



BU0200 – en-GB

NORDAC *FLEX* (SK 200E series)

Users Manual for Frequency Inverters



**Read document and keep for future reference**

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

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

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

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

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

Please also note the following documents:

- Catalogue "NORDAC electronic drive technology" ([E3000](#)),
- Documentation for optional accessories
- Documentation for equipment which is attached or provided.

Please contact [Getriebebau NORD GmbH & Co. KG](#) if you require further information.

Documentation

Title:	BU0200	
Order no.:	6072002	
Series:	SK 200E	
Device series:	SK 200E, SK 210E, SK 220E, SK 230E, SK 205E, SK 215E, SK 225E, SK 235E	
Device types:	SK 2xxE-250-112-O... SK 2xxE-750-112-O	0.25–0.75 kW, 1~ 100–120 V, Out: 230 V
	SK 2xxE-250-123-A... SK 2xxE-111-123-A	0.25–1.1 kW, 1~ 200–240 V
	SK 2xxE-250-323-A... SK 2xxE-112-323-A	0.25–11.0 kW, 3~ 200–240 V ¹
	SK 2xxE-550-340-A... SK 2xxE-222-340-A	0.55–22.0 kW, 3~ 380–500 V ²
	¹ Size 4 (5.5–11.0 kW) only as SK 2x0E variants	
	² Size 4 (11.0–22.0 kW) only as SK 2x0E variants	

Version list

Title, date	Order number	Software version of device	Remarks
BU0200 , March 2009	6072002/ 1009	V 1.1 R1	First edition
Further revisions: March, December 2010, May 2011, October 2011, June 2014 An overview of the changes in the above-mentioned editions can be found in the respective document.			
BU0200 , May 2015	6072002/ 2115	V 2.0 R1	Including • General corrections • Structural adaptations in the document (chapter "Options and accessories" broken down, content reorganised) • New parameters: P240–247, P330–334 • Adjustment of parameters: P003, 100, 105, 108, 109, 110, 200, 219, 220, 300, 312, 313, 315, 316, 327, 401, 418, 420, 436, 480, 481, 502, 504, 535, 538, 550, 709, 740, 741, 745 • Error messages E006, E007, E022–024, I000.6, I000.7 • Operation of PMSM possible • PLC available • New display of delivery scope / accessory overview • Revision of UL/cUL, plus inclusion of "Group fuse protection" • HTL encoder, zero track evaluation possible

Title, date	Order number	Software version of device	Remarks
BU0200 , March 2016	6072002/ 1216	V 2.1 R0	Including • General corrections • Structural modifications to the document • Removal of several descriptions of accessories (reference to further documentation → Technical information) • Adjustment of parameters: P513, 504, 520, 550, 560, 703 • Error messages I000.8, I000.9 added • Revision of chapter "UL/cUL", for CSA and others: Voltage limitation filter no longer required (SK CIF) → Module removed from document • Installation description of toroidal core (ferrite) for EMC improvement with size 4 added • AS-Interface, addition of device versions ...-AXB and ...-AUX • Update of EC/EU Declarations of Conformity
BU0200 , December 2017	6072002/ 5117	V 2.1 R3	Including • General corrections • Adaptation of safety information • Revision of warning and hazard information • Adaptations for ATEX, outdoor installation and braking resistors • Adapter kits for motor mounting and wall-mounting kits now divided into versions for IP55 and IP66 • Adjustment of parameters: P106, 107, 206, 208, 211, 212, 220, 330, 331, 400, 434, 546, 558, 709
BU0200 , July 2018	6072002/ 3118	V 2.1 R1	Including • General corrections • Adaptation of safety information • Adaptations for wall-mounting kits • Adaptations for ATEX, outdoor installation and braking resistors • Addition of EAC Ex • Adaptations for AS-Interface • Adjustment of parameters: P331, 332, 333, 555, 556, 557 • Correction of standardisation of setpoints and actual values • Motor data 100 Hz characteristic curve extended
BU0200 , December 2020	6072002/ 4920	V 2.2 R1	Including • General corrections • New parameters P336, P780 • Adjustment of parameters: P212, 245, 301, 504, 558, 556, 557 • Error message E7.1

Title, date	Order number	Software version of device	Remarks
BU0200 , July 2021	6072002/ 3021	V 2.2 R1	- Update of “Standards and approvals” - Update of EU Declaration of Conformity - Supplementation of data according to the Ecodesign Directive
BU0200 , February 2025	6072002/ 0725	V 2.3 R2	- General corrections - Update of “Standards and approvals” - Addition of disposal notes - Changes in the document layout - Addition of IE3 and IE5 data to the frequency inverter's parameterisation data
BU0200 , December 2025	6072002/ 5125	V 3.1 R0	Including - General corrections - Addition of disposal notes - PMSM: - Sensorless motor control with injection signal - New test signal principle for rotor position identification - Adjustment of parameters: P200, P434, P481, P554, P546, P553 - Addition of parameters: P221, P337 ... P342, P425, P712, P713, P554, P765, P766

Table 1: BU0200 version list

Copyright notice

As an integral component of the device described here, this document must be provided to all users in a suitable form.

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Table of Contents

1	General.....	14
1.1	Overview	16
1.2	Delivery	19
1.3	Scope of delivery.....	19
1.4	Safety, installation and application information	20
1.5	Warning and hazard information	25
1.5.1	Warning and hazard information on the product.....	25
1.5.2	Warning information	26
1.5.3	Other information.....	26
1.6	Standards and approvals	27
1.6.1	UL and CSA approval.....	29
1.7	Type code / nomenclature.....	31
1.7.1	Name plate	31
1.7.2	Frequency inverter type code - Basic device.....	32
1.7.3	Frequency inverter type code – Connection unit	32
1.7.4	Type code for option modules	33
1.7.5	Type code, connection unit for technology unit.....	34
1.7.6	Adapter Unit type code	34
1.8	Power-size assignment.....	35
1.9	Version in protection class IP55, IP66.....	35
2	Assembly and installation	37
2.1	Installation SK 2xxE	37
2.1.1	Installation of insulating plate – size 4	39
2.1.2	Motor installation work operations	40
2.1.2.1	Adapters for different motors	41
2.1.2.2	Dimensions, SK 2xxE mounted on motor	42
2.1.3	Wall mounting.....	43
2.1.3.1	Wall mounting kit without fan	43
2.1.3.2	Wall mounting kit with fan	45
2.1.3.3	Mounting positions: frequency inverter with wall-mounting kit	47
2.2	Installation of optional modules.....	48
2.2.1	Option locations on the device.....	48
2.2.2	Installation of internal customer unit SK CU4-... (installation)	50
2.2.3	Installation of external technology units SK TU4-... (attachment).....	51
2.3	Braking resistor (BW) - (from size 1).....	52
2.3.1	Internal brake resistor SK BRI4-...	52
2.3.2	External braking resistor SK BRE4-... / SK BRW4-... / SK BREW4-.....	55
2.3.3	Brake resistor assignments	57
2.4	Electrical Connection	58
2.4.1	Wiring guidelines	60
2.4.2	Electrical connection of power unit	61
2.4.2.1	Mains supply (L1, L2(N), L3, PE)	62
2.4.2.2	Motor cable	64
2.4.2.3	Braking resistor (+B, -B) – (from size 1)	64
2.4.2.4	Electromechanical brake	65
2.4.3	Electrical connection of the control unit	66
2.4.3.1	SK xU4-24V-... power supply – connection example	73
2.5	Encoder.....	75
2.5.1	Incremental encoders	75
2.5.2	Absolute encoders.....	76
2.6	Operation in potentially explosive environments	77
2.6.1	Operation in potentially explosive environments - ATEX zone 22 3D.....	78
2.6.1.1	Modification of the device for compliance with category 3D	78
2.6.1.2	Options for ATEX Zone 22, category 3D	79
2.6.1.3	Maximum output voltage and torque reduction	81
2.6.1.4	Commissioning information	81
2.6.1.5	EU conformity declaration - ATEX	83
2.6.2	Operation in potentially explosive environments - EAC Ex.....	84
2.6.2.1	Modification of the device	84

2.6.2.2	Further Information	85
2.6.2.3	EAC Ex certificate	85
2.7	Outdoor installation	86
3	Display, operation and options	87
3.1	Control and parametrisation options	88
3.1.1	Connection of multiple devices to one parametrisation tool	89
3.2	Optional modules	90
3.2.1	Internal customer interfaces SK CU4-... (installation of modules)	90
3.2.2	External technology units SK TU4-... (module attachment)	92
3.2.3	plug connectors	95
3.2.3.1	Plug connectors for power connections	95
3.2.3.2	Plug connectors for control connection	97
3.2.4	Potentiometer adapter, SK CU4-POT	98
4	Commissioning	100
4.1	Factory settings	100
4.2	Selecting the operating mode for motor control	101
4.2.1	Explanation of the operating modes (P300)	102
4.2.2	Parameter overview for controller settings	103
4.2.2.1	VFC open-loop and CFC closed-loop	103
4.2.2.2	CFC open-loop and CFC open-loop injection	104
4.2.3	Motor control commissioning steps	105
4.3	Starting up the device	106
4.3.1	Connection	106
4.3.2	Configuration	107
4.3.2.1	Parameterisation	107
4.3.2.2	DIP switches (S1)	108
4.3.2.3	DIP switches, analogue input (only SK 2x0E)	110
4.3.2.4	Potentiometers P1 and P2 (SK 2x0E size 4 and SK 2x5E)	111
4.3.3	Plug-in EEPROM ("Memory Module")	112
4.3.3.1	Switch of plug-in EEPROM ("memory module")	112
4.3.3.2	Copy function	113
4.3.4	Commissioning examples	115
4.3.4.1	SK 2x0E - Minimal Configuration	115
4.3.4.2	SK 2x5E - Minimal Configuration	116
4.4	Temperature sensors	118
4.5	AS Interface (AS-i)	121
4.5.1	The bus system	121
4.5.2	Features and technical data	122
4.5.3	Bus structure and topology	123
4.5.4	Commissioning	124
4.5.4.1	Connection	124
4.5.4.2	Displays	127
4.5.4.3	Configuration	128
4.5.4.4	Addressing	130
4.5.5	Certificate	131
5	Parameter	132
5.1	Parameter overview	135
5.2	Description of parameters	138
5.2.1	Explanation of parameter description	138
5.2.2	Operating displays	139
5.2.3	Basic parameters	141
5.2.4	Motor data / characteristic curve parameters	149
5.2.5	Speed control	159
5.2.6	Control terminals	171
5.2.7	Additional parameters	196
5.2.8	Positioning	218
5.2.9	Information	219
6	Operating status messages	231
6.1	Display of messages	232
6.2	Diagnostic LEDs on device	232
6.2.1	Diagnosis LEDs on SK 2x0E (sizes 1 ... 3)	233
6.2.2	Diagnosis LEDs on SK 2x0E (size 4) and SK 2x5E	234
6.3	Messages	236

6.4	FAQ operational problems	253
7	Technical data	255
7.1	General frequency inverter data.....	255
7.2	Technical data for determining the energy efficiency level.....	256
7.3	Electrical data	258
7.3.1	Electrical data 1~ 115 V.....	259
7.3.2	Electrical data 1~ 230 V.....	260
7.3.3	Electrical data 3~ 230 V.....	261
7.3.4	Electrical data 3~ 400 V.....	264
8	Additional information	267
8.1	Setpoint processing.....	267
8.2	Process controller	268
8.2.1	Sample application: Process controller.....	269
8.2.2	Process controller parameter settings	270
8.3	Electromagnetic compatibility (EMC)	271
8.3.1	General Provisions	271
8.3.2	EMC evaluation	272
8.3.3	EMC of device	273
8.4	Reduced output power	275
8.4.1	Increased heat dissipation due to pulse frequency.....	275
8.4.2	Reduced overcurrent due to time	276
8.4.3	Reduced overcurrent due to output frequency.....	277
8.4.4	Reduced output current due to low voltage	278
8.4.5	Reduced output current due to heat sink temperature.....	278
8.4.6	Reduced output current due to speed	279
8.5	Operation on the RCD.....	281
8.6	System bus	282
8.7	Energy efficiency optimisation when operating ASMs.....	285
8.8	Motor data – characteristic curves (Asynchronous motors)	286
8.8.1	50 Hz characteristic curve	286
8.8.2	87 Hz characteristic curve (only 400V devices).....	289
8.8.3	100 Hz characteristic curve (only 400 V devices).....	291
8.9	Motor data – characteristic curves (synchronous motors).....	293
8.10	Scaling of set-/actual values	294
8.11	Definition of set and actual value processing (frequencies)	295
8.12	Motor temperature monitoring.....	296
9	Maintenance and servicing information.....	297
9.1	Maintenance information.....	297
9.2	Service notes	298
9.3	Disposal	299
9.3.1	Disposal according to German law	299
9.3.2	Disposal outside of Germany.....	299
9.4	Abbreviations	300

List of illustrations

Figure 1: Device with internal SK CU4-...	18
Figure 2: Device with external SK CU4-...	18
Figure 3: Name plate	31
Figure 4: Connecting unit size 1 ... 3.....	40
Figure 5: Connecting unit size 4	40
Figure 6: Example of motor size adaptation	41
Figure 7: SK 2xxE with wall-mounting kit.....	43
Figure 8: SK TIE4-WMK-1-K (or -2-K)	44
Figure 9: SK TIE4-WMK-3.....	44
Figure 10: SK 2xxE with wall-mounting kit.....	45
Figure 11: SK TIE4-WMK-... (...1-EX / 2-EX)	45
Figure 12: SK 2xxE with wall-mounting kit.....	46
Figure 13: SK TIE4-WMK-L	46
Figure 14: Mounting positions: frequency inverter with wall-mounting kit.....	47
Figure 15: Option locations on the connection unit.....	48
Figure 16: Jumpers for mains adaptation	63
Figure 17: Connection example: SK xU4-24V-... power supply	73
Figure 18: SK 2xxE (size 1), top view	87
Figure 19: SK 2xxE (size 1), internal view	87
Figure 20: internal customer units SK CU4 ... example	90
Figure 21: external technology units SK TU4-... (example).....	92
Figure 22: Examples of devices with connectors for connecting the power.....	95
Figure 23: Wiring diagram SK CU4-POT, example SK 2x0E	98
Figure 24: Wiring diagram SK CU4-POT and parameterisation, example SK 2x5E.....	99
Figure 25: Replacement of the plug-in EEPROM	112
Figure 26: Connecting terminals AS-i, left size 1 – 3, right size 4.....	124
Figure 27: Diagnostic openings on SK 2x0E (sizes 1 ... 3)	233
Figure 28: Diagnostic openings on SK 2x0E size 4 or SK 2x5E.....	234
Figure 29 Setpoint processing	267
Figure 30: Flow chart: Process controller	268
Figure 31: Sample application: Dancing roller	269
Figure 32: Wiring recommendation.....	274
Figure 33: Heat losses due to pulse frequency	275
Figure 34: Reduced output current due to low voltage	278
Figure 35: Derating factor "k" for motor installation (self-ventilated)	279
Figure 36: Derating factor "k" for IE5 motors	280
Figure 37: Energy efficiency due to automatic flux optimisation	285
Figure 38: Characteristic curve 50 Hz	286
Figure 39: 87 Hz characteristic curve	289
Figure 40: Characteristic curve 100 Hz	291

List of tables

Table 1: BU0200 version list.....	6
Table 2: Additional characteristics, sizes 1 ... 3.....	17
Table 3: Additional characteristics, size 4.....	17
Table 4: Warning and hazard information on the product.....	25
Table 5: Standards and approvals.....	27
Table 6: Standards and approvals for explosion hazard environments	28
Table 7: Assignment of brake resistors to frequency inverter	57
Table 8: Connection data	61
Table 9: Encoder colour and contact assignment – HTL (SK 2xxE)	76
Table 10: External bus modules and IO extensions SK TU4-	93
Table 11: external modules with power supply SK TU4-24V- ... / SK TU4-POT-	94
Table 12: external modules – maintenance switch SK TU4-MSW-	94
Table 13: Temperature sensors, adjustment	118
Table 14: AS Interface, connection of signal and supply lines.....	124
Table 15: FAQ operational problems.....	254
Table 16: EMC comparison between EN 61800-3 and EN 55011.....	272
Table 17: Overview according to product standard EN 61800-3	274
Table 18: Overcurrent relative to time	276
Table 19: Overcurrent relative to pulse and output frequency	277
Table 20: Set and actual value processing in the frequency inverter.....	295

1 General

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

The power range is from 0.25 kW to 22.0 kW.

The device series can be adapted to individual requirements by means of modular assemblies.

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

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



Information

Accessories

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

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

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

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

Up to firmware version **1.4 R1**, the data was stored in the plug-in EEPROM. The EEPROM then had to remain plugged in during operation.

In the simplest configuration (SK 2x0E size 4, SK 2x5E), it is possible to set all important parameters via two potentiometers and eight DIP switches even if the EEPROM is not plugged in. LEDs are available for diagnosing the operating states. The use of a control module is therefore not mandatory.

Information

Adaptation of parameter structure

With the frequency inverter's software change from version **V1.1 R1 to V1.2 R0**, the structure of individual parameters has been changed (Section 4.3.2.1 "Parameterisation"), for example: (**P417**) was a simple parameter up to version V1.1 R2; for version V1.2 R0 and higher, it has been subdivided into two arrays ((**P417**) [-01] and [-02]).

When moving an EEPROM from a frequency inverter with an earlier software version to a frequency inverter with software version V1.2 and higher, the stored data is automatically adapted to the new format. New parameters are stored in the default setting. This ensures correct functioning.

However, it is not permissible to plug an EEPROM (memory module) with software version V1.2 and higher into a frequency inverter with an earlier software version, as this may result in complete loss of data.

Information

DIP switch function change

With the frequency inverter's software change from version **V1.4 R1 to V1.4 R2**, the functional assignment of DIP switch S1-6 has been changed (Section 4.3.2.2 "DIP switches (S1)"). The V/f function (switching between ISD control and V/f characteristic curve) has been changed to the "COPY" function (triggering data exchange from the external EEPROM (memory module) to the internal EEPROM).

Firmware version 3.x Rx can only be used with hardware status FAA or higher.

1.1 Overview

This manual describes two very similar basic versions of the SK 200E product family (NORDAC FLEX). Wherever the *SK 2xxE* is mentioned in the following, this refers to information that applies to all devices in this family.

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

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

Basic properties

- High starting torque and precise motor speed control setting by means of sensorless current vector control
- Can be installed directly on, or close to the motor.
- Permissible ambient temperature -25°C to 50°C (please refer to technical data)
- Integrated EMC mains filter for limit curve A Category C2 or C3 (not with 115 V devices)
- Automatic measurement of the stator resistance and determination of the precise motor data possible
- Programmable direct current braking
- Built-in brake chopper for 4-quadrant operation, optional braking resistors (internal/external)
- Separate temperature sensor input (TF+/TF-)
- Evaluation of an incremental encoder via digital inputs possible
- NORD system bus for linking modular additional modules
- Four separate parameter sets that can be changed over online
- 8x DIP switches for minimal configuration
- LEDs for diagnosis (SK 2x5E incl. DI/DO signal statuses)
- RS232/485 interface via RJ12 plug
- Plug-in data memory (EEPROM)
- Integrated "POSICON" positioning control ( [BU0210](#))
- CANopen absolute value encoder evaluation via the NORD system bus
- Operation of *three-phase current asynchronous motors* (ASM) and **Permanent Magnet Synchronous Motors** (PMSM)
- Integrated PLC ( [BU0550](#))

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

Additional characteristics, sizes 1 ... 3

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

Table 2: Additional characteristics, sizes 1 ... 3
Additional characteristics, size 4

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

Table 3: Additional characteristics, size 4

Option modules

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

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

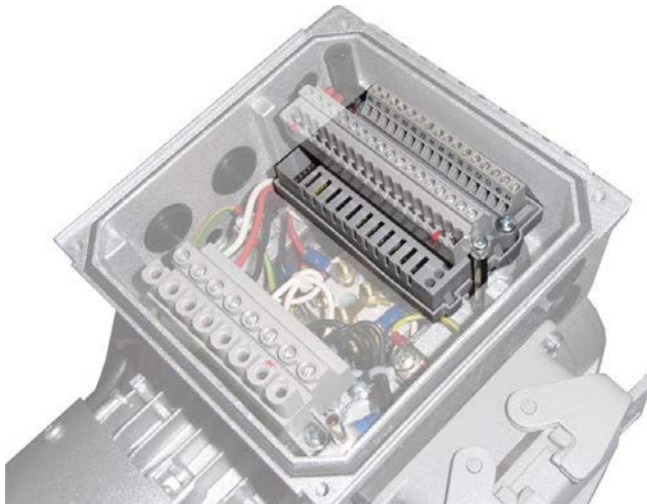


Figure 1: Device with internal SK CU4-...



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

Attachment variant

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

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

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

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

Built-in variant

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

An exception among the “SK CU4 modules” is the **SK CU4-POT** potentiometer adapter, which is not integrated but mounted to the device.

The communication between “intelligent” optional modules and the device takes place via the system bus. Intelligent optional modules are modules with integrated processor or communication technology as is the case with field bus modules, for example.

The frequency inverter is able to manage the following options via its system bus:

- 1x SK PAR-5H ParameterBox (via RJ12 plug)
- 1x Field bus option (for example PROFINET IO), internal or external
- 2x I/O extension (SK xU4-IOE-...), internal and/or external
- 1 x CANopen absolute encoder

Up to four frequency inverters with corresponding options can be connected to a system bus.

1.2 Delivery

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

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

Important! This also applies if the packaging is undamaged.

1.3 Scope of delivery

NOTICE

Defect in the device

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

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

Standard version:

- Device in IP55 design (optionally IP66)
- Operating instructions as PDF file on CD-ROM including NORDCON (PC parameterisation software)

1.4 Safety, installation and application information

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

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

These safety instructions must be kept in a safe place!

1. General

Do not use defective devices or devices with defective or damaged housings or missing covers (e.g. blind plugs for cable glands). Otherwise, there is a risk of serious injury or death from electric shock or rupture of electrical components, e.g. high power capacitors.

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

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

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

The device is not equipped with a master mains switch and is thus always live when connected to mains voltage. Voltages may therefore be connected to a connected motor at standstill.

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

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

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

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

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

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

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

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

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

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

Further information can be found in this documentation.

Triggering of a circuit breaker

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

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

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

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

2. Qualified specialist personnel

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

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

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

3. Intended use – general

The frequency inverters are devices for industrial and commercial systems that are used to operate three-phase asynchronous motors with squirrel-cage rotors and permanent magnet synchronous motors (PMSM). These motors must be suitable for operation with frequency inverters, other loads must not be connected to the devices.

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

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

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

CE-labelled devices meet the requirements of the Low Voltage Directive 2014/35/EU. The harmonised standards stated in the Declaration of Conformity are used for the devices.

a. Supplementation: Intended use within the European Union

When installed in machines, commissioning of the devices (i.e. commencement of intended operation) is prohibited until it has been established that the machine fulfils the provisions of EC Directive 2006/42/EC (Machinery Directive); EN 60204-1 must also be complied with.

Commissioning (i.e. commencement of intended operation) is only permitted if the EMC directive (2014/30/EU) is complied with.

b. Supplementation: Intended use outside the European Union

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

4. Do not make any modifications.

Unauthorised changes and the use of spare parts and additional equipment not purchased from or recommended by NORD may cause fire, electric shock and injury.

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

Do not make any structural modifications to the product.

