energy Efficiency

WARNING

Unexpected movement due to overload

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

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

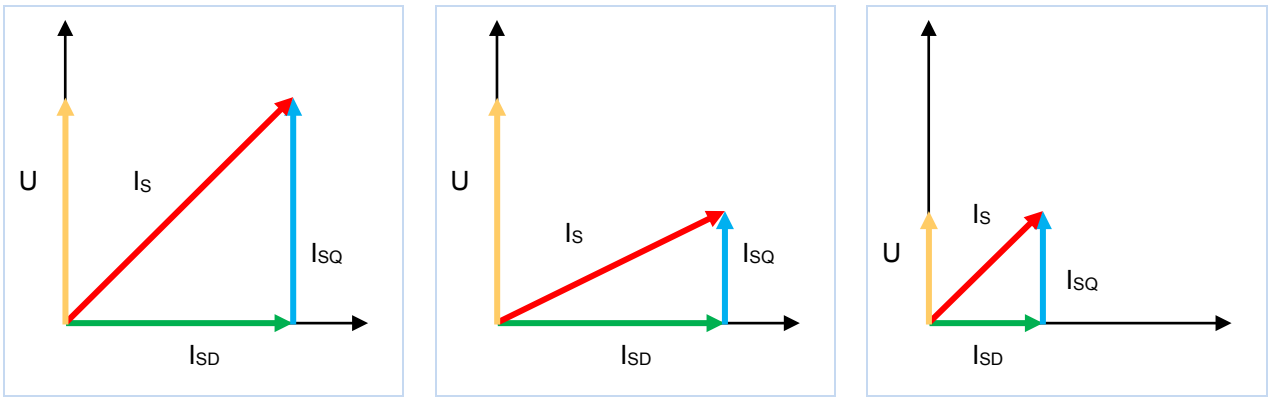
To prevent any risk, the following must be observed:

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

NORD frequency inverters have a low power consumption and are therefore highly efficient. In addition, with the aid of "Automatic flux optimisation" (Parameter (P219)) the inverter provides a possibility for increasing the overall efficiency of the drive in certain applications (in particular applications with partial load).

According to the torque required, the magnetisation current through the frequency inverter or the motor torque is reduced to the level which is required for the momentary drive power. The resulting considerable reduction in power consumption, as well as the optimisation of the cos φ factor of the motor rating in the partial load range contributes to creating optimum conditions both with regard to energy consumption and mains characteristics.

A parameterisation which is different from the factory setting (Factory setting = 100%) is only permissible for applications which do not require rapid torque changes. (For details, see Parameter (P219))



I_S = Motor current vector (line current)
I_{SD} = Magnetisation current vector (magnetisation current)
I_{SQ} = Load current vector (load current)

Figure 16: Energy efficiency due to automatic flux optimisation

8.8 Standardisation of setpoint / target values

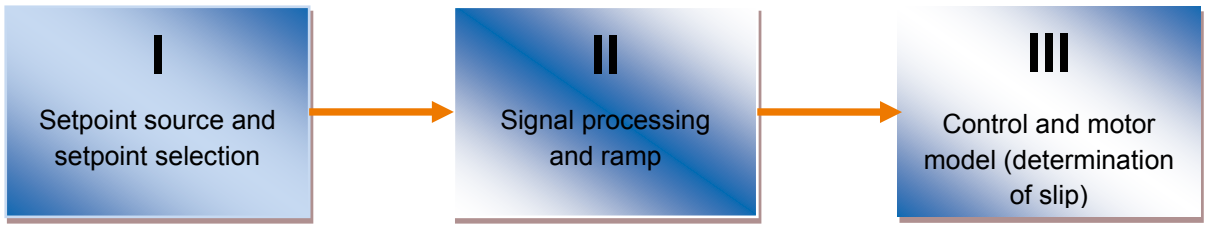
The following table contains details for the standardisation of typical setpoint and actual values. These details relate to parameters (P400), (P418), (P543), (P546), (P740) or (P741).