5. Phases of life

Transport, storage

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

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

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

Installation and assembly

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

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

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

Electrical connection

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

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

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

Information regarding EMC-compliant installations such as shielding, earthing, location of filters and routing of cables can be found in the documentation for the devices and in the technical information manual [T180_0011](#). This information must always be observed even with devices with a CE label. Compliance with the limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

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

The device may only be operated with effective earth connections which comply with local regulations for large leakage currents (> 3.5 mA). Detailed information regarding connections and operating conditions can be obtained from the technical Information manual [T180_0019](#).

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

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

Setup, troubleshooting and commissioning

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

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

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

Operation

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

All covers must be kept closed during operation.

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

Maintenance, repair and decommissioning

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

Disposal

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

6. Potentially explosive environment (ATEX, EAC Ex)

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

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

- Only persons who are qualified, i.e. trained and authorised for all assembly, service, commissioning and operation work on association with explosion hazard environments may work with the devices described here (including the motors, geared motors, any accessories and all connection technology).
- Explosive concentrations of dust may cause explosions if ignited by hot or sparking objects. Such explosions may cause serious or fatal injuries to persons or severe material damage.
- The drive must comply with the specifications of **"Planning guideline for the operating and installation instructions B1091"** [B1091-1](#).
- Only original parts which are approved for the device and for operation in an explosion hazard area ATEX Zone 22 3D, EAC Ex must be used.
- **Repairs may only be carried out by Getriebebau NORD GmbH & Co. KG.**

7. IT security

Once a device has been integrated into a network (e.g. field bus or Ethernet network), it is possible to change its settings or parameters – even remotely. For this reason, parameter changes, which are not visible from the outside, may cause unexpected but not uncontrolled system behaviour and have a negative impact on operational reliability, system availability or data security.

NORD frequency inverters do not have their own identification and authentication strategies for human users and must therefore be protected by organisational measures. Furthermore, the devices currently do not feature different access levels. The devices' IT security is only guaranteed if they are used in an environment that is protected by "defence-in-depth strategies".

Therefore, only use the devices in a protected and controlled environment in order to minimise the impact on the network and to ensure that external access to the devices is not possible. Continue using firewalls to protect the network of the automation system and to separate it from other networks. If it is not absolutely necessary due to the system or machine, the field buses should be separated from the higher-level network if possible.

Use access restrictions to prevent unauthorised persons from getting access to the devices and their communication interfaces. Lock and secure control cabinets accordingly.

According to the principle of least privilege, only the minimum rights and functions necessary for operation should be granted for each device. This particularly applies to UDP, TCP or AoE connections. With access via the diagnostic interface, the terminal device used should ideally not be connected to the internet during the device setup.

Clear responsibility for security during operation must be ensured. NORD recommends an information security management system according to ISO/IEC 270001 (security in data centres) and ISO/IEC 62443-2-4 (security for industrial automation and control systems).

1.5 Warning and hazard information

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

1.5.1 Warning and hazard information on the product

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

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

1) Texts are written in English.

Table 4: Warning and hazard information on the product

1.5.2 Warning information

Warning information for the safety of users are marked as follows:



This warning information warns of danger to persons that results in severe injuries or death.



This warning information warns of danger to persons that could result in severe injuries or death.

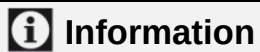


This warning information warns of danger to persons that could usually result in moderate injuries.



This warning information warns of material damage.

1.5.3 Other information



This information shows tips and important information.

1.6 Standards and approvals

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

Approval	Directive	Applied standards	Certificates	Label
CE (European Union)	Low Voltage 2014/35/EU	EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 61800-9-1 EN 61800-9-2	C310700, C310401	
	EMC 2014/30/EU			
	RoHS 2011/65/EU			
	Delegated Directive (EU) 2015/863			
	Ecodesign 2009/125/EC			
	EU Ecodesign Directive 2019/1781			
UL (USA)		UL 508C	E171342	
CSA (Canada)		C22.2 No.274-13	E171342	
RCM (Australia)	F2018L00028	EN 61800-3	133520966	
EAC (Eurasia)	TR CU 004/2011, TR CU 020/2011	IEC 61800-5-1 IEC 61800-3	EAЭC N RU Д- DE.HB27.B.02727/20	
UkrSEPRO (Ukraine)		EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 60947-1 EN 60947-4 EN 61558-1 EN 50581	C311900	
UKCA (United Kingdom)		EN 61800-5-1 EN 60529 EN 61800-3 EN 63000 EN 61800-9-1 EN 61800-9-2	C350700, C350401	

Table 5: Standards and approvals

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

Approval	Directive	Applied standards	Certificates	Labels
ATEX (European Union)	ATEX 2014/34/EU	EN 60079-0	C432710	
	EMC 2014/30/EU	EN 60079-31		
	RoHS 2011/65/EU	EN 61800-5-1		
	Ecodesign 2009/125/EC	EN 60529		
	EU Ecodesign Regulation 2019/1781	EN 61800-3		
		EN 63000		
		EN 61800-9-1		
		EN 61800-9-2		

Table 6: Standards and approvals for explosion hazard environments

1.6.1 UL and CSA approval

File No. E171342

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

All devices include motor protection.



Information

Group fuse protection

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

Conditions UL/CSA according to report



Information

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

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

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

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

"The device has to be mounted according to the manufacturer instructions."

"For NFPA79 applications only"



Information

Internal Break Resistors (PTCs)

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

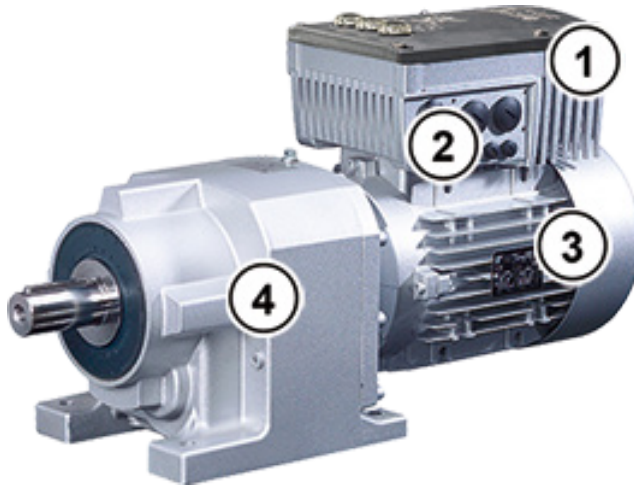
	Usage	Cat. No.
1	FS1-112, FS2-112, FS1-123, FS2-123	BRK-100R0-10-L or- M alternate PLR or PLRC100.61.41 100R 100W
2	FS1-323, FS2-323	BRK-200R0-10-L or- M alternate PLR or PLRC100.61.41 200R 100W
3	FS1-340	BRK-400R0-10-L or- M alternate PLR or PLRC100.61.41 400R 100W
4	FS3-323	BRM-100R0-10-L or- M alternate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

Size	valid	description
1 - 3	For 240 V for 1 phase models or 500V for 3 phase models only:	“Suitable For Use On A Circuit Capable Of Delivering Not More Than 65 000 rms Symmetrical Amperes, ____ Volt maximum”, “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated ____ Amperes, and ____ Volts”, as listed in ¹⁾.
	For 120 V, 240 V, 400 V, 500 V models only:	“Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, ____ Volts Maximum” and minimum one of the two following alternatives. When used together with Accessory SK TU4-MSW: “Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, ____ Volts Maximum” and minimum one of the two following alternatives. 1. “When Protected by Fuses manufactured by Bussmann, type ____”, as listed in¹⁾. 2. “When Protected by class RK5 Fuses or faster or when Protected by High-Interrupting Capacity, Current Limiting Class CC, G, J, L, R, T, etc. Fuses, rated ____ Amperes, and ____ Volts”, as listed in ¹⁾.
	Motor group installation (Group fusing):	“Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 500 V max” “When Protected by class RK5 Fuses or faster, rated 30_Ampere” “Suitable for motor group installation on a circuit capable of delivering not more than 100 000 rms symmetrical amperes, 500 V max” “When Protected by High-Interrupting Capacity, Current Limiting Class CC, G, J, L, R, T, etc. Fuses rated 30 Amperes” “Suitable for motor group installation on a circuit capable of delivering not more than 10 000 rms symmetrical amperes, 500 V max” “When Protected by Circuit Breaker (inverse time trip type) in accordance with UL 489, rated 30 Amperes and 500 Volts min”
	differing data CSA:	If device is used for Canadian market and bears the cUL Listing mark: “For Canada SCCR is limited to 5 000 rms Symmetrical Amperes.”. Marking not required for UL only marked devices.
4	Models -551-323-A; -751-323-A; -112-323-A only:	“Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, 240 Volts Maximum When Protected By High-Interrupting Capacity, Current Limiting Type Fuses such as Class CC, G, J, L, R, T, etc., rated 300V/60A.” “Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, 240 Volts Maximum When Protected By A Circuit Breaker Having An Interrupting Rating Not Less Than 10 000 rms Symmetrical Amperes, 300 Volts Maximum.”
	Models -112-340-A; -152-340-A; -182-340-A; -222-340-A only:	“Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 000 rms Symmetrical Amperes, 500 Volts Maximum When Protected By High-Interrupting Capacity, Current Limiting Type Fuses such as Class CC, G, J, L, R, T, etc., rated 600A/60A.” “Suitable For Use On A Circuit Capable Of Delivering Not More Than 10 000 rms Symmetrical Amperes, 500 Volts Maximum When Protected By A Circuit Breaker Having An Interrupting Rating Not Less Than 10 000 rms Symmetrical Amperes, 600 Volts Maximum.”

1)  7.3

1.7 Type code / nomenclature

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



1	Frequency inverter
2	Connection unit
3	Motors
4	Gear units

5	Optional module
6	Connection unit
7	Wall-mounting kit

1.7.1 Name plate

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

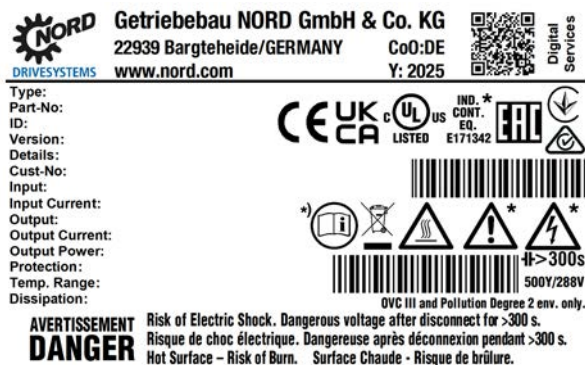
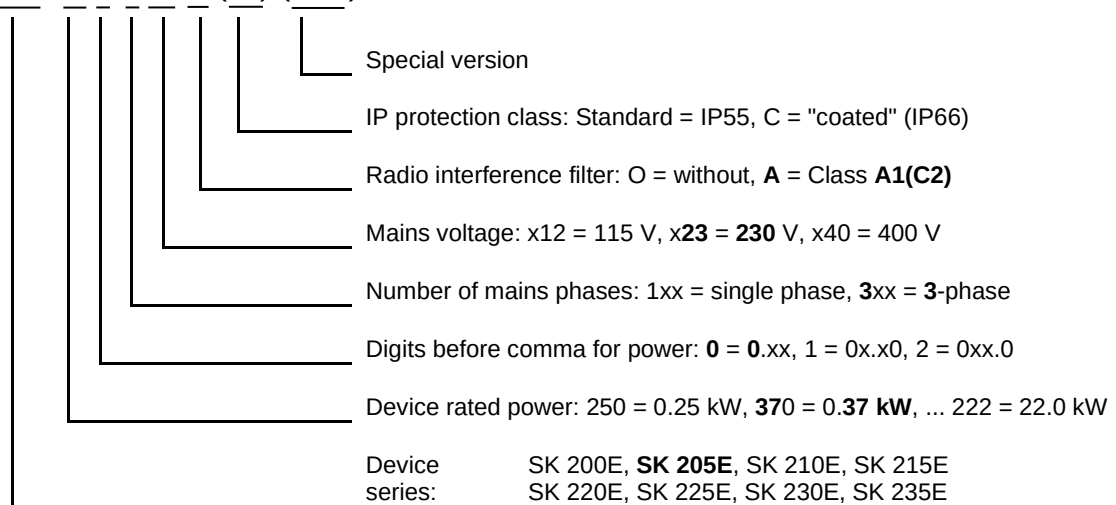


Figure 3: Name plate

1.7.2 Frequency inverter type code - Basic device

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

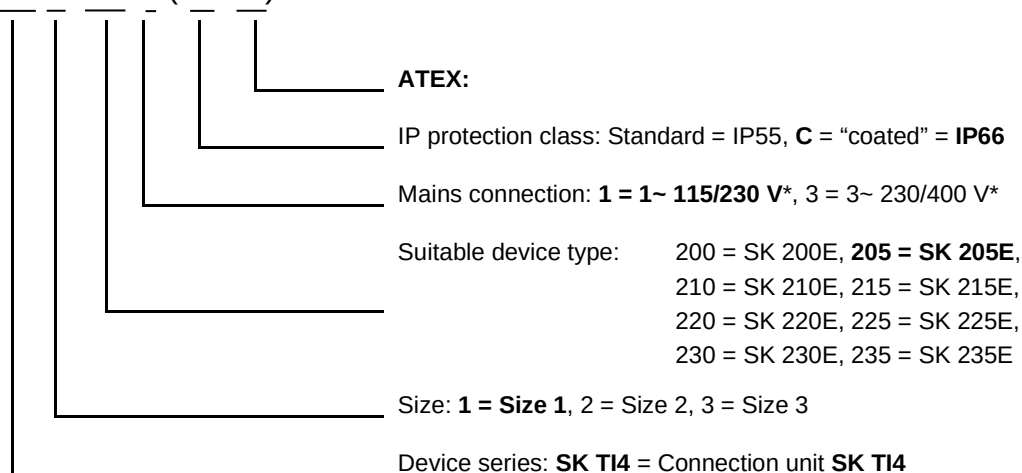


(...) Options, only implemented if required.

1.7.3 Frequency inverter type code – Connection unit

Sizes 1 to 3

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

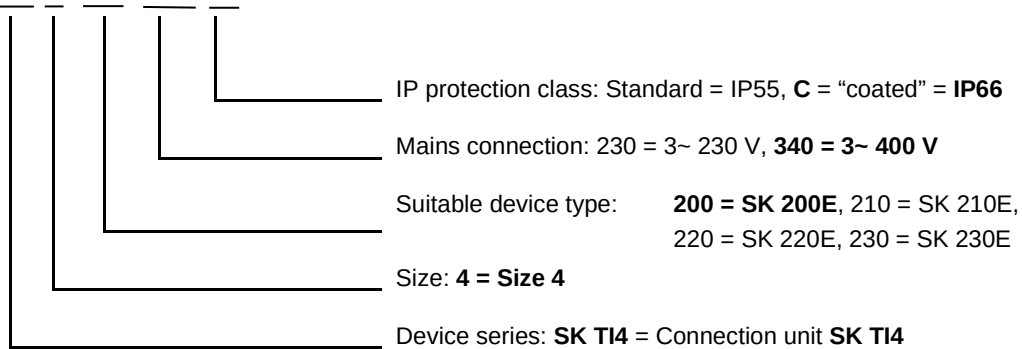


*) The voltage depends on the frequency inverter used. Please refer to the technical data as well.

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

Size 4

SK TI4-4-200-340 (-C)

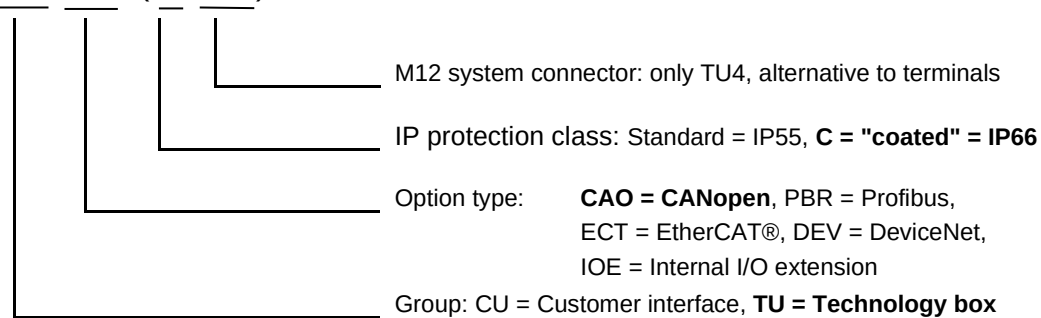


(...) Options, only implemented if required.

1.7.4 Type code for option modules

For bus module or I/O extension

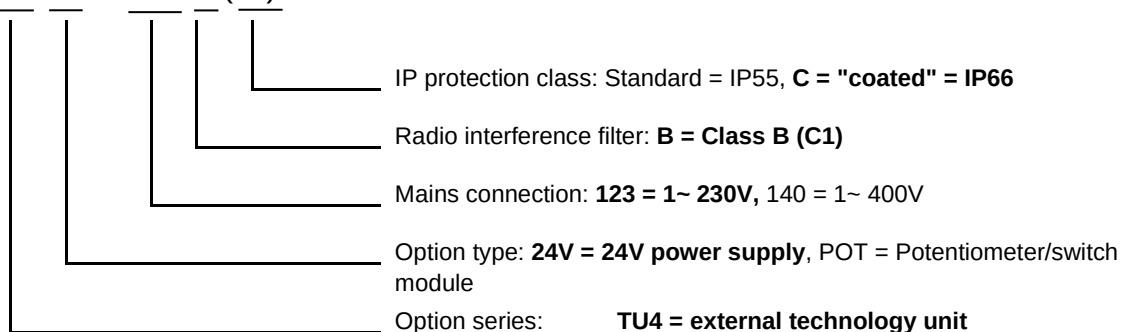
SK TU4-CAO (-C-M12)



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

For "PotiBox" power supply or potentiometer modules

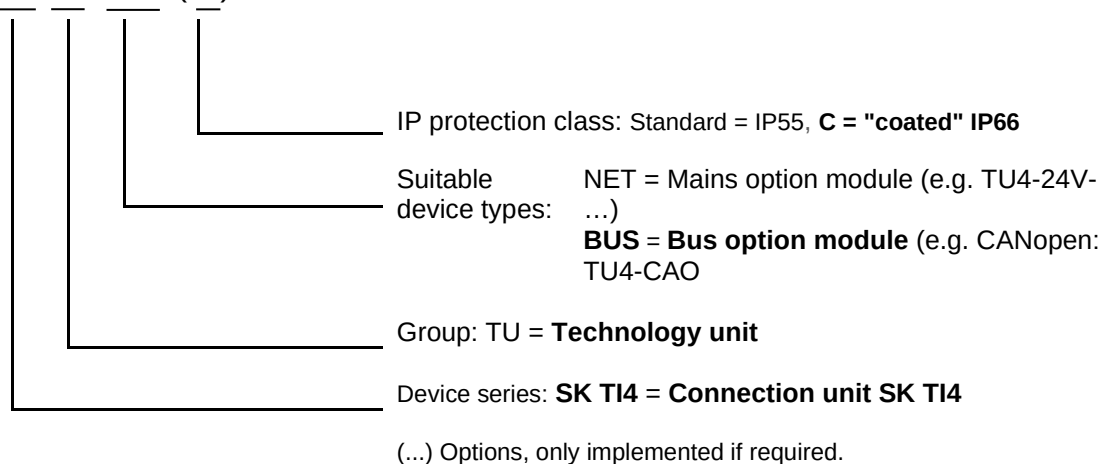
SK TU4-24V-123-B (-C)



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

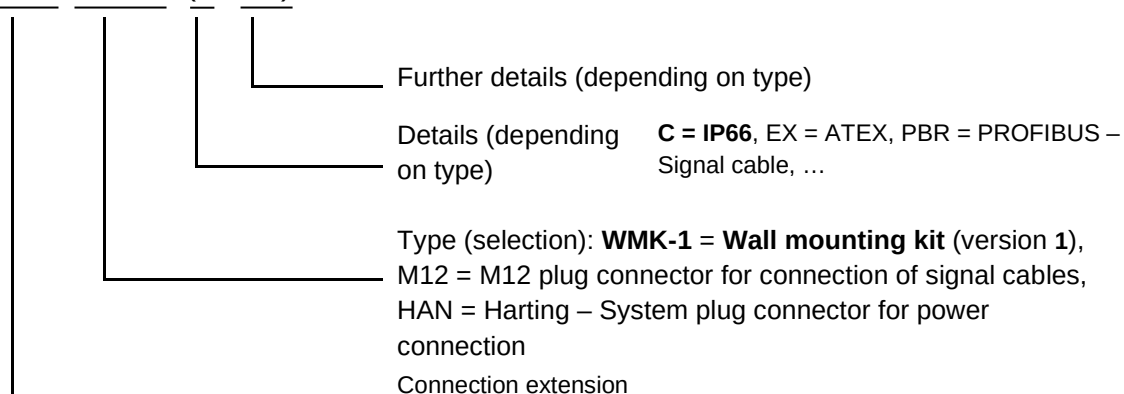
1.7.5 Type code, connection unit for technology unit

SK TI4-TU-BUS (-C)



1.7.6 Adapter Unit type code

SK TIE4-WMK-1 (-C- ...)



1.8 Power-size assignment

Size	Mains/power assignment SK 2xxE			
	1~ 110 - 120 V ¹⁾	1~ 200 – 240 V ²⁾	3~ 200 – 240 V	3~ 380 – 500 V
Size 1	0.25 ... 0.37 kW	0.25 ... 0.55 kW	0.37 ... 1.1 kW	0.55 ... 2.2 kW
Size 2	0.55 ... 0.75 kW	0.75 ... 1.1 kW	1.5 ... 2.2 kW	3.0 ... 4.0 kW
Size 3	-	-	3.0 ... 4.0 kW	5.5 ... 7.5 kW
Size 4 ³⁾	-	-	5.5 ... 11.0 kW	11.0 ... 22.0 kW

1) Only available as SK 2x5E model

2) Only available as SK 2x0E model in size 1

3) Only available as SK 2x0E model

1.9 Version in protection class IP55, IP66

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

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

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

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



Information

Cable laying

For all versions, care must be taken that the cables and the cable glands at least comply with the protection class of the device and the attachment regulations and are carefully matched. The cables must be inserted so that water is deflected away from the device (if necessary use loops). This is essential to ensure that the required protection class is maintained.

IP55 version:

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

IP66 version:

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

i Information

IP66 special measures

IP66 modules have an additional "-C" in their type code and are modified with the following special measures:

- Impregnated PCBs
 - RAL 9006 (white aluminium) powder coating for housings
 - Modified blind plugs (UV-resistant)
 - Diaphragm valve for pressure compensation in case of temperature changes
 - Vacuum test
 - The vacuum test requires a free M12 screw connection. After the test has been carried out, the diaphragm valve is inserted here. This screw connection is no longer available as a cable gland.
-

In case the device shall be assembled at a later point, i.e. the drive unit is not entirely from NORD, the diaphragm valve is delivered in the accessories kit. The valve must then be professionally installed on site by the system installer (**Note:** The valve must be installed in the highest possible position to avoid contact with waterlogging (for example standing water due to condensation)).

i Information

"SK 2xxE-...-C" devices, size 4

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

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

i Information

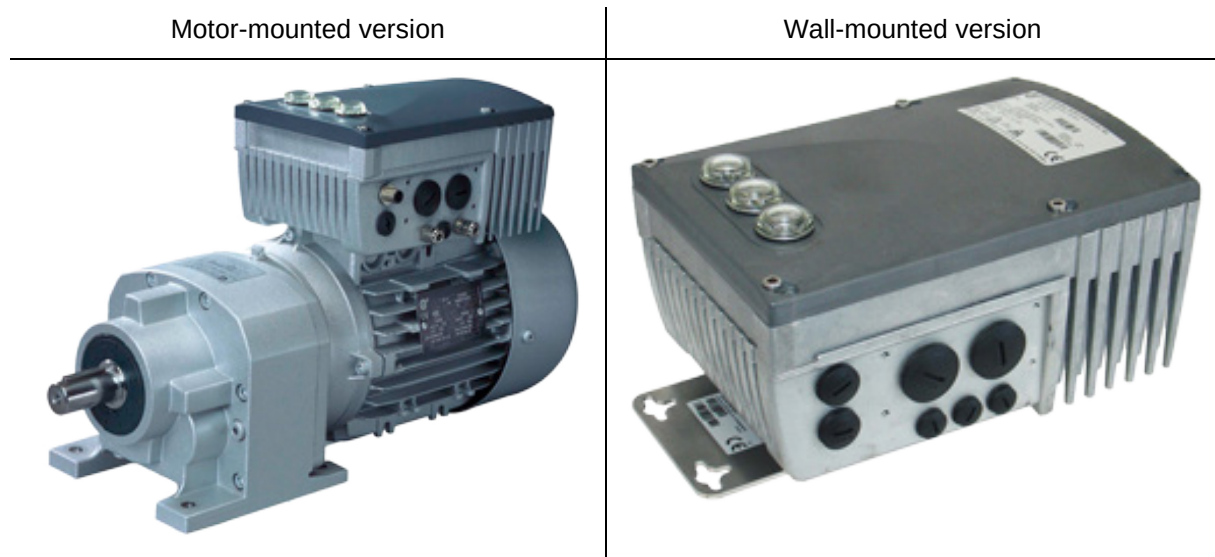
Diaphragm valve

The diaphragm valve (accessories kit of the IP66 version of the frequency inverter's connection unit) ensures the compensation of pressure differences between the inside of the frequency inverter and its environment, and also prevents the ingress of moisture. When mounting into an M12 screw fitting of the inverter's connection unit, care must be taken that the diaphragm valve does not make contact with waterlogging.

2 Assembly and installation

2.1 Installation SK 2xxE

The devices are available in various sizes depending on their output. They can be mounted on the terminal box of a motor or in its immediate vicinity.



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



Information

Device version IP6x

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

The SK 2xxE is connected to the motor or the wall-mounting kit using the size that is suitable for the SK TI4-... connection unit. The adapter unit can also be ordered separately for subsequent mounting on an existing motor or to replace a different motor-mounted frequency inverter.

The “**Adapter unit SK TI4**” module includes the following components:

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

Information

Power derating

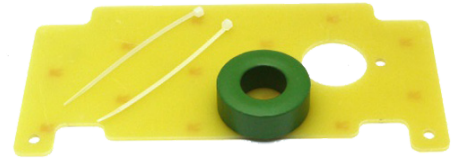
The equipment requires **sufficient ventilation** to protect against overheating. If this cannot be guaranteed, this results in power reduction (derating) of the frequency inverter. The ventilation is influenced by the type of installation (motor-mounting, wall-mounting) and/or with motor-mounting: the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

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

Details concerning output reduction and possible ambient temperatures, and other details ( Section 7.3 "Electrical data").

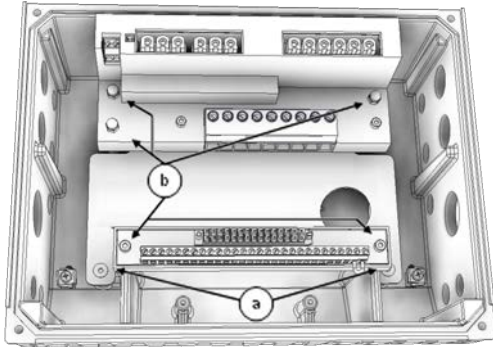
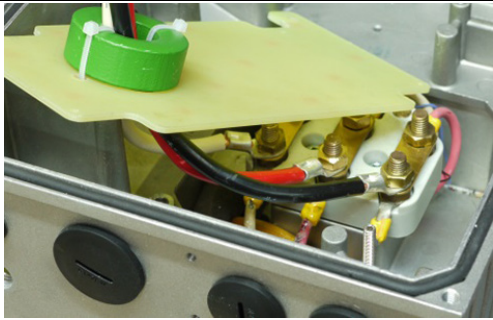
2.1.1 Installation of insulating plate – size 4

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



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

Assembly sequence

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

2.1.2 Motor installation work operations

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

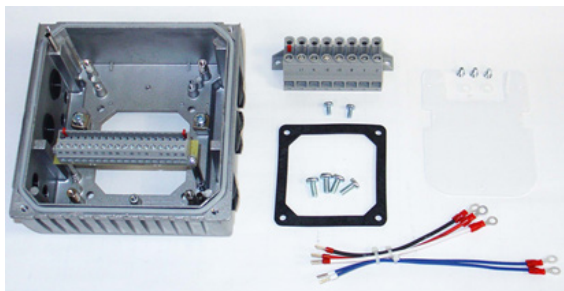


Figure 4: Connecting unit size 1 ... 3

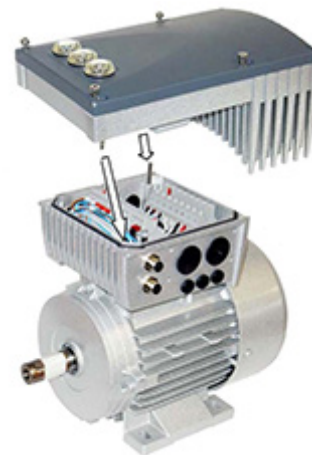


Figure 5: Connecting unit size 4

4. Fix insulating plate above the motor terminal block.
 - Size 4: Attach ring core to insulating plate (see Section 2.1.1 "Installation of insulating plate – size 4"). Screw on the power terminal block above this using 2x M4x8 screws and the plastic washers. (Size 4: 3x M4 cap nuts).
5. Make the electrical connections. For the cable gland of the connecting cable, appropriate screwed connections for cable cross-section must be used.
6. Fit the frequency inverter to the connection unit. With sizes 1 to 3, special attention must be paid to correct contacting of the PE pins. These are located diagonally in 2 corners of the frequency inverter and the connection unit.

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

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



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

2.1.2.1 Adapters for different motors

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

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

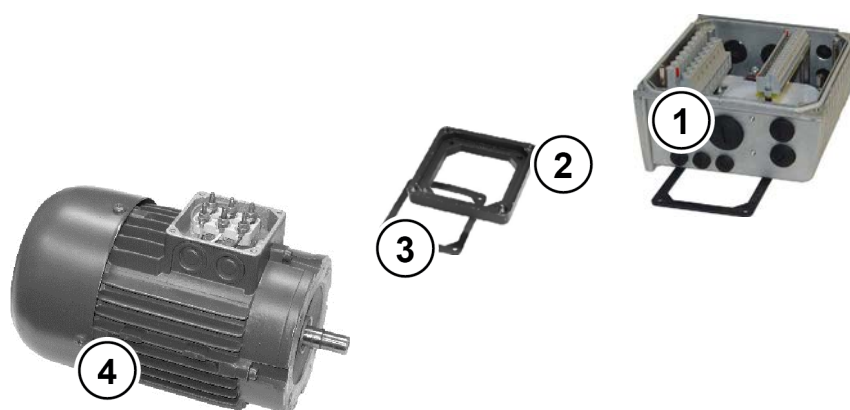


Information

External motors

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

Information about converting a drive to the device can be found in [BU0320](#).



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

Figure 6: Example of motor size adaptation

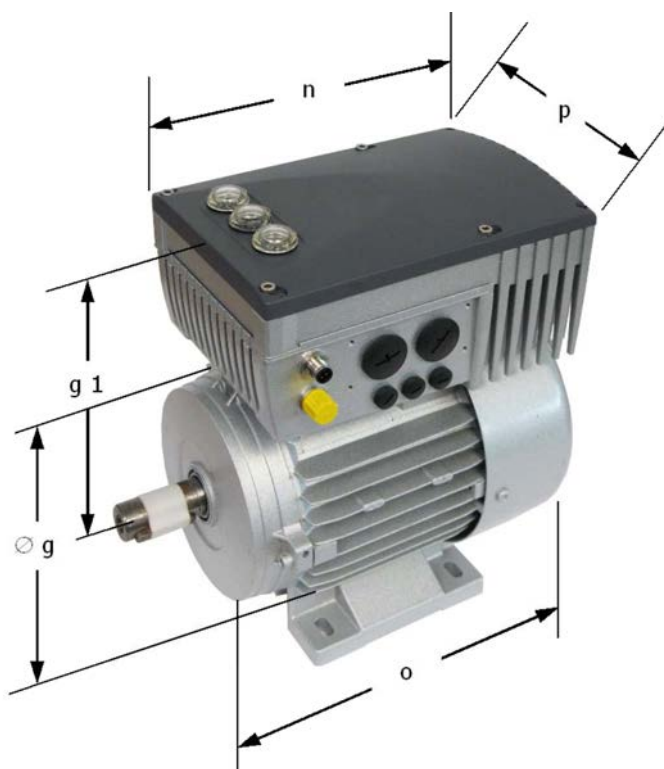
NORD motor sizes	Add-on SK 2xxE Size 1	Add-on SK 2xxE Size 2	Add-on SK 2xxE Size 3	Add-on SK 2xxE Size 4
Size 63 – 71	with adapter kit I	with adapter kit I	Not possible	Not possible
Size 80 – 112	Direct mounting	Direct mounting	with adapter kit II	Not possible
Size 132	Not possible	Not possible	Direct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

Overview of adapter kits

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

2.1.2.2 Dimensions, SK 2xxE mounted on motor

Size		Housing dimensions SK 2xxE / Motor					Weight of SK 2xxE without motor Approx. [kg]
FI	Motor	Ø g	g 1	n	o	p	
Size 1	Size 71 *	145	201	236	214	156	3.0
	Size 80	165	195		236		
	Size 90 S / L	183	200		251 / 276		
	Size 100	201	209		306		
Size 2	Size 80	165	202	266	236	176	4.1
	Size 90 S / L	183	207		251 / 276		
	Size 100	201	218		306		
	Size 112	228	228		326		
Size 3	Size 100	201	251	330	306	218	6.9
	Size 112	228	261		326		
	Size 132 S / M	266	262		373 / 411		
Size 4	Size 132	266	313	480	411	305	17.0
	Size 160	320	318		492		
	Size 180	358	335		614		
		All dimensions in [mm] *) including additional adapter and seal [13097000]					



2.1.3 Wall mounting

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

2.1.3.1 Wall mounting kit without fan

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

The wall-mounting kits are equally suitable for IP55 and IP66 applications and essentially consist of the following materials:

- SK TIE4-WMK-1-K: Plastic
- SK TIE4-WMK-2-K: Plastic
- SK TIE4-WMK-3: Stainless steel

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

Information

Derating

When using the wall-mounting kits SK TIE4-WMK-1-K and SK TIE4-WMK-2-K, the frequency inverter no longer has optimum ventilation. Especially with 3-phase frequency inverters, the maximum continuous power output can therefore be considerably lower than is typical for motor mounting. For details, please refer to the technical data (see chapter 7.3 "Electrical data" on page 258).

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

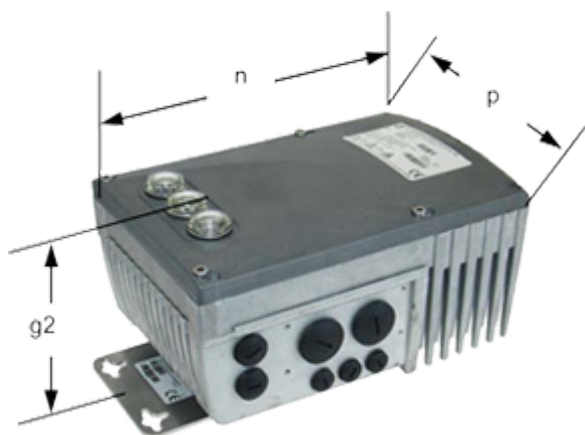


Figure 7: SK 2xxE with wall-mounting kit

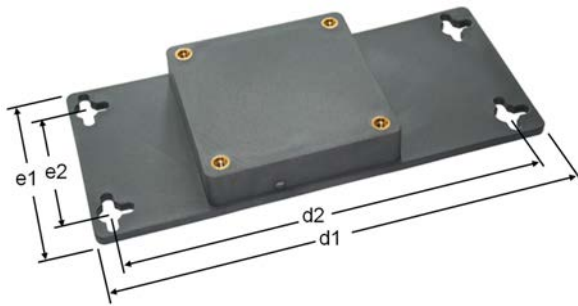


Figure 8: SK TIE4-WMK-1-K (or -2-K)

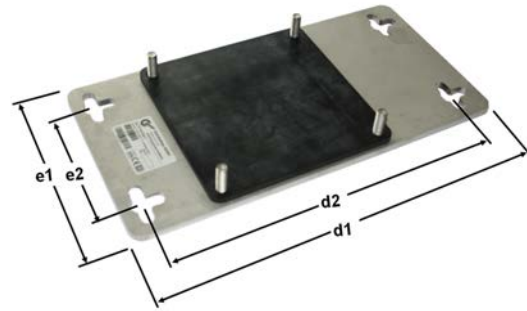


Figure 9: SK TIE4-WMK-3

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

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



Information

Derating

With the use of the wall mounting kit the frequency inverter is no longer optimally ventilated. Therefore, especially with 3-phase frequency inverters, the maximum continuous power output can be considerably lower than is typical for wall mounting. For details, please refer to the technical data (☞ Section 7.3 "Electrical data")

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

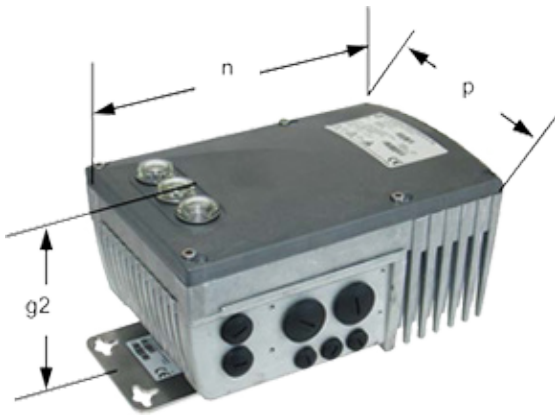
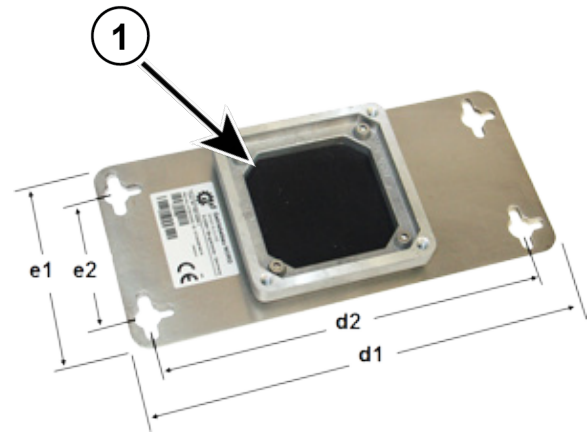


Figure 10: SK 2xxE with wall-mounting kit



1 Adapter plate

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

2.1.3.2 Wall mounting kit with fan

Wall-mounting kit SK TIE4-WMK-L-...

The wall-mounting kit SK TIE4-WMK-L-... enables the frequency inverter to be installed close to the motor. With this kit and depending on the version, the frequency inverter can comply with the IP55 or IP66 protection class.

- This kit is only available for inverter sizes 1 to 3.
- This kit cannot be combined with the device versions SK 22xE and SK 23xE (devices with AS-Interface).

When installing, make sure that the fan is located below the cooling ribs of the inverter. The fan connection cable must be inserted into the frequency inverter's connection unit through the cable inlet (see diagram below) and wired to +24 V DC (red cable) or GND (black cable) on the terminal block.

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



Information

Derating

When using the wall-mounting kit SK TIE4-WMK-L-1 (or -2), the frequency inverter has continuous ventilation. Therefore, the permissible continuous power outputs of a 3-phase frequency inverter correspond to those of a motor-mounted inverter. For single-phase frequency inverters, the same power data applies to wall mounting. For details, please refer to the technical data (see chapter 7.3 "Electrical data" on page 258).

FI size	Device type	Housing dimensions			Mounting dimensions						Total weight Approx. [kg]
		g2	n	p	d1	d2	d3	e1	e2	Ø	
Size 1	SK TIE4-WMK-L-1 IP55 Part. no. 275274005	150.5	236	156	257	187	61	130	100	5.5	3.3
	SK TIE4-WMK-L-1-C IP66 Part. no. 275274016										
Size 2	SK TIE4-WMK-L-1 IP55 Part No. 275274005	157.5	266	176							4.4
	SK TIE4-WMK-L-1-C IP66 Part. no. 275274016										
Size 3	SK TIE4-WMK-L-2 IP55 Part No. 275274006	174.5	330	218	303	212	81	150	120	5.5	7.3
All dimensions in [mm]											

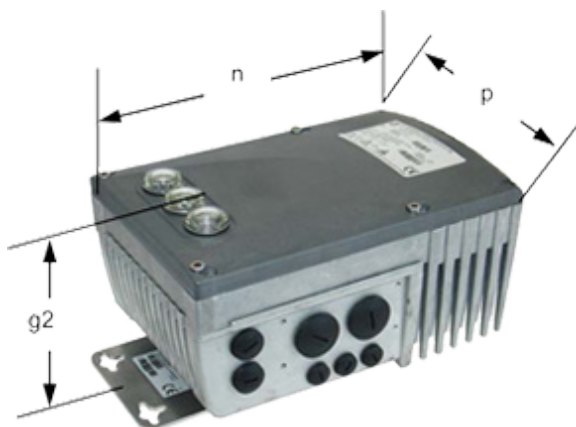
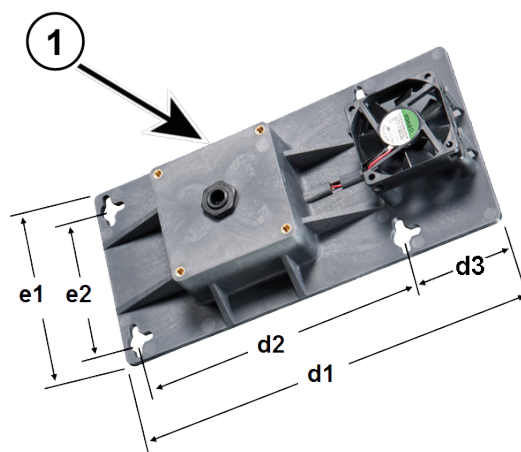


Figure 12: SK 2xxE with wall-mounting kit



1 Insertion of fan connecting cable

Figure 13: SK TIE4-WMK-L ...

2.1.3.3 Mounting positions: frequency inverter with wall-mounting kit

Installation of the frequency inverter close to the motor is permissible in the following mounting positions.

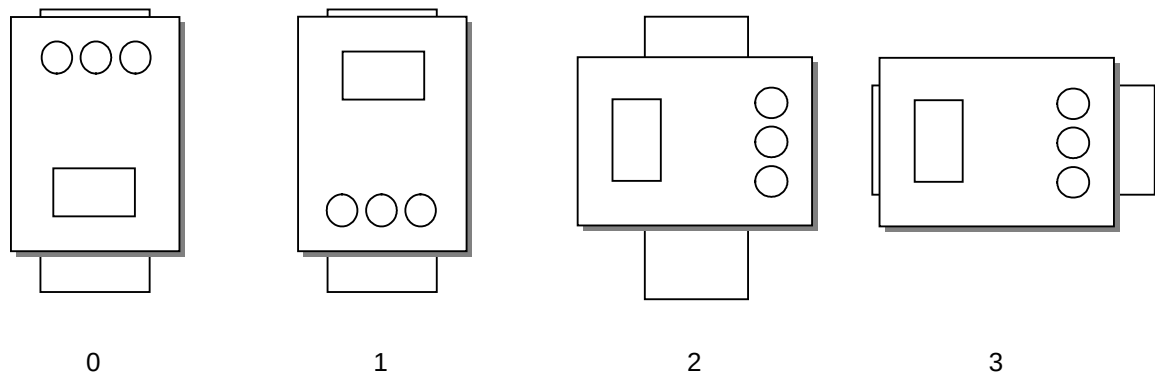


Figure 14: Mounting positions: frequency inverter with wall-mounting kit

		0	1	2	3
Mounting position	Frequency inverter	Vertical	Vertical	Horizontal	Horizontal
	Position of cooling fins (/ fans)	Bottom	Top	Lateral	Lateral
	Wall-mounting kit	Vertical	Vertical	Vertical	Horizontal
Type Wall-mounting kit	SK TIE4-WMK-1-K SK TIE4-WMK-2-K	–	√	√	√
	SK TIE4-WMK-1-EX SK TIE4-WMK-2-EX	–	√	√	√
	SK TIE4-WMK-3	√	-	√ ¹⁾	√
	SK TIE4-WMK-L-1 SK TIE4-WMK-L-2	–	√	–	√

√ = Permissible / – = Not permissible

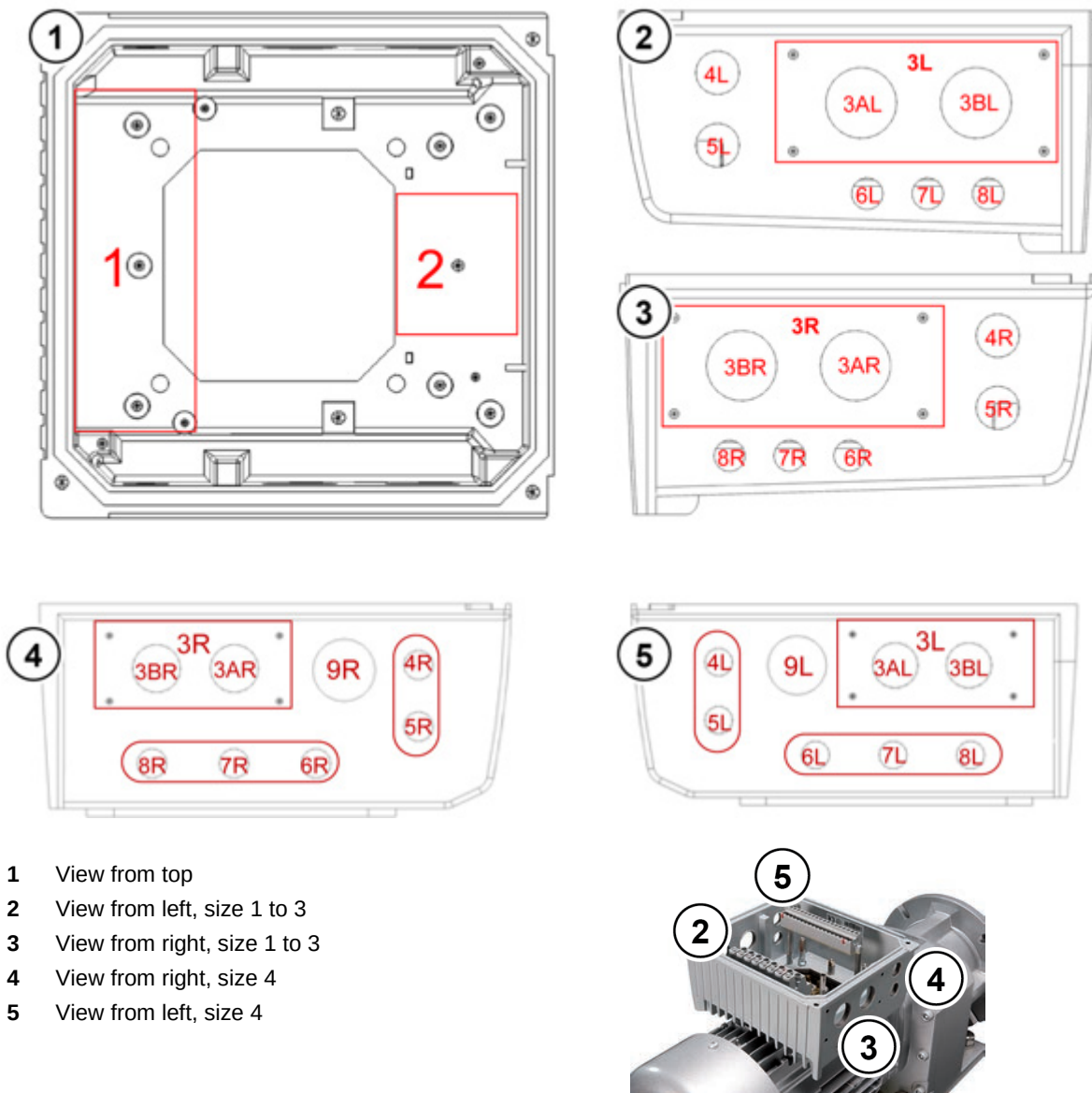
1) Cannot be used for size 4

2.2 Installation of optional modules

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

2.2.1 Option locations on the device

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



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

Figure 15: Option locations on the connection unit

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

2 Assembly and installation

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

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

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



Information

Installation location of customer unit

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

Prefabricated cables are provided with the customer unit.