Name	**Analog signal**		**Bus signal**						
Setpoint values {Function}	Value range	Standardisation	Value range	Max.value	Type	100% =	-100% =	Standardisation	Limitation absolute
Setpoint frequency {01}	0-10V (10V=100%)	P104 … P105 (min - max)	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Frequency addition {04}	0-10V (10V=100%)	P410 … P411 (min - max)	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P411	P105
Frequency subtraction { 05 }	0-10V (10V=100%)	P410 … P411 (min - max)	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P411	P105
Max. frequency {07}	0-10V (10V=100%)	P411	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * f_{soll}[Hz]/P411	P105
Actual valueProcess controller {14}	0-10V (10V=100%)	P105* U_{AIN}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Setpoint process controller { 15 }	0-10V (10V=100%)	P105* U_{AIN}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * $f_{setpoint}$[Hz]/P105	P105
Torque current limit {2}	0-10V (10V=100%)	P112* U_{AIN}(V)/10V	0-100%	16384	INT	4000_{hex} 16384_{dez}	/	4000_{hex} * Torque [%] / P112	P112
Current limit {6}	0-10V (10V=100%)	P536* U_{AIN}(V)/10V	0-100%	16384	INT	4000_{hex} 16384_{dez}	/	4000_{hex} * Current limit [%] / P536 * 100 [%]	P536
Ramp time {49} Acceleration time {56} Deceleration time {57}	0-10V (10V=100%)	10s* U_{AIN}(V)/10V	0…200 %	32767	INT	4000_{hex} 16384_{dec}	/	10s * Bus setpoint/4000hex	20s
Actual values {Function}									
Actual frequency {01}	0-10V (10V=100%)	P201* U_{AOut}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * f[Hz]/P201	
Actual speed {02}	0-10V (10V=100%)	P202* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * n[rpm]/P202	
Current {03}	0-10V (10V=100%)	P203* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * I[A]/P203	
Torque current {04}	0-10V (10V=100%)	P112* 100/ √((P203)²-(P209)²)* U_{AOut}(V)/10V	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * I_q[A]/(P112)*100/ √((P203)²-(P209)²)	
Master value Setpoint frequency {19} … {24}	0-10V (10V=100%)	P105* U_{AOut}(V)/10V	±100%	16384	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * f[Hz]/P105	
Speed from rotary encoder {22}	/	/	±200%	32767	INT	4000_{hex} 16384_{dez}	$C000_{hex}$ -16385_{dez}	4000_{hex} * n[rpm]/ P201*60/Number of pairs of poles or 4000_{hex} *n[rpm]/P202	

Table 18: Scaling of setpoints and actual values (Selection)

8.9 Definition of setpoint and actual value processing (frequencies)

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



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

Table 19: Processing of setpoints and actual values in the frequency inverter

9 Maintenance and servicing information

9.1 Maintenance Instructions

NORD frequency converters are *maintenance free* provided that they are properly used (please see chapter 7 "Technical data").

Dusty environments

If the device is being used in a dusty environment, the cooling-vane surfaces should be regularly cleaned with compressed air.

Long-term storage

The device must be regularly connected to the supply network for at least 60 min.

If this is not carried out, there is a danger that the device may be destroyed.

If a device is to be stored for longer than one year, it must be recommissioned with the aid of an adjustable transformer before normal connection to the mains.

Long-term storage for 1 - 3 years

- 30 min with 25 % mains voltage
- 30 min with 50 % mains voltage
- 30 min with 75 % mains voltage
- 30 min with 100 % mains voltage

Long-term storage for >3 years or if the storage period is not known:

- 120 min with 25 % mains voltage
- 120 min with 50 % mains voltage
- 120 min with 75 % mains voltage
- 120 min with 100 % mains voltage

The device must not be subject to load during the regeneration process.

After the regeneration process, the regulations described above apply again (at least 60 min on the mains 1x per year).

9.2 Service notes

Our Technical Support is available in case of technical queries.

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

The device must be sent to the following address if it needs repairing:

NORD Electronic DRIVESYSTEMS GmbH
Tjüchkampstraße 37
D-26605 Aurich, Germany

Please remove all non-original parts from the device.

No guarantee is given for any attached parts such as power cables, switches or external displays.

Please back up the parameter settings before sending in the device.

Information

Please note the reason for sending in the component/device and specify a contact for any queries that we might have.

You can obtain a return note from our web site (Link) or from our technical support.

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

Information

In order to rule out the possibility that the cause of a device fault is due to an optional module, the connected optional modules should also be returned in case of a fault.

Contacts (Phone)

Technical support	During normal business hours	+49 (0) 4532-289-2125
	Outside normal business hours	+49 (0) 180-500-6184
Repair inquiries	During normal business hours	+49 (0) 4532-289-2115

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

9.3 Abbreviations

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

D

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T

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V

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T: +49 (0) 4532 / 289-0
F: +49 (0) 4532 / 289-22 53
info@nord.com, www.nord.com

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