Connections are made according to the following table:



Similar to illustration
Bag enclosed with internal customer unit

Wiring harness assignments (enclosed with the customer interface)

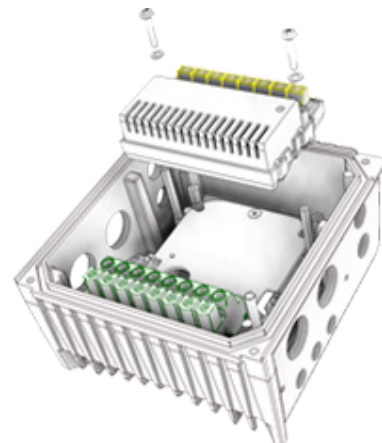
	Function	Terminal label		Cable colour
Field bus / IOE	Voltage supply (24V DC) (between device and customer interface)	44	24V	brown
		40	GND / 0V	blue
	System bus	77	SYS H (+)	black
		78	SYS L (-)	grey
Mains unit	Voltage supply (24V DC) (between device and customer interface)	44	24V	brown
		40	GND / 0V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

The bus modules require a 24V supply voltage.

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

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

Only one Customer Unit per device is possible!



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

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



Information

Detailed installation information

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

Connection unit	Document
SK TI4-TU-BUS	TI 275280000
SK TI4-TU-BUS-C	TI 275280500
SK TI4-TU-NET	TI 275280100
SK TI4-TU-NET-C	TI 275280600
SK TI4-TU-MSW	TI 275280200
SK TI4-TU-MSW-C	TI 275280700
SK TI4-TU-SAFE	TI 275280300
SK TI4-TU-SAFE-C	TI 275280800

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

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

CAUTION

Hot surfaces

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

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

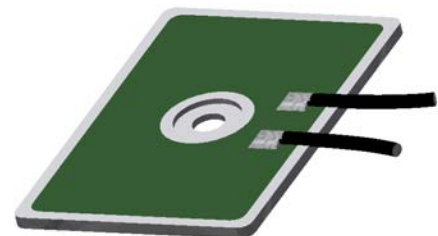
Information

Parameterisation of braking resistor data

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

2.3.1 Internal brake resistor SK BRI4-...

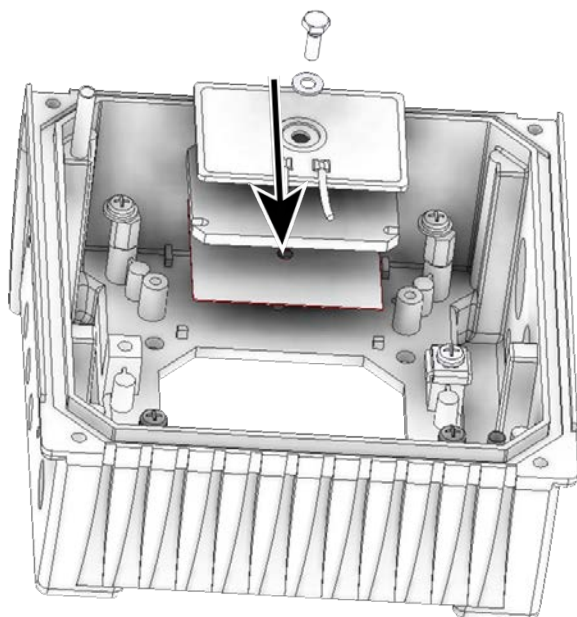
The internal brake resistor can be used if only slight, short braking phases are to be expected. For the individual power ranges of size 4, the item includes a set of 2 brake resistors. These must be connected in parallel and thereby achieve the electrical data from the description of the material. The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



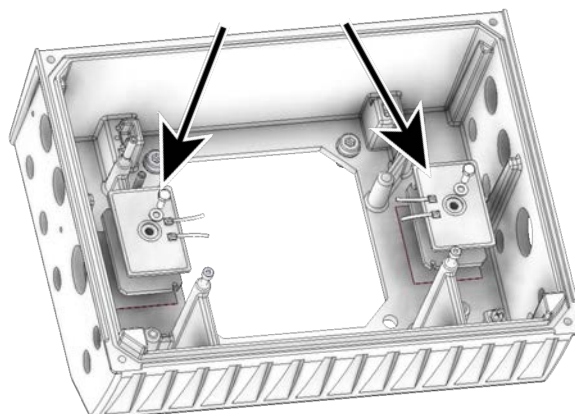
similar to Figure

Assembly

Size 1 ... 3



Size 4



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

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

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

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



Information

Peak load limitation - DIP switches (S1)

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

Electrical data

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

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

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

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



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

Electrical data

Designation ¹⁾ (IP67)	Resistance	Max. continuous power (P _n)	Energy consumption ²⁾ (P _{max})
SK BRx4-1-100-100	100 Ω	100 W	2.2 kW
SK BRx4-1-200-100	200 Ω	100 W	2.2 kW
SK BRx4-1-400-100	400 Ω	100 W	2.2 kW
SK BRx4-2-100-200	100 Ω	200 W	4.4 kW
SK BRx4-2-200-200	200 Ω	200 W	4.4 kW
SK BRx4-3-050-450	50 Ω	450 W	3.0 kW
SK BRx4-3-100-450	100 Ω	450 W	3.0 kW
¹⁾ SK BRx4-: versions: SK BRE4-, SK BRW4-, SK BREW4- ²⁾ Maximum once within 120s			

External brake resistors for motor-mounted frequency inverters

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

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

Name	Material number	Document
SK BRE4-1-100-100	275273005	TI275273005
SK BRE4-1-200-100	275273008	TI275273008
SK BRE4-1-400-100	275273012	TI275273012
SK BRE4-2-100-200	275273105	TI275273105
SK BRE4-2-200-200	275273108	TI275273108
SK BRE4-3-050-450	275273201	TI275273201
SK BRE4-3-100-450	275273205	TI275273205

External brake resistors for wall-mounted frequency inverters

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

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

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

Name	Material number	Document
SK BRW4-1-100-100	275273305	TI275273305
SK BRW4-1-200-100	275273308	TI275273308
SK BRW4-1-400-100	275273312	TI275273312
SK BRW4-2-100-200	275273405	TI275273405
SK BRW4-2-200-200	275273408	TI275273408
SK BRW4-2-400-200	275273412	TI275273412
SK BRW4-3-100-450	275273505	TI275273505
SK BREW4-1-100-100	275273605	TI275273605
SK BREW4-1-200-100	275273608	TI275273608
SK BREW4-1-400-100	275273612	TI275273612
SK BREW4-2-100-200	275273705	TI275273705
SK BREW4-2-200-200	275273708	TI275273708
SK BREW4-2-400-200	275273712	TI275273712



Information

Braking resistor

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

2.3.3 Brake resistor assignments

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

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

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

Table 7: Assignment of brake resistors to frequency inverter

2.4 Electrical Connection

WARNING

Electric shock

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

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

WARNING

SK 2x0E only: Hazardous voltage at the U, V and W contacts

Touching the contacts may cause an electric shock.

WARNING

SK 2x5E only: Hazardous voltage at the TF+, TF-, MB+, MB-, U, V and W contacts

Touching the contacts may cause an electric shock.

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

NOTICE

Device failure due to increased input current

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

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



Information

Temperature sensor and PTC resistor (TF)

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

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

Observe the notes on long-term storage in Chapter 9.1 "Maintenance information

".

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

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

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

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

	Connecting terminals for
(1)	Power cable Motor cable Brake resistance lines
(2)	Control lines Electromechanical brake PTC (TF) of motor
(3)	PE



2.4.1 Wiring guidelines

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

1. Ensure that all devices are securely earthed to a common earthing point or earthing rail using short earthing cables with a large cross-section. It is especially important that each control unit which is connected to the electronic drive technology (e.g. an automatic device) has a short cable with a large cross-section, which is connected to the same earthing point as the device itself. Flat cables (e.g. metal clamps) are preferable, as they have a lower impedance at high frequencies.
2. The bonding cable of the motor controlled by the soft starter should be connected directly to the earthing terminal of the associated device. The presence of a central earthing bar in the control cabinet and the grouping together of all bonding conductors to this bar normally ensures safe operation.
3. Where possible, shielded cables should be used for control circuits. The shielding at the cable end should be carefully sealed and it must be ensured that the wires are not laid over longer distances without shielding.
The shielding of analogue setpoint cables should only be earthed on one side on the device.
4. Control cables should be installed as far as possible from power cables, using separate cable ducts, etc. Where cables cross, an angle of 90° should be ensured as far as possible.
5. Ensure that the contactors in the cabinet are interference protected, either by RC circuits in the case of AC contactors or by free-wheeling diodes for DC contactors, for which **the interference suppressors must be positioned on the contactor coils**. Varistors for over-voltage limitation are also effective.
6. Shielded or armoured cables should be used for the load connections (motor cable if necessary). The shielding or armouring must be earthed at both ends. The earthing should be provided directly to the PE of the device if possible.

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

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

NOTICE!

Damage due to high voltage

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

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



Information

Looping through the mains voltage

When looping through the mains voltage, the permissible current load of the connection terminals, plugs and feeders must be observed. Non-observance may lead to thermal damage to live modules and their immediate surroundings, for example.

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

2.4.2 Electrical connection of power unit

NOTICE

EMC interference to the environment

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

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

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

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

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

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



Information

Connection cables

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

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

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

Table 8: Connection data

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

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

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

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

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

Adaptation to IT networks – (from size 1)

WARNING

Unexpected movement in case of mains faults

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

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

NOTICE

IT network operation

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

- Connect a braking resistor to dissipate excess energy.

Note: The following applies up to firmware version V3.1 R0: When the “Safe Torque Off” (STO) state is active, the excess energy cannot be dissipated. In this case, the frequency inverter has no self-protection.

- Ensure that the frequency inverter control unit is ready for operation when necessary:
 - If a device with an integrated power supply (**SK 2x0E**) is used, the internal control and therefore all monitoring functions switch on automatically.
 - If a device without an integrated power supply (**SK 2x5E**) is used, the 24 V supply of the device must be switched on before the mains voltage is switched on. The 24 V supply to the device must only be switched off after the device has been disconnected from the mains voltage.
- Despite connection of the braking resistor, the error message “*Overvoltage Ud*” may occur. The use of the braking resistor to dissipate the charging prevents the destruction/damage of the device.

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

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

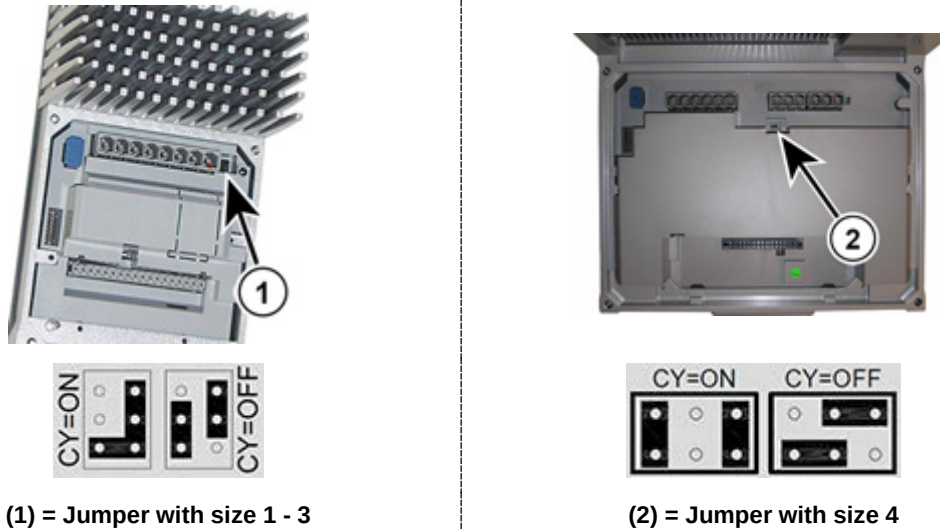


Figure 16: Jumpers for mains adaptation

Adaptation to HRG networks – (from size 1)

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

Use with differing supply networks or network types

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

2.4.2.2 Motor cable

The U, V, W and PE terminals are intended for connection of the motor cable. The motor cable may have a **total length of 25 m** if it is a standard cable type (observe EMC). If a shielded motor cable is used or if the cable is installed in a metallic and well-grounded duct, the total length should not exceed **5 m** (connect cable shield to PE at both ends).

NOTICE!

Output switching

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

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

Information

Multi-motor operation

Multi-motor operation is the parallel control of several asynchronous motors (ASM) by a frequency inverter.

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

For multi-motor operation, the total motor cable length is made up of the sum of the individual motor cable lengths.

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

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

CAUTION

Hot surfaces

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

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

2.4.2.4 Electromechanical brake

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

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

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

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

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

Information

Parameter P107/P114

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

Activate the brake monitoring in parameter **P539**. In case of a short circuit, this prevents the motor from rotating against the applied brake and from heating up impermissibly.

2.4.3 Electrical connection of the control unit

Connection data:

Terminal block		Sizes 1–4	Size 4
		Typical	Terminals 79/ 80
Ø cable*	[mm²]	0.2 ... 2.5	0.2 ... 4
AWG standardisation		24-14	24-12
Tightening torque	[Nm]	0.5 ... 0.6	0.5 ... 0.6
	[lb-in]	4.42 ... 5.31	4.42 ... 5.31
Slotted screwdriver	[mm]	3.5	3.5

* Flexible cable with electric wire ferrules (with or **without** plastic collar) or rigid cable

SK 2x0E

The device generates its own 24 V DC control voltage and provides it at terminal 43 (for example for connection of external sensors).

Devices of size 4, however, can also be supplied via an external control voltage source (connection to terminal 44). Switching between internal and external power supply takes place automatically.

SK 2x5E

The device must be supplied with external 24 V DC control voltage. Alternatively, an optional 24 V DC power supply of type SK CU4-... or SK TU4-... can be used.

For devices that use the AS-Interface (SK 225E and SK 235E), the control voltage must be supplied via the yellow AS-Interface cable. In this case, however, the frequency inverter must not be additionally supplied via terminal 44 in order to prevent damage to the power supply or the ASi bus.

Information

Control voltage overload

An overload of the control unit by impermissibly high currents may destroy it. Impermissibly high currents occur when the actual total current exceeds the permissible total current or when the 24 V DC control voltage for other devices is conducted through the frequency inverter. To prevent any conduction, double electric wire ferrules must be used, for example.

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

Information

Total currents

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

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

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

Information

Response time of digital inputs

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

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

A parallel channel exists for each of the digital inputs DIN2 and DIN3 that passes the pulses between 250 Hz and 205 kHz directly to the processor, thus enabling encoder evaluation.

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.

Details on control terminals

Labelling, function

SH:	Function: Safe stop	DOUT:	Digital output
ASI+/-:	Integrated AS-Interface	24 V	'Safe stop' input
		SH:	
24 V:	24 V DC control voltage	0 V SH:	'Safe stop' reference potential
10 V REF:	10 V DC reference voltage for AIN	AIN +/-:	Analogue input
AGND:	Reference potential of analogue signals	SYS	System bus
		H/L:	
GND:	Reference potential for digital signals	MB+/-:	Electromechanical brake control
DIN:	Digital input	TF+/-:	PTC resistor connection of the motor

Connections depending on configuration level

You can find detailed information on **functional safety** (safe stop) in the supplementary [BU0230](#) manual.

Please also note the supplementary instructions on the **PROFIsafe bus interface** in the supplementary [BU2800](#) manual.

Sizes 1 ... 3

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

1 When using the AS-Interface, terminal 44 provides an output voltage (26.5 V DC ... 31.6 V DC, max. 60 mA). In this case, no voltage source may be connected to this terminal!

2 Max. load at DOUT for SK 2x0E: 20 mA

3 Max. load at DOUT for SK 2x5E: 200 mA

Size 4

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

Meaning, Functions		Description / Technical data		
Terminal			Parameter	
No.	Designation	Meaning	No.	Function of factory setting
Digital outputs		Signalling of device operating statuses		
		24 V DC With inductive loads: Provide protection via free-wheeling diode!	Maximum load 20 mA	
1	DOUT1	Digital output 1	P434 [-01]	Fault
3	DOUT2	Digital output 2	P434 [-02]	Fault
Notes:				
Size 4: Max. load 50 mA				
SK 2x5E: Voltage level depending on input voltage level (18 – 30 V DC)				
Analogue inputs		Actuation of device by external controller, potentiometer or the like.		
		Resolution 12Bit U= 0 ...10 V, R _i =30 kΩ I= 0/4 ... 20 mA Burden resistance (250 Ω) via DIP switch AIN1/2 Maximum permissible voltage at analogue input: 30 V DC	Matching of the analogue signals is performed via P402 and P403. +10 V Reference voltage: 5 mA not short-circuit resistant	
11	10V REF	+10 V Reference voltage	-	-
14	AIN1+	Analogue input 1	P400 [-01]	Setpoint frequency
16	AIN2+	Analogue input 2	P400 [-02]	No function
40	GND	Reference potential GND	-	-
NOTICE: SK 200E and SK 210E: Terminal 12 must be used instead of terminal 40 (AGND/0V)				
Digital inputs		Actuation of device via an external controller, switch or the like, connection of HTL transmitter (DIN2 and DIN3 only)		
		as per EN 61131-2, type 1 Low: 0-5 V (~ 9.5 kΩ) High: 15-30 V (~ 2.5 - 3.5 kΩ) Scan time: 1 ms Reaction time: 4 - 5 ms	Input capacitance 10 nF (DIN1, DIN 4) 1.2 nF (DIN 2, DIN 3) DIN 2 and DIN 3 double allocation Min.: 250 Hz, Max.: 205 kHz	
21	DIN1	Digital input 1	P420 [-01]	ON right
22	DIN2	Digital input 2	P420 [-02]	ON left
23	DIN3	Digital input 3	P420 [-03]	Fixed frequency 1 (→ P465[-01])
24	DIN4	Digital input 4	P420 [-04]	Fixed frequency 2 (→ P465[-02])
PTC resistor input		Monitoring of motor temperature using PTC		
		If the device is installed near the motor, a shielded cable must be used.	The input is always active. In order to make the device operational, a temperature sensor must be connected or both contacts must be jumpered.	
38	TF+	PTC resistor input	-	-
39	TF-	PTC resistor input	-	-

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

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

Note: Size 4: Max. load 500 mA

Control voltage connection		Supply voltage for the device		
		24 V DC $\pm 25\%$ (sizes 1 – 3) 24 V DC $\pm 25\%$ (size 4) 200 mA ... 800 mA, depending on the load on inputs and outputs and use of options	Size 4: Automatic switching between terminal 44 and internal power supply unit if connected control voltage is insufficient. If AS-Interface is used: Do not connect a voltage source! Output voltage: 26.5 V – 31.6 V, ≤ 60 mA	
44	24 V	Input voltage	-	-
40	GND / 0V	Reference potential GND	-	-

System bus		NORD-specific bus system for communicating with other devices (e.g. smart option modules or frequency inverter)		
		Up to four frequency inverters (SK 2xxE, SK 1x0E) can be operated on a single system bus.	→ Address = 32 / 34 / 36 / 38	
77	SYS H	System bus+	P509/P510	Control terminals / Auto
78	SYS L	System bus-	P514/P515	250 kBaud / Address 32

System bus terminating resistor		Termination at the physical ends of the bus system		
		The correct setting of the terminating resistors must be checked before commissioning. (1x at the beginning and 1x at the end of a system bus connection)		
S2				Factory setting "ON" (For deviating factory setting, see explanation above)

Brake actuation		Connection and actuation of an electromechanical brake. The device generates an output voltage for this. This depends on the mains voltage. The assignment of the correct brake coil voltage must be taken into account in the selection.		
		Connected loads: 📖 Section 2.4.2.4 "Electromechanical brake" Current: ≤ 500 mA	Permissible switching cycle time: to 150 Nm ≤ 1 /s to 250 Nm ≤ 0.5 /s	
79	MB+	Brake control	P107/P114	0 / 0
80	MB-	Brake control		

INFORMATION

SK 2x0E, size 4: ≤ 600 mA

This function is identical to **P434 = 1**

AS-Interface		Control of the device via the simple field bus level: Actuator-sensor interface		
		26.5–31.6 V SK 220E and SK 230E: ≤ 25 mA SK 225E and SK 235E: ≤ 290 mA, of which a maximum of 60 mA is required for supplying external actuators	Only yellow AS-Interface cable can be used; auxiliary voltage supply via black cable is not possible. Configuration via DIP switches S1:4 and 5	
84	ASI+	ASI+	P480 ...	-
85	ASI-	ASI-	P483	-
Functional Safety "Safe Stop"		Fail-safe input		
		Details: BU0230, "Technical data"	The input is always active. In order to make the device ready for operation, this input must be provided with the required voltage.	
89	VI/24V SH	24 V input	-	-
88	VI/0V SH	Reference potential	-	-
Communication interface		Connection of the FI to various communication tools		
		24 VDC ± 20%	RS485 (for connecting a parametrisation box) 9600 ... 38400 Baud Terminating resistor (1 kΩ) fixed RS232 (for connection to a PC (NORDCON)) 9600 ... 38400 Baud	
1	RS485 A+	Data cable RS485	P502 ...	 1 - 2 - 3 - 4 - 5 - 6
2	RS485 B-	Data cable RS485	P513 [-02]	
3	GND	Bus signal reference potential		
4	RS232 TXD	Data cable RS232		
5	RS232 RXD	Data cable RS232		
6	+24 V	Voltage output		

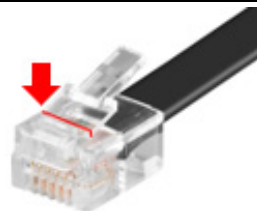
Make sure that the diagnostic connection is sealed with the transparent screw cap (diagnostic glass) when not in use. This is the only way to ensure that the device achieves the specified protection class.

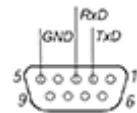
Information

Use RJ12 plugs without latching tab

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

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



Connection cables (accessories / optional)	Connection of the device to an MS-Windows® PC with NORDCON software		
	Length: approx. 3.0 m + approx. 0.5 m Part number: 275274604 Suitable for connection to a USB port in a PC or alternatively to a SUB-D9 connection. Details: T1275274604		

2.4.3.1 SK xU4-24V-... power supply – connection example

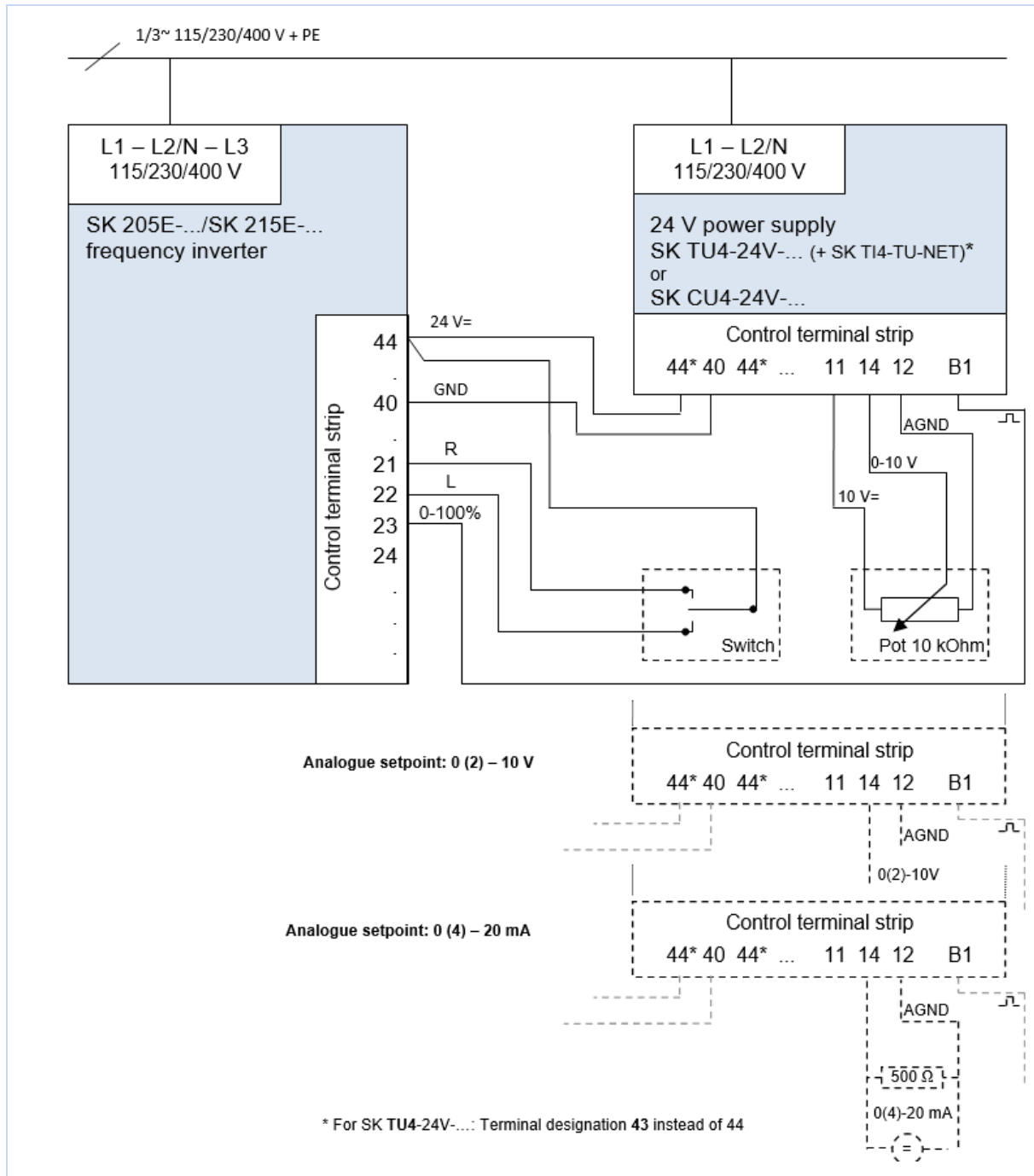


Figure 17: Connection example: SK xU4-24V-... power supply

Setting (S1):
(DIP switch)

DIP3 = off, DIP4 = on, DIP5 = off (chapter 4.3.2.2)

(Can only be used for 0–10 V or 0–20 mA signals!)

or

Recommended
parameter setting,
S1: DIP1-8 = off

P400 [07] = 1	P420 [02] = 2
P420 [01] = 1	P420 [03] = 26 (for 0–10 V / 0–20 mA signals)
	27 (for 2–10 V / 4–20 mA signals)

With device variants **SK 2x0E** a mains unit is integrated, meaning that no external 24 V DC is required. For *Sizes 1 – 3*, connection of an external power source (e.g. mains unit SK xU4-24V-...) is not intended. No connection terminals are provided for this. *Size 4* is equipped with the relevant connection terminals and enables connection of an external power source (📖 Section 2.4.3 "Electrical connection of the control unit").

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

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

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

2.5 Encoder

Each frequency inverter is equipped with a CANopen interface and an interface to which an HTL encoder can be connected. For position control, both interfaces can be independently selected in the various parameter sets of the frequency inverter, and can therefore be assigned to two different drive axes.

2.5.1 Incremental encoders

Depending on the resolution (pulse number), incremental encoders generate a defined number of pulses per revolution of the encoder shaft (track A / track A inverse). This way, the precise speed of the incremental encoder or the motor mounted to it can be measured by the frequency inverter. By using a second track (B / B inverse) that is offset by 90° ($\frac{1}{4}$ period), the direction of rotation can also be determined.

The resolution can be between 500 and 8192 increments (setting via **P301**). For cable lengths > 20 m and motor speeds above 1500 rpm, the resolution of the incremental encoder used should be a maximum of 2048 increments.

The supply voltage for the encoder is usually 10 ... 30 V DC (note the technical data of the incremental encoder). An external source or the frequency inverter's internal voltage (depends on the model) can be used as the voltage source.

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

The incremental encoder's maximum current consumption must not exceed 150 mA.

In order to be able to use the encoder, at least the resolution and direction of rotation of the encoder (**P301**) must be parameterised.



Information

Incremental encoder data sheet

For deviations from the standard equipment for motors (encoder type 5820.0H30, 10 ... 30 V encoder, HTL), please note the data sheet enclosed with the delivery or consult your supplier.



Information

Direction of rotation

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



Information

Double assignment of DIN 2 and DIN 3

The digital inputs DIN 2 and DIN 3 are used for two different functions:

1. For the parameterisable digital functions (e.g. "Enable left")
2. For the evaluation of an incremental encoder

Both functions are coupled by an "OR" link.

Evaluation of an incremental encoder is always activated. This means that if an incremental encoder is connected, it must be ensured that the digital functions are disabled (parameters **P420 [-02] = 0** and **P420 [-03] = 0**).

HTL incremental encoder

The frequency inverter's digital inputs are used to connect an incremental encoder with HTL signal. The digital inputs used must be parameterised accordingly.



Information

Encoder signal faults

Unrequired wires (e.g. track A inverse/B inverse) must be insulated. Otherwise, if these wires come into contact with each other or the cable shield, short circuits may occur, which can cause encoder signal faults or encoder damage.

Function	Cable colours ¹	Connection terminals	Terminal designation	Note
10 ... 30 V supply ²	Brown/Green	43/(44)	24 V (VO)	-
0 V supply	White/Green	40	0 V (GND)	-
Track A	Brown	22	DIN2	P420 [-02] = 0
Track A inverse	Green	-	-	
Track B	Grey	23	DIN3	P420 [-03] = 0
Track B inverse	Pink	-	-	
Track 0	Red	21	DIN1	P420 [-01] = 42 or P420 [-01] = 43
Cable shield	Connect to the shield bracket of the optional EMC kit over a large surface area.			

1 The cable colours depend on the encoder type.

2 The voltage range depends on the encoder type.

Table 9: Encoder colour and contact assignment – HTL (SK 2xxE)

2.5.2 Absolute encoders

Absolute encoders are required for position detection (positioning). For more detailed information, please refer to the POSICON manual BU0210.

2.6 Operation in potentially explosive environments

WARNING

Explosion hazard due to electricity

Sparks caused by electricity may ignite an explosive atmosphere.



- Do not open the device in an explosive atmosphere and do not remove any covers (e.g. diagnostic openings).
- All work on the device must only be carried out with the system in **de-energised state**.
- Observe the waiting period after switch-off (≥ 30 minutes).
- Before starting work, use suitable measuring equipment to check that all relevant components (voltage source, connecting cables, connection terminals of the device) are voltage-free.

WARNING

Explosion hazard due to high temperatures

High temperatures may cause the ignition of an explosive atmosphere.



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

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

WARNING

Explosion hazard due to electrostatic charge



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

The housing cover is made of plastic. It may become electrostatically charged, for example due to a particle flow caused by the fan.

- Avoid air movements or air currents at the operating site of the device.

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

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

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

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

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

2.6.1.1 Modification of the device for compliance with category 3D

Only a specially modified device is permitted for operation in ATEX zone 22. This adjustment is exclusively made at the NORD site. In order to use the device in the ATEX zone 22, the diagnostic caps are replaced with anodised oil inspection glasses, among other things.



(1) Year of manufacture

(2) Labelling of the device (ATEX)

IP55:



II 3D Ex tc IIIB T125 °C Dc X

IP66:



II 3D Ex tc IIIC T125 °C Dc X

Assignment:

- Protected by a "housing"
- Method "A" Zone "22" Category 3D
- Protection class IP55/IP66 (depending on the device)
→ IP66 required for conductive dust
- Maximum surface temperature 125 °C
- Ambient temperature -20 °C to +40 °C



Information

Possible damage caused by mechanical overload

Devices of the SK 2xxE series and the approved options are only designed for a degree of mechanical load which corresponds to a low impact energy of 4J.

Higher loads result in damages to or in the device.

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

2.6.1.2 Options for ATEX Zone 22, category 3D

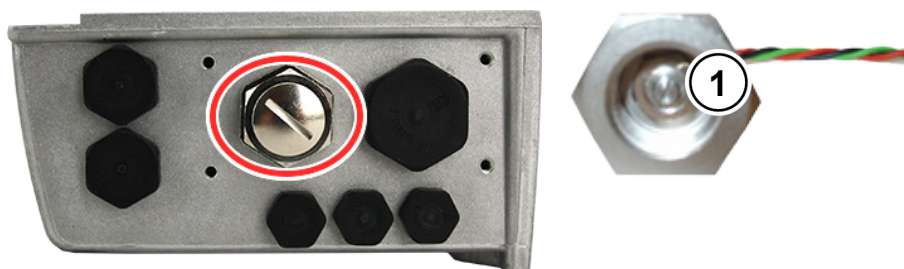
In order to ensure that the device is ATEX-compliant, its optional modules must also be approved for potentially explosive areas. Option modules that are not in the following list may **not** be used in an ATEX zone 22 3D. This also includes connectors and switches that may also not be used in such an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

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

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

SK ATX-POT

The Category 3D frequency inverter can be equipped with an ATEX-compliant 10 kΩ potentiometer (SK ATX-POT), which can be used to setpoint (e.g. speed) adjustment on the device. The potentiometer is used with an M20-M25 extension in one of the M25 cable glands. The selected setpoint can be adjusted with a screwdriver. Due to the detachable screw closing cap, this component complies with ATEX requirements. Permanent operation may only be carried out with the cap closed.



1 Setting adjustment using a screwdriver

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

Information

Internal “SK BRI4-...” braking resistor

If an internal “SK BRI4-x-xxx-xxx” braking resistor is used, its power limitation must be activated in any case (see Section 2.3.1 “Internal brake resistor SK BRI4-...”). Only the resistors assigned to the respective inverter type may be used.

2.6.1.3 Maximum output voltage and torque reduction

As the maximum possible output voltage depends on the pulse frequency to be set, the torque specified in document [B1091-1](#) must be reduced for values above the nominal pulse frequency of 6 kHz.

For $F_{\text{pulse}} > 6 \text{ kHz}$, the following applies: $T_{\text{Reduction}}[\%] = 1\% * (F_{\text{pulse}} - 6 \text{ kHz})$

The maximum torque must therefore be reduced by 1% per kHz pulse frequency above 6 kHz. The torque limitation must be taken into account upon reaching the break frequency. The same applies to the modulation depth (P218). With a factory setting of 100%, a torque reduction of 5% must be taken into account in the field weakening range:

For $P218 > 100\%$, the following applies: $T_{\text{Reduction}}[\%] = 1\% * (105 - P218)$

No reduction needs to be taken into account for values above 105%. Values above 105%, however, will not result in a torque increase compared to the planning guideline. Modulation depths $> 100\%$ may lead to oscillation and vibrating motor operation due to increased harmonics.

Information

Power derating

For pulse frequencies above 6 kHz (400 V devices) or 8 kHz (230 V devices), power derating must be taken into account when designing the drive.

If parameter (P218) $< 105\%$ is set, derating must be noted for the modulation depth in the field weakening range.

2.6.1.4 Commissioning information

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

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

In addition, care must be taken that a NORD motor from the motor list (P200) is set. If a standard 4-pole NORD motor or a motor from a different manufacturer is not used, the data for the motor parameters ((P201) to (P208)) must be adjusted to those on the motor rating plate. *The stator resistance of the motor (see P208) must be measured by the inverter and at ambient temperature. In order to do this, parameter P220 must be set to "1".* In addition, the frequency inverter must be parameterised so that the motor can be operated with a maximum speed of 3000 rpm. For a four-pole motor, the "maximum frequency" must be set to a value which is smaller or equal to 100 Hz ((P105) ≤ 100). Here the maximum permissible output speed of the gear unit must be observed. In addition, the monitoring "I²t-Motor" (Parameter (P535) / (P533)) must be switched on and the pulse frequency set to between 4 kHz and 6 kHz.

Overview of required parameter settings:

Parameter	Setting value	Factory setting	Description
P105 Maximum frequency	≤ 100 Hz	[50]	This value relates to a 4-pole motor. On principle, the value must only be so large that a motor speed of 3000 rpm is not exceeded.
P200 Motor list	Select appropriate motor power	[0]	If a 4-pole NORD motor is used, the pre-set motor data can be called up.
P201 – P208 Motor data	Data according to rating plate	[xxx]	If a 4-pole NORD motor is not used, the motor data on the rating plate must be entered here.
P218 Degree of modulation	$\geq 100\%$	[100]	Determines the maximum possible output voltage
P220 Parameter identification	1	[0]	Measures the stator resistance of the motor. When the measurement is complete, the parameter is automatically reset to "0". The value that is determined is written to P208
P504 Pulse frequency	4 kHz ... 6 kHz	[6]	For pulse frequencies above 6 kHz a reduction of the maximum torque is necessary.
P533 Factor I ² t-Motor	< 100%	[100]	A reduction in torque can be taken into account with values less than 100 in the I ² t monitoring.
P535 I ² t motor	According to motor and ventilation	[0]	The I ² t- monitoring of the motor must be switched on. The set values depend on the type of ventilation and the motor used. See B1091-1

2.6.1.5 EU conformity declaration - ATEX

GETRIEBEBAU NORD

Member of the NORD DRIVESYSTEMS Group



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C432710_1121

EU Declaration of Conformity

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

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

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

with ATEX labeling  **II 3D Ex tc IIIB T125°C Dc X** (in IP55) or
 **II 3D Ex tc IIIC T125°C Dc X** (in IP66)

comply with the following regulations:

ATEX Directive for products	2014/34/EU	OJ. L 96 of 29.3.2014, p. 309–356
EMC Directive	2014/30/EU	OJ. L 96 of 29.3.2014, p. 79–106
Ecodesign Directive	2009/125/EG	OJ. L 285 of 31.10.2009, p. 10–35
Regulation (EU) Ecodesign	2019/1781	OJ. L 272 of 25.10.2019, p. 74–94
RoHS Directive	2011/65/EU	OJ. L 174 of 1.7.2011, p. 88–11
Delegated Directive (EU)	2015/863	OJ. L 137 of 4.6.2015, p. 10–12

Applied standards:

EN 60079-0:2018	EN 60079-31:2014	EN 61800-9-1:2017
EN 61800-5-1:2007+A1:2017	EN 61800-3:2018	EN 61800-9-2:2017
EN 60529:1991+A1:2000+A2:2013+AC:2016	EN 63000:2018	

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

First marking was carried out in 2010.

Bargteheide, 17.03.2021



U. Küchenmeister
Managing Director



pp F. Wiedemann
Head of Inverter Division

Page 1 of 1

2.6.2 Operation in potentially explosive environments - EAC Ex

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

2.6.2.1 Modification of the device

 Section 2.6.1.1 applies.

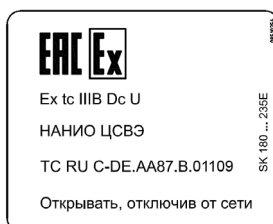
The labelling of the device according to EAC Ex differs as follows.

Labelling of the device:

The following applies for wall mounted devices;

IP55: Ex tc IIIB T125 °C Dc X

IP66: Ex tc IIIC T125 °C Dc X



The following applies for motor mounted devices;

IP55: Ex tc IIIB Dc U

IP66: Ex tc IIIC Dc U

Categorisation:

- Protection with "housing"
- Procedure "A" Zone "22" Category 3D
- Protection class IP55 / IP66 (depending on the device)
→ IP66 is required for conductive dust
- Maximum surface temperature 125 °C
- Ambient temperature -20 °C to +40 °C

Information

"U" label

The "U" label applies to devices which are intended for motor mounting. Devices labelled like this are considered to be incomplete and may only be operated in combination with a corresponding motor. If a device labelled "U" is mounted on a motor, the labels and restrictions on the motor or the geared motor also apply.

Information

"X" label

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

2.6.2.2 Further Information

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

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

2.6.2.3 EAC Ex certificate

TC RU C-DE.AA87.B.01109

2.7 Outdoor installation

For outdoor installation of the device and technology units, the following requirements must be met:

- IP66 design (with UV-resistant blind plugs, see special measures, Section 1.9 "Version in protection class IP55, IP66")
- Anodised oil inspection glasses (part number: 201114000), quantity: 3
- Cover device to ensure protection against direct weather influences (rain/sun)
- Accessories used (e.g. plug connectors), also at least IP66



Information

Older types of devices

If older types of devices (year of manufacture 2010 and older) are to be subsequently installed outdoors, it may be necessary to replace the housing cover with a UV-resistant version. Please contact the Getriebebau NORD service department.

3 Display, operation and options

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

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



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



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

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



Information

Diagnostic caps' tightening torques

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

3.1 Control and parametrisation options

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

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

Designation		Part number	Document
Switch and potentiometer (attachment)			
SK CU4-POT	Switch/potentiometer	275271207	 Section 3.2.4 "Potentiometer adapter, SK CU4-POT"
SK TIE4-POT	Potentiometer 0-10 V	275274700	TI275274700
SK TIE4-SWT	"L-OFF-R" switch	275274701	TI275274701
Control and parameterisation units (handheld)			
SK CSX-3H	SimpleBox	275281013	BU0040
SK PAR-5H	ParameterBox	275281614	BU0040

Connection of a control and parameterisation unit

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



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

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

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



Information

Diagnostic caps' tightening torques

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

3.1.1 Connection of multiple devices to one parameterisation tool

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

1. Physical bus structure

Establish a CAN connection (system bus) between the devices

2. Parameterisation

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

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

Conditions / Restrictions:

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

3.2 Optional modules

By using function-enhancing modules or modules for display, control and parameterisation, the device can be conveniently adapted to a wide range of applications.

Alpha-numeric display and control modules can be used for commissioning and parameter adaptation (📖 Section 3.1 "Control and parameterisation options").

For more complex tasks, software-based solutions are available.

Software	Description	Required accessories	Part number
NORDCON APP	Free control and parameterisation software for mobile terminal devices, available for iOS and Android, communication and Bluetooth	NORDAC ACCESS BT (SK TIE5-BT-STICK)	275900120
NORDCON	Free control and parameterisation software for Windows PC	Connection cable	275274604

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

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



Figure 20: internal customer units SK CU4 ... example

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

3 Display, operation and options

Designation ¹		Part number	Document
Bus interfaces			
SK CU4-ETH(-C) ²	Industrial Ethernet	275271027 / (275271527)	TI275271027 / (TI275271527)
SK CU4-CAO(-C)	CANopen	275271001 / (275271501)	TI275271001 / (TI275271501)
SK CU4-DEV(-C) ³	DeviceNet	275271002 / (275271502)	TI275271002 / (TI275271502)
SK CU4-ECT(-C) ³	EtherCAT	275271017 / (275271517)	TI275271017 / (TI275271517)
SK CU4-EIP(-C) ³	EtherNet/IP	275271019 / (275271519)	TI275271019 / (TI275271519)
SK CU4-PBR(-C) ³	PROFIBUS DP	275271000 / (275271500)	TI275271000 / (TI275271500)
SK CU4-PNT(-C) ³	PROFINET IO	275271015 / (275271515)	TI275271015 / (TI275271515)
SK CU4-POL(-C) ³	POWERLINK	275271018 / (275271518)	TI275271018 / (TI275271518)
IO extensions			
SK CU4-IOE(-C)		275271006 / (275271506)	TI275271006 / (TI275271506)
SK CU4-IOE2(-C) ³		275271007 / (275271507)	TI275271007 / (TI275271507)
SK CU4-REL(-C)		275271011 / (275271511)	TI275271011 / (TI275271511)
Power supplies			
SK CU4-24V-123-B(-C)		275271108 / (275271608)	TI275271108 / (TI275271608)
SK CU4-24V-140-B(-C)		275271109 / (275271609)	TI275271109 / (TI275271609)
Other			
SK CU4-FUSE(-C)	Fuse module	275271122 / (275271622)	TI275271122 / (TI275271622)
SK CU4-MBR(-C)	El. brake rectifier	275271010 / (275271510)	TI275271010 / (TI275271510)
SK CU4-SSR(-C)	Solid state relay	275271124 / (275271624)	TI275271124 / (TI275271624)
SK CU4-SSR-400(-C)	Solid state relay	275271128 / (275271628)	TI275271128 / (TI275271628)
SK CU4-PD1(-C)	Power discharger	275271025 / (275271525)	TI275271025 / (TI275271525)

¹ All modules labelled **-C** have varnished PCBs so that they can be used in IP6x devices.

² Dialects that can be set: EtherCAT, EtherNet/IP, PROFINET IO

³ In the discontinuation process. Not compatible with devices using firmware version ≥ 3.0 R0.

3.2.2 External technology units SK TU4-... (module attachment)

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

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

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



Figure 21: external technology units SK TU4-... (example)

With the bus modules or the I/O extension, it is possible to access the system bus via the RJ12 socket, which is located behind a transparent screwed cable gland (diagnostics glass). All active devices connected to the system bus (frequency inverters, additional SK xU4 modules) can thus be accessed via ParameterBox (SK PAR-5H) or the Windows-based NORDCON software.

The bus modules require a 24 V supply voltage. If the supply voltage is applied, the bus modules are also ready when the frequency inverter is not operating.

3 Display, operation and options

Type	IP55	IP66	M12	Designation	Part number	Document
Industrial Ethernet (dialects that can be set: EtherCAT, EtherNet / IP, PROFINET IO)	X			SK TU4-ETH	275 281 132	TI275281132
		X		SK TU4-ETH-C	275 281 182	TI275281182
	X		X	SK TU4-ETH-M12	275 281 233	TI275281233
		X	X	SK TU4-ETH-M12-C	275 281 283	TI275281283
CANopen	X			SK TU4-CAO	275 281 101	TI275281101
		X		SK TU4-CAO-C	275 281 151	TI275281151
	X		X	SK TU4-CAO-M12	275 281 201	TI275281201
		X	X	SK TU4-CAO-M12-C	275 281 251	TI275281251
DeviceNet	X			SK TU4-DEV ¹	275 281 102	TI275281102
		X		SK TU4-DEV-C ¹	275 281 152	TI275281152
	X		X	SK TU4-DEV-M12 ¹	275 281 202	TI275281202
		X	X	SK TU4-DEV-M12-C ¹	275 281 252	TI275281252
EtherCAT	X			SK TU4-ECT ¹	275 281 117	TI275281117
		X		SK TU4-ECT-C ¹	275 281 167	TI275281167
EtherNet/IP	X		X	SK TU4-EIP ¹	275 281 119	TI275281119
		X	X	SK TU4-EIP-C ¹	275 281 169	TI275281169
POWERLINK	X			SK TU4-POL ¹	275 281 118	TI275281118
		X		SK TU4-POL-C ¹	275 281 168	TI275281168
PROFIBUS DP	X			SK TU4-PBR ¹	275 281 100	TI275281100
		X		SK TU4-PBR-C ¹	275 281 150	TI275281150
	X		X	SK TU4-PBR-M12 ¹	275 281 200	TI275281200
		X	X	SK TU4-PBR-M12-C ¹	275 281 250	TI275281250
PROFINET IO	X			SK TU4-PNT ¹	275 281 115	TI275281115
		X		SK TU4-PNT-C ¹	275 281 165	TI275281165
	X		X	SK TU4-PNT-M12 ¹	275 281 122	TI275281122
		X	X	SK TU4-PNT-M12-C ¹	275 281 172	TI275281172
PROFIsafe	X			SK TU4-PNS ¹	275 281 116	TI275281116
		X		SK TU4-PNS-C ¹	275 281 166	TI275281166
	X		X	SK TU4-PNS-M12 ¹	275 281 216	TI275281216
		X	X	SK TU4-PNS-M12-C ¹	275 281 266	TI275281266
I/O extension	X			SK TU4-IOE	275 281 106	TI275281106
		X		SK TU4-IOE-C	275 281 156	TI275281156
	X		X	SK TU4-IOE-M12	275 281 206	TI275281206
		X	X	SK TU4-IOE-M12-C	275 281 256	TI275281256
Required accessories (each module requires a corresponding adapter unit)						
Adapter unit	X			SK TI4-TU-BUS	275 280 000	TI275280000
		X		SK TI4-TU-BUS-C	275 280 500	TI275280500
Optional accessories						
Wall-mounting kit	X	X		SK TIE4-WMK-TU	275 274 002	TI275274002

¹ In the discontinuation process. Not compatible with devices using firmware version > 3.0 R0.

Table 10: External bus modules and IO extensions SK TU4- ...

Type	IP55	IP66	Designation	Part Number	Document
Power supply 24V / 1~ 230V	X		SK TU4-24V-123-B	275 281 108	TI275281108
		X	SK TU4-24V-123-B-C	275 281 158	TI275281158
Power supply 24V / 1~ 400V	X		SK TU4-24V-140-B	275 281 109	TI275281109
		X	SK TU4-24V-140-B-C	275 281 159	TI275281159
PotentiometerBox 1~ 230V	X		SK TU4-POT-123-B	275 281 110	TI275281110
		X	SK TU4-POT-123-B-C	275 281 160	TI275281160
PotentiometerBox 1~ 400V	X		SK TU4-POT-140-B	275 281 111	TI275281111
		X	SK TU4-POT-140-B-C	275 281 161	TI275281161
Required accessories (each module must have an associated connection unit)					
Connection unit	X		SK TI4-TU-NET	275 280 100	TI275280100
		X	SK TI4-TU-NET-C	275 280 600	TI275280600
Optional accessories					
Wall-mounting kit	X	X	SK TIE4-WMK-TU	275 274 002	TI275274002

Table 11: external modules with power supply SK TU4-24V- ... / SK TU4-POT- ...

Type	IP55	IP66	Designation	Part number	Document
Maintenance switch	X		SK TU4-MSW	275 281 123	TI275281123
		X	SK TU4-MSW-C	275 281 173	TI275281173
Required accessories (each module requires a corresponding adapter unit)					
Adapter unit	X		SK TI4-TU-MSW	275 280 200	TI275280200
		X	SK TI4-TU-MSW-C	275 280 700	TI275280700
Optional accessories					
Wall-mounting kit	X	X	SK TIE4-WMK-TU	275 274 002	TI275274002

Table 12: external modules – maintenance switch SK TU4-MSW- ...

3.2.3 plug connectors

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

3.2.3.1 Plug connectors for power connections

Various connectors are available for the motor or mains connection.



Figure 22: Examples of devices with connectors for connecting the power

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

Mounting version	Meaning
... - LE	Power input
... - LA	Power output
... - MA	Motor output

Connector (selection)

Type	Data	Designation	Material no.	Document
Power input	500 V, 16 A	SK TIE4-HANQ8-K-LE-MX	275 135 030	TI275135030
Power input	500 V, 16 A	SK TIE4-HAN10E-M1B-LE	275 135 070	TI275135070
Power input	500 V, 16 A	SK TIE4-HAN10E-M2B-LE	275 135 000	TI275135000
Power input	690 V, 20 A	SK TIE4-QPD_3PE-K-LE	275 274 125	TI275274125
Power input	630 V, 16 A	SK TIE4-NQ16-K-LE	275 274 133	TI275274133
Power input + power outlet	400 V, 16 A	SK TIE4-2HANQ5-K-LE-LA	275 274 110	TI275274110
Power input + motor outlet	600 V, 16 A	SK TIE4-2HANQ5-M-LE-MA-001	275 274 123	TI275274123
Power output	500 V, 16 A	SK TIE4-HAN10E-M2B-LA	275 135 010	TI275135010
Power output	500 V, 16 A	SK TIE4-HANQ8-K-LA-MX	275 135 040	TI275135040
Motor output	500 V, 16 A	SK TIE4-HAN10E-M2B-MA	275 135 020	TI275135020
Motor output	500 V, 16 A	SK TIE4-HANQ8-K-MA-MX	275 135 050	TI275135050

Information

Looping through the mains voltage

When looping through the mains voltage, the permissible current load of the connection terminals, plugs and feeders must be observed. Non-observance may lead to thermal damage to live modules and their immediate surroundings, for example.

3.2.3.2 Plug connectors for control connection

Various M12 round plug connectors are available as flanged plugs or flanged sockets. The plug connectors are intended for installation in an M16 cable gland of the device, or in an external technology unit. The protection class (IP67) of the plug connector only applies in the screwed state. Similarly to the use of coding pins / grooves, the colour coding of the connectors (plastic unit inside and cover caps) is based on functional requirements and is intended to avoid erroneous operation.

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



i Information

Control unit overload SK 2x0E

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

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

Connector (selection)

Type	Version	Designation	Part Number	Document
Power supply	Connector	SK TIE4-M12-POW	275 274 507	TI275274507
Sensors / actuators	Socket	SK TIE4-M12-INI	275 274 503	TI275274503
Initiators and 24 V	Connector	SK TIE4-M12-CAO	275 274 516	TI275274516
AS Interface	Connector	SK TIE4-M12-ASI	275 274 502	TI275274502
AS Interface – Aux	Connector	SK TIE4-M12-ASI-AUX	275 274 513	TI275274513
PROFIBUS (IN + OUT)	Plug connector + socket	SK TIE4-M12-PBR	275 274 500	TI275274500
Analogue signal	Socket	SK TIE4-M12-ANA	275 274 508	TI275274508
CANopen or DeviceNet IN	Connector	SK TIE4-M12-CAO	275 274 501	TI275274501
CANopen or DeviceNet OUT	Socket	SK TIE4-M12-CAO-OUT	275 274 515	TI275274515
Ethernet	Socket	SK TIE4-M12-ETH	275 274 514	TI275274514
System bus IN	Connector	SK TIE4-M12-SYSS	275 274 506	TI275274506
System bus OUT	Socket	SK TIE4-M12-SYSM	275 274 505	TI275274505
HTL transmitter	Socket	SK TIE4-M12-HTL	275 274 512	TI275274512
Safe stop	Socket	SK TIE4-M12-SH	275 274 509	TI275274509

3.2.4 Potentiometer adapter, SK CU4-POT

Part no.: 275 271 207

The digital signals R and L can be directly applied to the frequency inverter's digital inputs 1 and 2.

The potentiometer (0 - 10 V) can be evaluated via an analogue input from the frequency inverter (if available) or from an I/O extension. An optional 24 V module (SK xU4-24V-...) allows for the conversion of analogue setpoints to proportional pulses (frequency). These pulses can then be evaluated in the form of a setpoint (**P400 [-06]/[-07]**) via either of the frequency inverter's digital inputs 2 or 3 (**P420 [-02]/[-03] = 26/27**).



Module		SK CU4-POT Part no.: 275 271 207)	Connection: Terminal no.			Function
			SK 2x0E	SK 2x5E		
Pin	Colour		FI	FI	Power supply unit	
1	Brown	24 V supply voltage	43		44	Rotary switch L - OFF - R
2	Black	Enable R (e.g. DIN1)	21	21		
3	White	Enable L (e.g. DIN2)	22	22		
4	White	Tap on AIN1+	14		14	Potentiometer 10 kΩ
5	Brown	Reference voltage 10 V	11		11	
6	Blue	Analogue ground AGND	12		12	

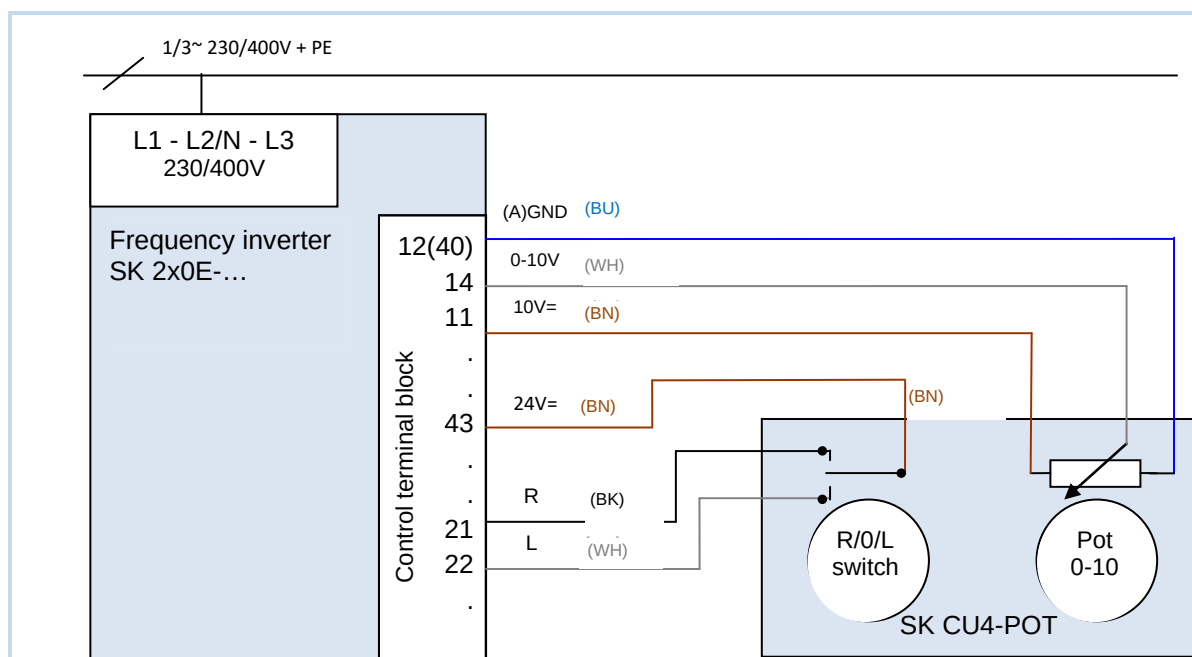


Figure 23: Wiring diagram SK CU4-POT, example SK 2x0E

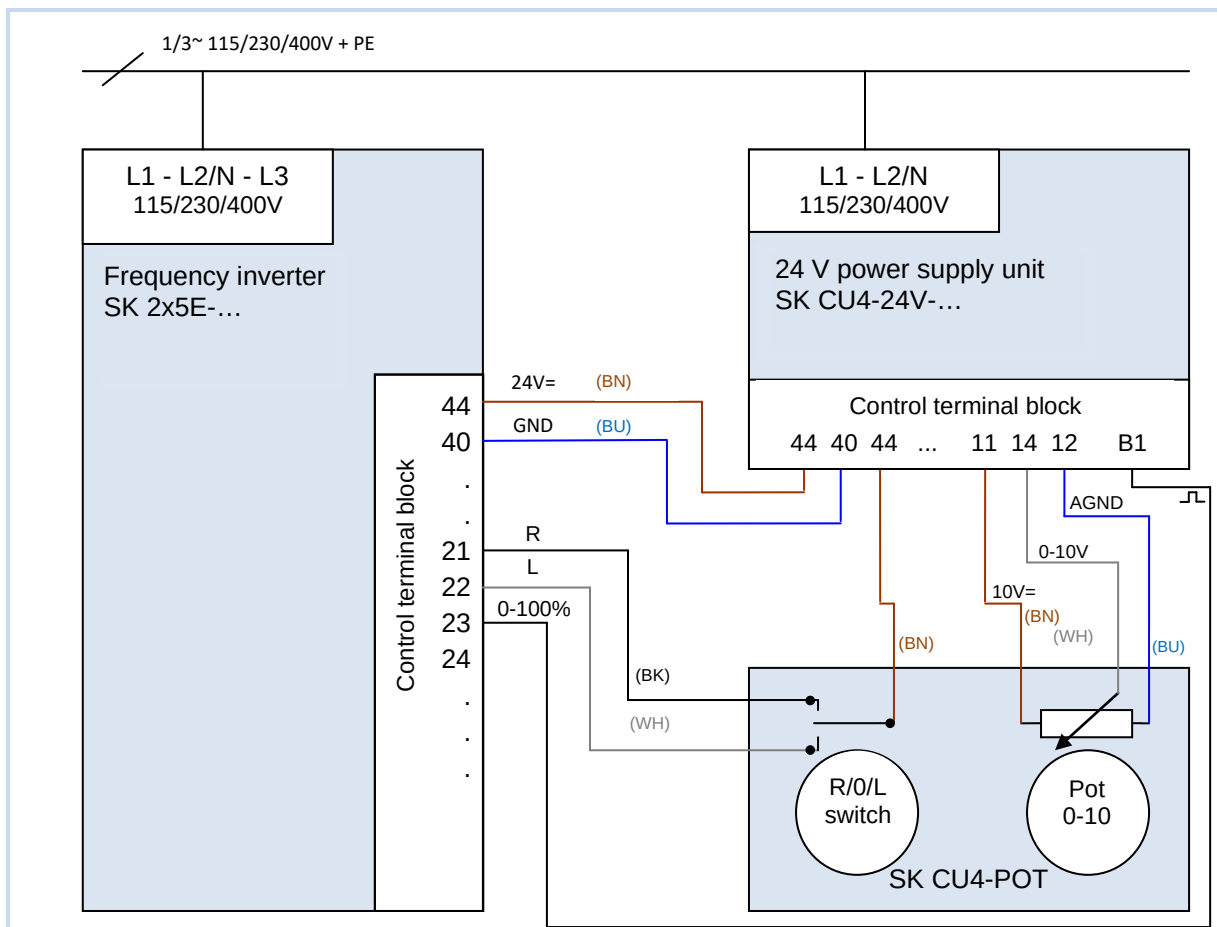


Figure 24: Wiring diagram SK CU4-POT and parameterisation, example SK 2x5E

DIP switch setting (S1):

DIP3 = off, DIP4 = on, DIP5 = off (see chapter 4.3.2.2 "DIP switches (S1)" on page 108)

or

Recommended parameter setting,

P400 [-07] = 1 **P420 [-02] = 2**

S1: DIP1-8 = off

P420 [-01] = 1 **P420 [-03] = 26**

4 Commissioning

WARNING

Unexpected movement

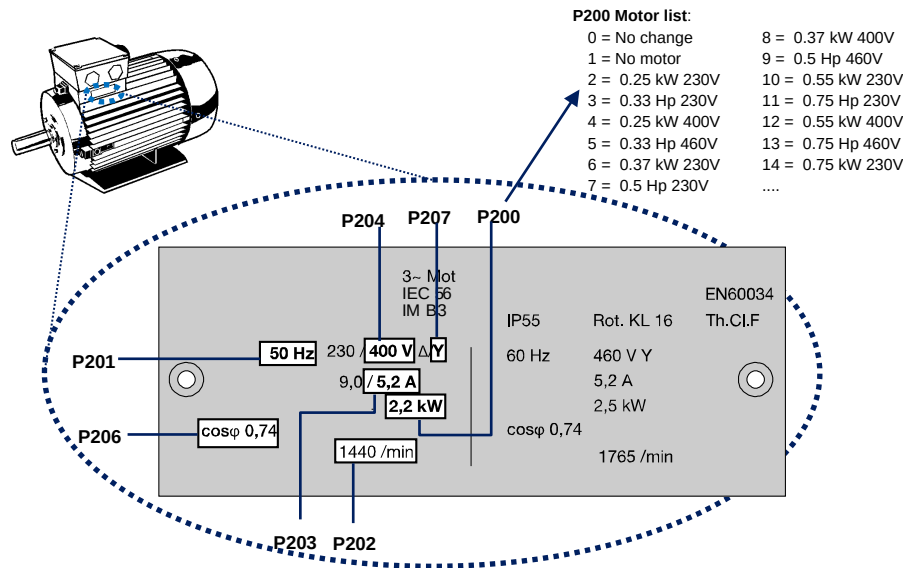
Connection of the supply voltage may directly or indirectly set the device into motion. This can cause unexpected movement of the drive and the attached machine, which may result in serious or fatal injuries and/or material damage. Possible causes of unexpected movements are e.g.:

- Parameterisation of an “automatic start”
 - Incorrect parameterisation
 - Control of the device with an enabling signal from a higher level control system (via IO or bus signals)
 - Incorrect motor data
 - Incorrect encoder connection
 - Release of a mechanical holding brake
 - External influences such as gravity or other kinetic energy which acts on the drive unit
 - In IT networks: Mains fault (earth fault)
- To avoid any resulting hazard, the drive / drive chain must be secured against unexpected movements (mechanical blocking and/or decoupling, provision of protection against falling etc.) In addition, it must be ensured that there are no persons within the area of action and the danger area of the system.

4.1 Factory settings

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

All motor data (IE1, IE3, IE4, IE5) can be pre-set with parameter **P200**. After the function has been used, this parameter is reset to 0 = no change! The data is automatically loaded once into parameter **P201...P209** and can be compared with the data on the motor type plate.



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

The NORDCON software provides the motor data for all common NORD motors. Using the "Import motor parameter" function (see also the NORDCON software manual [BU0000](#)), the required data set can be selected and imported into the device.

Information

Double assignment of DIN 2 and DIN 3

The digital inputs DIN 2 and DIN 3 are used for two different functions:

1. For the parameterisable digital functions (e.g. "Enable left")
2. For the evaluation of an incremental encoder

Both functions are coupled by an "OR" link.

Evaluation of an incremental encoder is always activated. This means that if an incremental encoder is connected, it must be ensured that the digital functions are disabled (parameters **P420 [-02] = 0** and **P420 [-03] = 0**).

Information

Prioritisation of DIP switches

Note that the DIP switch settings on the frequency inverter (**S1**) have priority over the parameter settings.

Also take into account the settings of the integrated potentiometers **P1** and **P2**.

4.2 Selecting the operating mode for motor control

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

In terms of control technology, the operation of synchronous motors shows many special features. In order to achieve ideal results, the frequency inverter was therefore designed for the control of

synchronous motors from NORD, which match the type of an IPMSM (Interior Permanent Magnet Synchronous Motor) in terms of structure. In these motors, the permanent magnets are embedded in the rotor. The operation of other manufacturer's motors must be checked by NORD, if required. See also technical information [TI60_0001](#), "Planning and commissioning guide for NORD synchronous motors (PMSM) with NORD frequency inverters" and the application guide [AG0101](#), "Drive optimisation: Guideline for PMSM – CFC Closed-Loop".

4.2.1 Explanation of the operating modes (P300)

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

- VFC open-loop mode (**P300 = 0**)

This operating mode is based on a voltage-controlled, field-oriented control method (Voltage Flux Control Mode "VFC"). It is used with ASM and PMSM. In the context of the operation of asynchronous motors, the term "ISD control" is also used.

Control takes place without encoder and only based on fixed parameters and measurement results of actual electrical values. No specific setting of the speed control is required to use this operating mode. However, the parameterisation of motor data as precisely as possible is an essential condition for high-quality operation.

For the ASM mode, there is also the possibility of control according to a simple V/f characteristic curve. This mode is suitable for the operation of several, mechanical, non-coupled motors in parallel on one frequency inverter, or if the motor data cannot be precisely determined.

Operation according to a V/f characteristic curve is only suitable for drive applications with low requirements on speed quality and dynamics (ramp times ≥ 1 s). Even for machinery that, due to its design, tends towards mechanical vibrations, control according to a V/f characteristic curve may be advantageous. V/f characteristic curves are usually used to control fans, certain pump drives, or for agitators. Operation according to V/f characteristic curve is activated via the parameters **P211 = 0** and **P212 = 0**.

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

In comparison with **P300 = 0**, this is generally a control with current-controlled field orientation (Current Flux Control). For this operating mode, which with ASM is functionally identical to the previous designation "servo control", the use of an encoder is mandatory. This way, the motor's exact speed characteristics are recorded and included in the calculation for the motor control. The encoder also allows for the determination of the rotor position, where for the operation of a PMSM the initial value of the rotor position must be additionally determined. This allows for a more precise and faster control of the drive.

For ASM and PMSM, this operating mode provides optimal results in control behaviour, and is especially suitable for lifting gear applications or applications with requirements on optimal dynamic behaviour (ramp times ≥ 0.05 s). This operating mode provides the greatest benefit in connection with a PMSM (energy efficiency, dynamics, precision).

- CFC open-loop mode (**P300 = 2**)

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

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

This operating mode also allows a significantly higher dynamic than is possible in open-loop mode (ramp times ≥ 0.2 s for enabled drive with completed rotor position detection).
In principle, the full overload capacity is only available above 20% of the nominal frequency.

4.2.2 Parameter overview for controller settings

The following tables provide an overview of all parameters that are relevant depending on the selected operating mode. In principle, the following applies: The more precise the settings, the more accurate the control and the higher the values possible in terms of dynamics and precision in drive operation. A detailed description of the individual parameters can be found in chapter 5 "Parameter".

4.2.2.1 VFC open-loop and CFC closed-loop

"Ø" = Parameter has no meaning "√" = Parameter adjustment is relevant		"-" = Leave the parameter in the factory setting			
Group	Parameter	Operating mode			
		VFC open-loop		CFC closed-loop	
		ASM	PMSM	ASM	PMSM
Motor data	P201 ... P209	√	√	√	√
	P210	√ ¹	√	√	√
	P211, P212	- ²	-	-	-
	P215, P216	- ¹	-	-	-
	P217	√	√	Ø	Ø
	P220	√	√	√	√
	P240, P241	-	√	-	√
	P243	-	Ø	-	√
	P244	-	√	-	√
	P246	-	-	√	√
	P245, P247	-	√	Ø	Ø
Controller data	P300	√	√	√	√
	P301	Ø	Ø	√	√
	P310 ... P320	Ø	Ø	√	√
	P330	Ø	Ø	Ø	√
	P331 ... P333	Ø	Ø	Ø	Ø
	P334	Ø	Ø	-	√

1 For the V/f characteristic curve: precise parameter adjustment is important

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

4.2.2.2 CFC open-loop and CFC open-loop injection

"Ø" = Parameter has no meaning "√" = Parameter adjustment is relevant		"-" = Leave the parameter in the factory setting		
Group	Parameter	Operating mode		
		CFC open-loop		CFC open-loop injection
		ASM	PMSM	PMSM
Motor data	P201 ... P209	√	√	√
	P210	√	√	-
	P211	-	-	-
	P212	-	-	√
	P215, P216	-	-	-
	P217	√	√	-
	P220	√	√	√
	P240, P241, P243, P244	-	√	√
	P246	√ ¹	√ ¹	√
	P245, P247	Ø	-	-
Controller data	P300	√	√	√
	P301	Ø	Ø	-
	P310 ... P320	√	√	√
	P330	-	Ø	-
	P331 ... P333	-	√	√
	P334	Ø	Ø	-
	P337 ... P339	Ø	Ø	√
	P340	Ø	Ø	-
	P341	Ø	Ø	√

1 Only effective from the switch-over point, because the CFC open-loop PMSM initially starts up in VFC (without the influence of P246) and only has an influence after the switch-over point with CFC.

4.2.3 Motor control commissioning steps

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

1. Carry out the frequency inverter and motor connection as usual (note Δ / Y!). Connect the encoder, if present.
2. Connect the mains supply.
3. Carry out the factory setting (P523).
4. Select the basic motor from the motor list (P200) (ASM types are at the beginning of the list, PMSM types are at the end, designated by their type (e.g. ...**80T**...)).
5. Check the motor data (P201 ... P209) and compare with the name plate/motor data sheet.
6. Measure the stator resistance (P220) → P208, P241 [-01] are measured, P241 [-02] is calculated. (Note: If an SPMSM is used, P241 [-02] must be overwritten with the value from P241 [-01]). Leave the existing values for parameters P241 [-03] to P241 [-06].)
7. Encoders: Check the settings (P301, P735)
8. With PMSM only:
 - a. EMF voltage (P240) → Motor name plate/motor data sheet
 - b. Determine/set reluctance angle (P243) (not required with NORD motors)
 - c. Peak current (P244) → Motor data sheet (not required with NORD motors)
 - d. Only for PMSMs in VFC mode:
Determine (P245), (P247)
 - e. Determine (P246)
9. Select the operating mode (P300).
10. Determine/set the current controller (P312 ... P316).
11. Determine/set the speed controller (P310, P311).
12. PMSM only:
 - a. Select the procedure for the recognition of the rotor position (P330).
 - b. Make the settings for the starting behaviour (P331 ... P333).
 - c. Make the settings for the 0 pulse of the encoder (P334 ... P335)
 - d. Activation of slip error monitoring (P327 $\neq$ 0 and P328 $\neq$ 0)



Information

Commissioning of NORD synchronous motors

Further information on the commissioning of NORD synchronous motors with NORD frequency inverters can be found in the [AG0101](#) application guide.

4.3 Starting up the device

The frequency inverter can be commissioned in various ways:

- For simple applications (e.g conveyor applications) by means of the DIP switches (S1) integrated in the frequency inverter (internal) and the externally accessible potentiometers (SK 2x5E only).
In this configuration the plug-in EEPROM is not required.
- By means of parameter adaptations using the control and parametrisation box (SK CSX-3H or SK PAR-3H) or the NORD CON PC - supported software.

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

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

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



Information

Presetting of physical I/O and I/O bits

For commissioning standard applications, a limited number of the frequency inverter inputs and outputs (physical and I/O bits) have predefined functions. These settings may need to be changed (Parameters (P420), (P434), (P480), (P481)).

4.3.1 Connection

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

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



Information

Control voltage SK 2x5E:

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

4.3.2 Configuration

Changes to individual parameters are usually necessary for operation.

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



Information

Configuration via DIP switch

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

4.3.2.1 Parameterisation

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

Parameter group	Parameter numbers	Functions	Remarks
Basic parameter	P102 ... P105	Ramp times and frequency limits	
Motor data	P201 ... P207, (P208)	Type plate data for motor	
	P220, Function 1	Calibrate stator resistance	Value is written to P208
	alternatively P200	Motor data list	Selection of a 4-pole NORD standard motor from a list
	alternatively P220, Function 2	Motor identification	Complete calibration of a connected motor Condition: Motor is not more than 3 power levels smaller than frequency inverter
Control terminals	P400, P420	Analogue/digital inputs	



Information

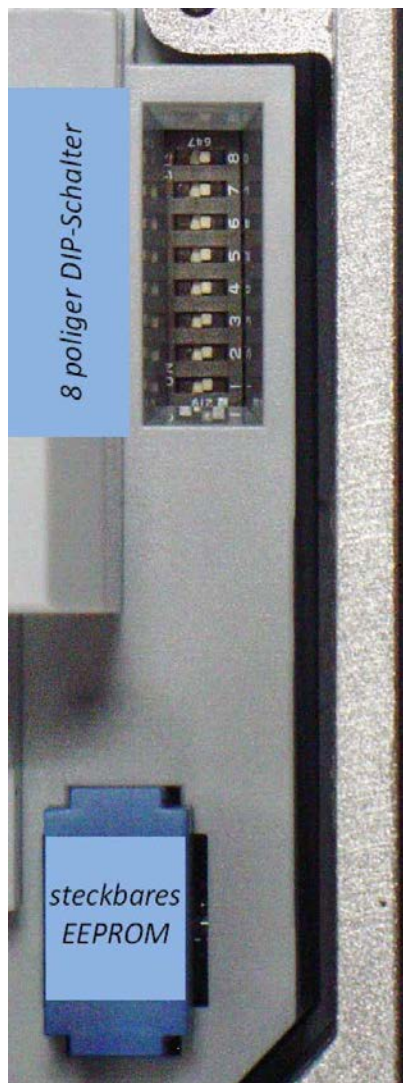
Factory settings

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

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

4.3.2.2 DIP switches (S1)

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



No.		DIP switch (S1)	
Bit			
8 2 ⁷	Int R_{Brake} Internal brake resistor	0	Internal brake resistor not existing
		1	Internal brake resistor existing ( Section 2.3.1)
7 2 ⁶	60Hz¹⁾ 50/60Hz operation	0	Motor data corresponding to the rated power of the FI in kW relative to 50 Hz, f _{max} = 50 Hz
		1	Motor data corresponding to the rated power of the FI in hp relative to 60 Hz, f _{max} = 60 Hz
6 2 ⁵	COPY²⁾ EEPROM copy function	0	No function
		1	EEPROM copy function active, once
5/4 2 ^{4/3}	I/O Potentiometer function, digital inputs and AS interface	DIP-No 5 4	
		0 0	Corresponding to P420 [1-4] and P400 [1-2] or P480 [1-4] and P481 [1-4]
		0 1	Further details in the next table. (depends on the DIP3 "BUS")
		1 0	
3 2 ²	BUS Source control word and setpoint value	0	Corresponding to P509 and P510 [1] [2]
		1	System bus (⇒ P509=3 and P510=3)
2/1 2 ^{1/0}	ADR System bus address/ baud rate	DIP-No 2 1	
		0 0	Corresponding to P515 and P514 [32, 250kBaud]
		0 1	Address 34, 250 kBaud
		1 0	Address 36, 250 kBaud
		1 1	Address 38, 250 kBaud
1) A changed setting is applied the next time the mains is switched on. Existing settings in parameters P201-P209 and P105 are overwritten!			
2) up to firmware version 1.4 R1 the DIP switch designation was U/F . A changeover between the control procedures (U/F / ISD control) has been made possible via the DIP switch.			



Information

Factory setting, as delivered!

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



Information

IO bit factory settings:

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

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

Details of DIP switch S1: 5/4 and 3

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

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

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

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

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

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

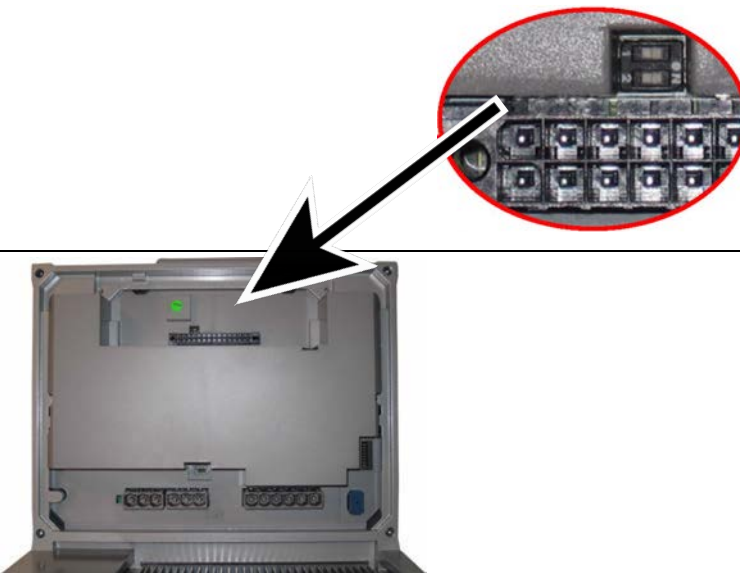
4.3.2.3 DIP switches, analogue input (only SK 2x0E)

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

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



Access to DIP switches

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

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

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



Potentiometers

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

The function of P1 and P2 depends on DIP 4/5. The meaning changes according to the setting.

As standard, P1 sets the setpoint value of 0-100 % and P2 sets the ramp from 0.2-7 sec.

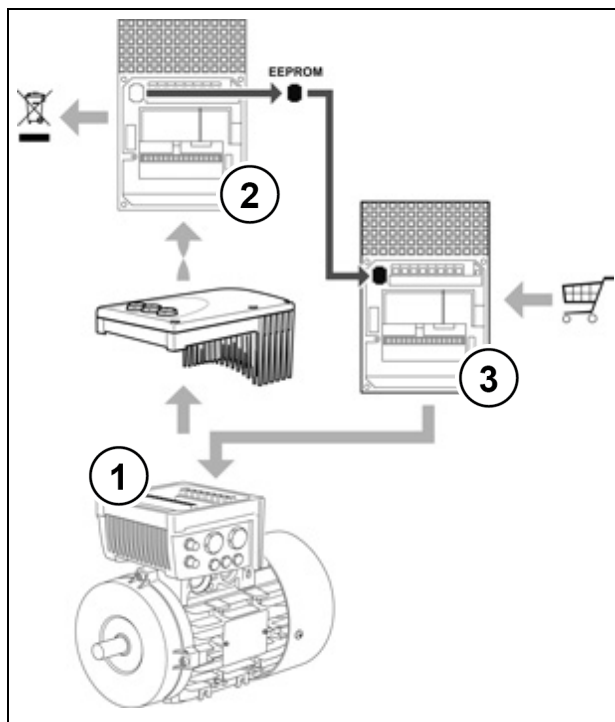
4.3.3 Plug-in EEPROM ("Memory Module")

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

4.3.3.1 Switch of plug-in EEPROM ("memory module")

A major advantage in servicing the SK 2xxE is the easy transfer of data from the damaged frequency inverter to the replacement device. When exchanging data via the plug-in EEPROM, the following must be noted:

- Data transfer must be activated specifically (📖 Section 4.3.3.2 "Copy function").
- Possible limitations resulting from switching between devices of different generations must be taken into account.



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

Removing the defective frequency inverter (2) from the adapter unit (1) provides access to the EEPROM. The EEPROM is unlocked by gently squeezing the short sides and pulling it out.

It must then be reinstalled in the replacement device. It is correctly seated when the EEPROM lock audibly clicks into place. Reverse insertion of the EEPROM is not possible.

(1)	Adapter unit
(2)	Frequency inverter, defective
(3)	Frequency inverter, replacement device

Figure 25: Replacement of the plug-in EEPROM

Devices with hardware version "**EAA**" or higher have a more powerful processor than first-generation devices (hardware version "**AAA**"). This also enables a wider range of functions, such as integrated PLC functionality and operation of PMSM motors.

To manage the larger data set, the capacity of the plug-in EEPROM ("memory module") was expanded. The EEPROM with the higher memory capacity can be identified by the additional raised marking ("**II**") on the housing. Alternatively, a sticker labelled "**V2**" may also be attached.



Downward compatibility:

In general, frequency inverters from an older generation can be operated with a newer-generation EEPROM, and vice versa.

Please note:

Before exchanging data, it is necessary to compare not only the firmware versions (software versions) of the two frequency inverters, but also the hardware versions of the frequency inverters and the EEPROMs, because:

- Frequency inverters with hardware versions “EAA” and “FAA” can **only read** data from an EEPROM of the first generation (EEPROM without marking). The EEPROM cannot be written by the frequency inverter, meaning that parameter changes are saved only in the device itself and no longer in the EEPROM.
- Frequency inverters with hardware version “AAA” can read and write data from an EEPROM of the second generation (EEPROM with marking). However, only data stored on the EEPROM that the frequency inverter can process due to its older design is used (incompatibility).

Information

Incompatibility

When transferring data sets between devices with different firmware versions (software versions), where the replacement device has an older version than the defective one, incompatibilities in certain functions may occur. We therefore recommend updating the firmware to the latest available version for this device generation.

After the data transfer, it is generally recommended to reinstall the EEPROM supplied with the replacement device into that device, and then copy the data from the device to the EEPROM.

4.3.3.2 Copy function

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

Copy function DIP switches S1 – 6 "COPY"

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

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

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

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

If necessary, the copying process must be repeated.

Starting the copy function

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

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

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

Carry out the following steps to trigger the process again:

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

**Information****Parameter P550**

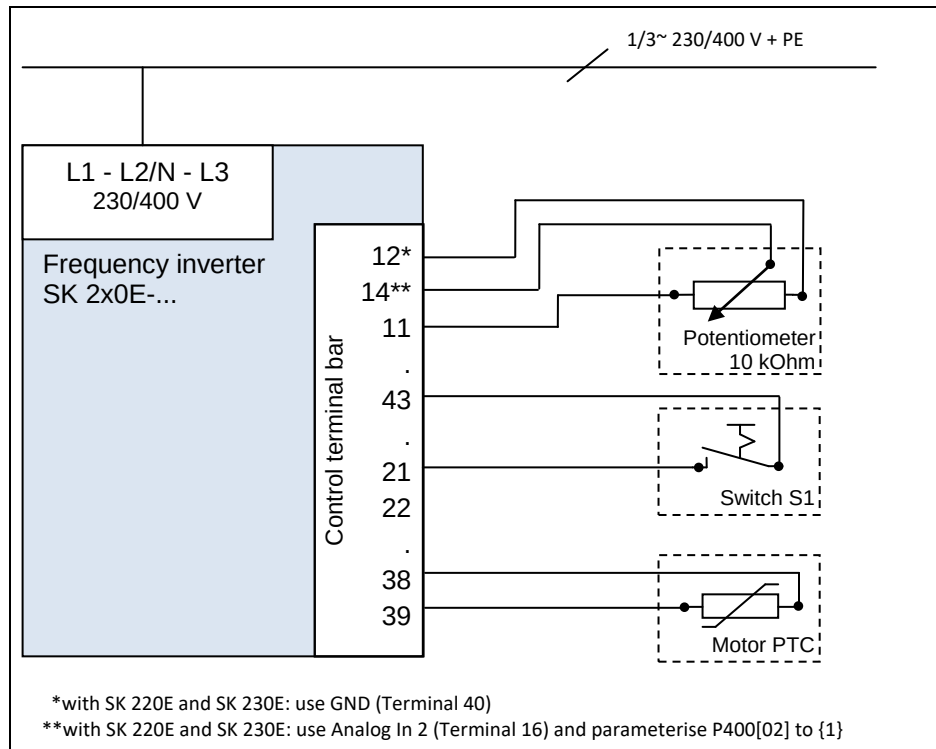
The COPY function of the DIP switch S1-6 is comparable with the parameter function P550 ("EEPROM copy order" setting { 1 } "Ext. → Int. EEPROM"). This function is still available.

4.3.4 Commissioning examples

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

4.3.4.1 SK 2x0E - Minimal Configuration

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

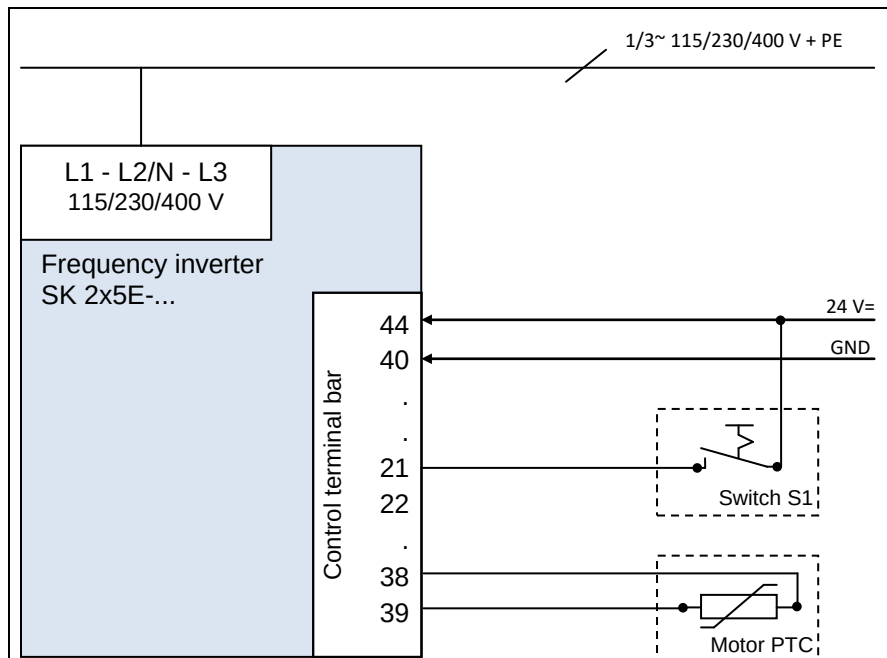


Function	Setting
Setpoint	External 10 kΩ potentiometer
Controller enable	External switch S1

4.3.4.2 SK 2x5E - Minimal Configuration

Minimal configuration without options

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



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

Minimal configuration with options

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



Information

Convert analogue signal

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

Test operation

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

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

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

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

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

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

**Information****Test operation**

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

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

4.4 Temperature sensors

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



Information

Determination of motor stator resistance

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

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



Information

Pay attention to polarity

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

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

Approved temperature sensors

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

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

Table 13: Temperature sensors, adjustment

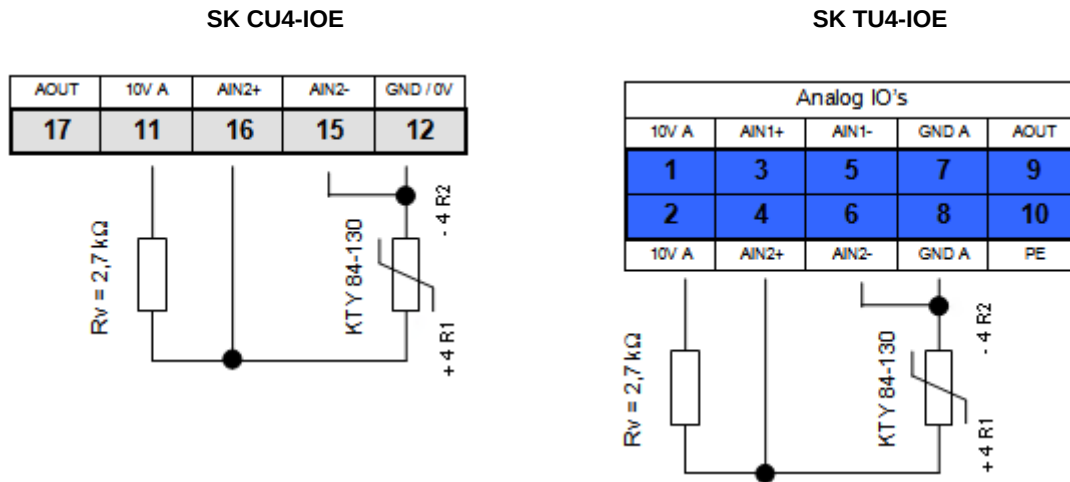
Connection of a temperature sensor is made according to the following examples.

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

Connection examples

SK CU4-IOE / SK TU4-IOE-...

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



(Illustration shows a section of the terminal strips)

Parameter settings (Analogue input 2)

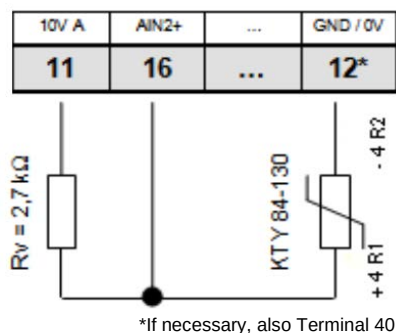
The following parameters must be set for the function of the KTY84-130.

1. The motor data **P201-P207** must be set according to the rating plate.
2. The motor stator resistance **P208** is determined at 20°C with **P220 = 1**.
3. Analogue input 2 function, **P400 [-04] = 30**
(motor temperature)
4. The mode analogue input 2 **P401 [-02] = 1**
(negative temperatures are also measured)
(As of firmware version: V1.2)
5. Adjustment of analogue input 2: **P402 [-02] = 1.54 V** and **P403 [-02] = 2.64 V**
(with $R_v = 2.7 \text{ k}\Omega$)
6. Adjust time constants: **P161 [-02] = 400ms** (Filter time constant is at a maximum)
Parameter (P161) is a module parameter. It cannot be set at the frequency inverter, but must be set directly at the I/O module.
Communication takes place by directly connecting a ParameterBox to the RS232 interface of the module, for example, or by means of connecting to the frequency converter via the system bus. (Parameter (P1101) object selection → ...)
7. Motor temperature control (display): **P739 [-03]**

SK 2x0E

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

SK 2x0E



Parameter settings (Analogue input 2)

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

1. The motor data **P201-P207** must be set according to the rating plate.
2. The motor stator resistance **P208** is determined at 20°C with **P220 = 1**.
3. Function analogue input 2, **P400 [-02] = 30**
(Motor temperature)
4. The mode analogue input 2 **P401 [-06] = 1**
(negative temperatures are also measured)
5. Adjustment of analogue input 2: **P402 [-06] = 1.54 V** and **P403 [-06] = 2.64 V**
(with RV= 2.7 kΩ)
6. Adjust time constants: **P404 [-02] = 400 ms** (Filter time constant is maximum)
7. Motor temperature control (display): **P739 [-03]**

SK 2x5E

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

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

4.5 AS Interface (AS-i)

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

4.5.1 The bus system

General information

The **Actuator Sensor Interface (AS-Interface)** is a bus system for the lower field bus level. It has been defined in the AS-Interface *Complete Specification* and standardised according to EN 50295, IEC62026.

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

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

Devices with slave profiles **S-7.0** and **S-7.A.** can be operated together within an AS-i network with version 2.1 and higher (**master profile M4**), considering the address assignment (see example).

Permissible	Not permissible
Standard slave 1 (address 6)	Standard slave 1 (address 6)
A/B slave 1 (address 7A)	Standard slave 2 (address 7)
A/B slave 2 (address 7B)	A/B slave 1 (address 7B)
Standard slave 2 (address 8)	Standard slave 3 (address 8)

Addressing is done via the master that also provides further management functions, or via a separate addressing unit.

Device-specific information

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

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

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

4.5.2 Features and technical data

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

Features

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

Technical data for AS interface

Designation	Value		
	SK 220E / SK 230E SK 225E-...-AXB SK 235E-...-AXB	SK 225E / SK 235E	SK 225E-...-AUX SK 235E-...-AUX
AS-i supply, PWR connection	24 V DC, max. 25 mA	26.5 – 3.6 V DC, max. 290 mA ¹⁾	24 V DC, max. 25 mA
Slave profile	S-7.A	S-7.0	
I/O-Code	7	7	
ID Code	A	0	
External ID Code 1 / 2	7	F	
Address	1A – 31A and 1B - 31B (Delivery condition 0A)	1 – 31 (Delivery condition: 0)	
Cycle time	Slave → Master ≤ 10 ms Master → Slave ≤ 21 ms	≤ 5 ms	
Quantity of BUS I/O	4I / 4O	4I / 4O	

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

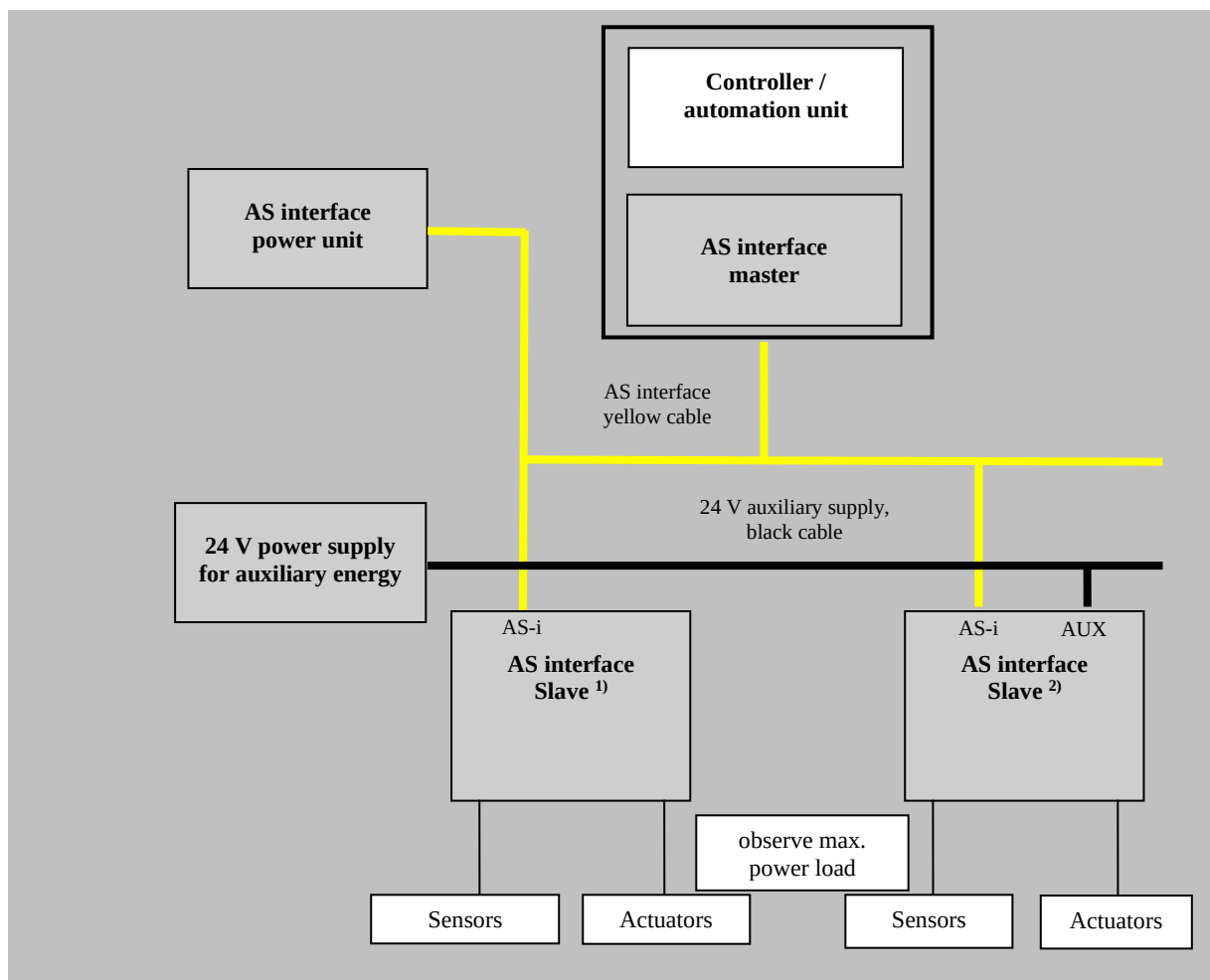
4.5.3 Bus structure and topology

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

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

To avoid interferences, the **PE connection of the AS-Interface power supply unit** (if available) **must be earthed**.

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



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

4.5.4 Commissioning

4.5.4.1 Connection

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

Details of control terminals (📖 Section 0 "Details on control terminals ")

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

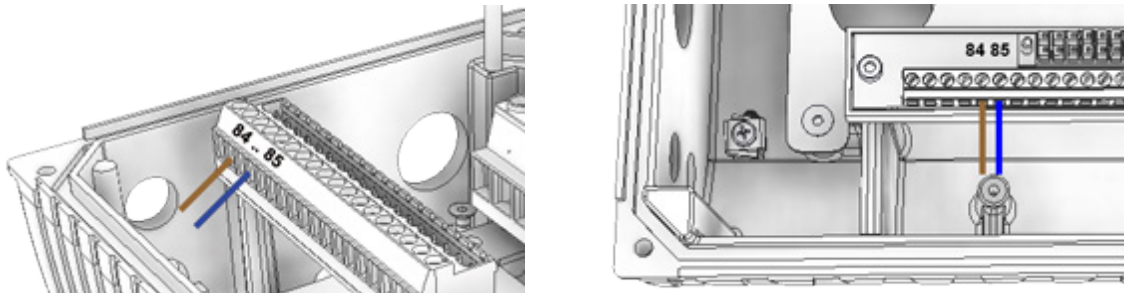


Figure 26: Connecting terminals AS-i, left size 1 – 3, right size 4

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

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

2) Connection possible, but not required.

Table 14: AS Interface, connection of signal and supply lines

If the AS interface ("yellow cable") is not used, the normal connection requirements for the device apply (📖 Section 0 "Details on control terminals ").

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

With the use of the yellow AS interface line:

- the supply voltage (26.5 - 31.6 V DC) for the use of the digital inputs or other external peripherals (e.g. activators) **can be obtained from terminals 44/40**. The permissible total current for this is limited to **60 mA!**

The terminal "44" is protected against short circuit. In case of an overload it will switch off by a thermal fuse element. After a cooling time that depends on the ambient conditions, the fuse will reset.

- **no voltage source may be connected to terminals 44/40,**
- the frequency inverter is supplied via the yellow AS-i line.

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

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



Information

Use of wall mounting kit with fan

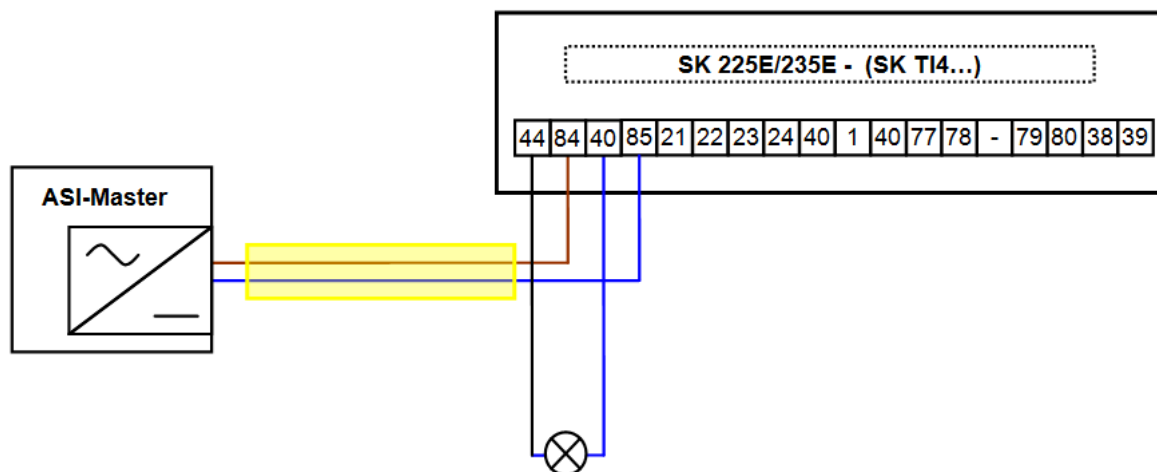
If the frequency inverter is operated with a **SK TIE4-WMK-L-...** (📖 Section 2.1.3.2 "Wall mounting kit with fan") wall mounting kit, the following must be noted:

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

Variant 1 – connection to 24 V (Terminal 44)

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

Connection example:



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

The diagram shows the following components and connections:

- ASI-Master:** A control unit on the left with a yellow output terminal block.
- SK 225E/235E - (SK TI4...):** A top component with a terminal block containing positions: 44, 84, 40, 85, 21, 22, 23, 24, 40, 1, 40, 77, 78, -, 79, 80, 38, 39.
- SK CU4-24V:** A bottom component with a terminal block containing positions: 44, 40, 44, 40, 11, 14, 12, B1, 40, L1, L2, PE, PE.
- Connections:**
 - Blue lines connect the ASI-Master to the SK 225E/235E and SK CU4-24V.
 - Yellow lines connect the ASI-Master to the SK 225E/235E.
 - Red lines connect the SK 225E/235E to the SK CU4-24V.
 - Green lines connect the SK CU4-24V to the SK TI4... (represented by a box with a tilde symbol).
 - A light bulb symbol is connected to the SK CU4-24V terminal block.

4.5.4.2 Displays

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



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

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

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

4.5.4.3 Configuration

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

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

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



Information

DIP switch

With the DIP switch default settings (S1: DIP4/5 = "0" ("off")) the digital inputs of the frequency inverter are active. However, as soon as one of the two DIP switches is moved to position "I" ("ON"), the digital inputs are deactivated. However, the gateway function of digital inputs 1 and 2 on AS-i-Out bits 2 and 3 is retained.



Information

Overloading of the 24V supply

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

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

Bus I/O bits

WARNING

Unexpected movement due to automatic starting

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

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

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

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

BUS IN	Function (P480[-01...-04])	Status		Status
		Bit 1	Bit 0	
Bit 0	Enable right	0	0	Motor is switched off
Bit 1	Enable left	0	1	Right rotation field is present at the motor
Bit 2	Fixed frequency 2 (→ P465[-02])	1	0	Left rotation field is present at the motor
Bit 3	Acknowledge fault ¹⁾	1	1	Motor is switched off

1) Acknowledge with flank 0 → 1.

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

BUS OUT	Function (P481 [-01 ... -04])	Status		Status
		Bit 1	Bit 0	
Bit 0	Inverter ready	0	0	Error active
Bit 1	Warning	0	1	Warning
Bit 2 ¹⁾	Digital-In 1 status	1	0	Start disabled
Bit 3 ¹⁾	Digital-In 2 status	1	1	Standby / Run

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

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

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

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

4.5.4.4 Addressing

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

Course of action

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

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

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



Information

Special conditions for SK 2x5E

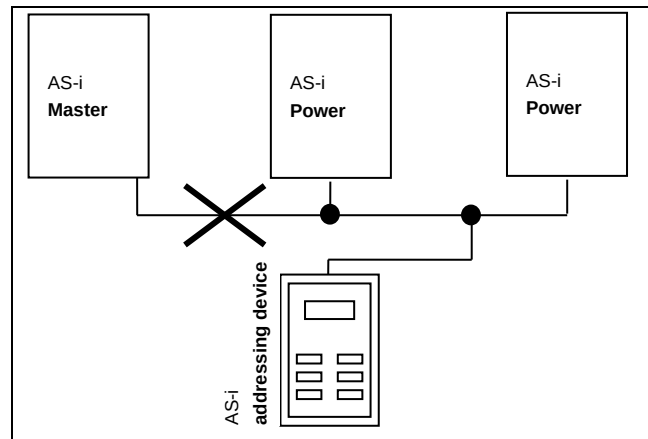
Does not apply to special versions ...-AUX and -AXB

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

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

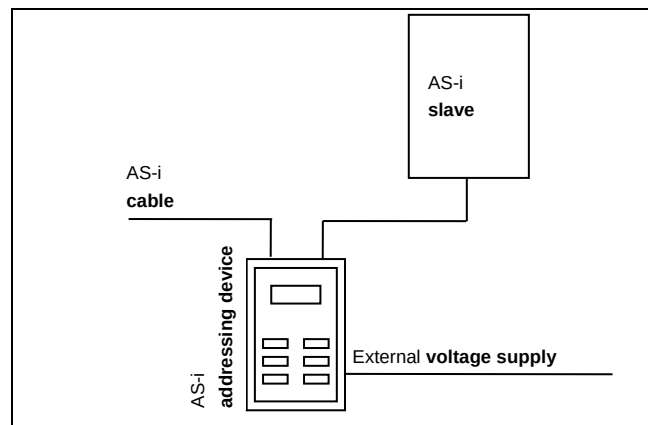
Version 1

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



Version 2

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



4.5.5 Certificate

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

5 Parameter

WARNING

Unexpected movement

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

- Parameterisation of an “automatic start”
 - Incorrect parameterisation
 - Control of the device with an enabling signal from a higher level control system (via IO or bus signals)
 - Incorrect motor data
 - Incorrect encoder connection
 - Release of a mechanical holding brake
 - External influences such as gravity or other kinetic energy which acts on the drive unit
 - In IT networks: Mains fault (earth fault)
- To avoid any resulting hazard, the drive / drive chain must be secured against unexpected movements (mechanical blocking and/or decoupling, provision of protection against falling etc.) In addition, it must be ensured that there are no persons within the area of action and the danger area of the system.

WARNING

Unexpected movement due to changes in the parameterisation

Parameter changes become effective immediately. Under certain conditions, dangerous situations may occur, even when the drive is in standstill. Functions such as **P428** “Automatic starting” or **P420** “Digit inputs” or the “Brake off” setting can put the drive in motion and put persons at risk due to moving parts.

Therefore:

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

WARNING

Unexpected movement due to overload

Overloading the drive carries the risk of the motor “breaking down” (sudden loss of torque). An overload may be caused by inadequate dimensioning of the drive or by the occurrence of sudden load peaks, for example. Sudden load peaks may be of mechanical origin (e.g. blockage) or caused by extremely steep acceleration ramps (**P102**, **P103**, **P426**).

Depending on the type of application, a “breakdown” of the motor may cause unexpected movement (e.g. dropping of loads with lifting equipment).

To avoid this risk, the following must be observed:

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

The relevant parameters for the device are described in the following. The parameters are accessed using a parametrisation tool (e.g. NORDCON software or control and parametrisation unit, see also (📖 Section 0 "Connection of a control and parameterisation unit") and therefore makes it possible to adapt the device to the drive task in the best possible way. Different device configurations can result in dependencies for the relevant parameters.

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

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

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

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

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



Information

Incompatibility

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

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

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

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

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

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

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

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

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

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

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

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

The individual parameters are combined 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 operating values
Basic parameters	(P1--)	Basic device settings such as switch-on and switch-off behaviour
Motor data	(P2--)	Electrical settings for the motor (motor current or initial voltage (starting voltage))
Control parameters	(P3--)	Setting of current and speed controllers as well as encoder settings (incremental encoders)
		Settings for the integrated PLC (details see BU0550)
Control terminals	(P4--)	Assignment of functions for the inputs and outputs
Additional parameters	(P5--)	Mainly monitoring functions and other parameters
Positioning	(P6--)	Setting of the positioning function (details see BU0210)
Information	(P7--)	Display of operating values and status messages

Information

Factory setting (P523)

The factory settings of the entire parameter set can be loaded at any time using parameter **P523**. For example, this can be useful during commissioning if it is not known which device parameters have been previously changed and could therefore have an unexpected influence on the operating behaviour of the drive.

Restoring the factory settings (**P523**) normally affects all parameters. This means that all motor data must subsequently be checked or reconfigured. However, parameter **P523** also offers the option of excluding the motor data or the parameters relevant for bus communication when restoring the factory settings.

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

5.1 Parameter overview

The respective parameter descriptions can be found on the following pages.

Operating displays

P001	Select of disp.value	P002	Display factor	P003	Supervisor-Code
Basic parameters					
P100	Parameter set	P101	Copy parameter set	P102	Acceleration time
P103	Deceleration time	P104	Minimum frequency	P105	Maximum frequency
P106	Ramp smoothing	P107	Brake response time	P108	Disconnection mode
P109	DC brake current	P110	Time DC-brake on	P111	P-factor torque limit
P112	Torque current limit	P113	Jog frequency	P114	Brake release time
P120	Option monitoring				
Motor data					
P200	Motor list	P201	Nominal frequency	P202	Nominal speed
P203	Nominal current	P204	Nominal voltage	P205	Nominal power
P206	Cos phi	P207	Star Delta con.	P208	Stator resistance
P209	No Load Current	P210	Static boost	P211	Dynamic boost
P212	Slip compensation	P213	ISD ctrl. loop gain	P214	Torque precontrol
P215	Boost precontrol	P216	Time boost prectrl.	P217	Oscillation damping
P218	Modulation depth	P219	Auto.magn.adjustment	P220	Par.-identification
P221	Missing angleCFC-Inj	P240	EMF voltage PMSM	P241	Inductivity PMSM
P243	Reluct. angle IPMSM	P244	Peak current PMSM	P245	Osc damping PMSM VFC
P246	Mass Inertia PMSM	P247	Switch freq VFC PMSM		
Control parameters					
P300	Control method	P301	Incremental encoder	P310	Speed Ctrl P
P311	Speed Ctrl I	P312	Torque curr. ctrl. P	P313	Torque curr. ctrl. I
P314	Torq curr ctrl limit	P315	Field curr. ctrl. P	P316	Field curr. ctrl. I
P317	Field curr ctrl lim	P318	P-Weak	P319	I-Weak
P320	Weak Border	P321	Speedctr.I brake off	P325	Function encoder
P326	Ratio encoder	P327	Speed slip error	P328	Speed slip delay
P330	Ident startrotor pos	P331	Switch over freq.	P332	Hyst.Switchover Freq
P333	Flux feedb.fact.PMSM	P334	Encoder offset PMSM	P336	Mode Rotorpos ident
P337	Switch time CFC-Inj	P338	Voltage CFC-Inj.	P339	ReinforcePLL CFC-Inj
P340	CurrentfilterCFC-Inj	P341	Dyn.I-Ctrl. CFC-Inj.	P342	Synchron Start PMSM
P350	PLC Functionality	P351	PLC set val. select.	P353	Bus status vial PLC
P355	PLC Integer setvalue	P356	PLC long setvalue	P360	PLC display value
P370	PLC status				

Control terminals

P400 Setpoint I/P Funct	P401 Mode analog in	P402 Adjust: 0%
P403 Adjust: 100%	P404 Analog input filter	P410 Min. freq. a-in 1/2
P411 Max. freq. a-in 1/2	P412 Nom.val process ctrl	P413 PI-control P comp.
P414 PI-control I comp.	P415 Processcontrol Limit	P416 Ramptime PI setpoint
P417 Offset analog output	P418 Analog output func.	P419 Analog output scal.
P420 Digit inputs	P425 Function PTC input	P426 Quick stop time
P427 Quick stop on Error	P428 Automatic starting	P434 Digital out function
P435 Dig. out scaling	P436 Dig.out. hysteresis	P460 Watchdog time
P464 Fixed Frequency Mode	P465 Fixed freq. Array	P466 Min.freq. proc.ctrl.
P475 Delay on/off switch	P480 Funct. BusIO In Bits	P481 Funct-BusIO Out Bits
P482 Norm. BusIO Out Bits	P483 Hyst. BusIO Out Bits	

Additional parameters

P501 Inverter name	P502 Value Masterfunction	P503 Leading func. output
P504 Pulse frequency	P505 Absolute mini. freq.	P506 Automatic acknowld.
P509 Source control word	P510 Source Setpoints	P511 USS baud rate
P512 USS address	P513 Telegram time-out	P514 CAN bus baud rate
P515 CAN bus address	P516 Skip frequency 1	P517 Skip freq. area 1
P518 Skip frequency 2	P519 Skip freq. area 2	P520 Flying start
P521 Fly. start resol.	P522 Fly. start offset	P523 Factory setting
P525 Load control max	P526 Load control min	P527 Load control freq.
P528 Load control delay	P529 Mode Load control	P533 Factor I ² t Motor
P534 Torque disconn.limit	P535 I ² t motor	P536 Current limit
P537 Pulse Disconnection	P539 Check output voltage	P540 Mode phase sequence
P541 Set digital out	P542 Set analog out	P543 Bus actual value
P546 Func. bus-setpoint	P549 Pot Box Function	P550 EEPROM Copy Order
P552 CAN master circle	P553 PLC set values	P555 P-limit chopper
P556 Braking resistor	P557 Brake resistor type	P558 Flux delay
P559 DC Run-on time	P560 Mode of param.save	

Positioning

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

Information

P700 Current operating state	P701 Last fault	P702 Freq. last error
P703 Current. last error	P704 Volt. last error	P705 Dc.lnk volt.last er
P706 P set last error	P707 Software-Version	P708 State of digital in.
P709 Analog input voltage	P710 Analog output volta.	P711 State of digital out
P712 Energy consumption	P713 Energy breake res.	P714 Operating time
P715 Running time	P716 Current frequency	P717 Current speed
P718 Current set freq.	P719 Actual current	P720 Act. torque current
P721 Actual field current	P722 Current voltage	P723 Voltage -d
P724 Voltage -q	P725 Current cos phi	P726 Apparent power
P727 Mechanical Power	P728 Input Voltage	P729 Torque
P730 Field	P731 Parameter set	P732 Phase U current
P733 Phase V current	P734 Phase W current	P735 Speed encoder
P736 D.c. link voltage	P737 Usage rate brakeres.	P738 Usage rate motor
P739 Temperature	P740 PZD bus in	P741 PZD bus out
P742 Data base version	P743 Inverter ID	P744 Configuration
		P747 Inverter Volt. Range
P748 Status CANopen	P749 Status Dip-switches	P750 Stat. overcurrent
P751 Stat. Overvoltage	P752 Stat. mains failure	P753 Stat. overtemperatur
P754 Stat. parameter lost	P755 Stat. system error	P756 Stat. Timeout
P757 Stat. Customer error	P760 Input current	P780 Device ID
P799 Op.-time last error		

5.2 Description of parameters

5.2.1 Explanation of parameter description

Pxxx (parameter number)	Parameter name		x ¹	S	P
Setting range (or display range)	Display of the typical display format, possible setting range and number of decimal places.	Other applicable parameter(s):	List of other directly related parameters.		
Arrays	[-01]	If parameters are substructured into several arrays, this is shown here.			
Factory setting	{ 0 }	Typical default setting that the parameter has in the delivery state of the device, or to which it is set after restoring the factory settings (see parameter P523).			
Scope of application	List of device variants this parameter applies to. If the parameter is generally valid, i.e. for the entire series, this line may be empty or omitted.				
Description	Description, functionality, meaning and the like for this parameter.				
Note	Additional notes about this parameter.				
Setting values (or display values)	List of possible setting values with description of their respective functions.				

1 x = Other codes

Information

Information lines may be empty or omitted entirely when not used.

Notes / Explanations

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

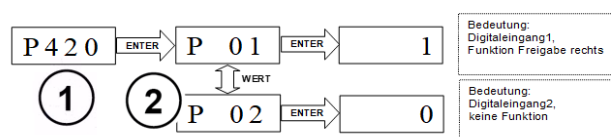
Array parameter display

For some parameters, it is possible to display settings or views in multiple levels ("array"). After selecting one of these parameters, the array level appears and must then also be selected.

When using the SimpleBox SK CSX-3H, the array level is shown as _ - **01**. With the Parameter Box SK PAR-5H, the display of the array level (example: **[01]**) appears in the upper right corner of the screen.

Array display:

SimpleBox SK CSX-3H



- 1 Parameter number
- 2 Array

ParameterBox SK PAR-5H



- 1 Parameter number
- 2 Array

5.2.2 Operating displays

P001	Select of disp.value		
Setting range	0 ... 65		
Factory setting	{ 0 }		
Description	Selection of the operating display for presentation via 7-segment display.		
Setting values	Value Meaning		
	0	Actual frequency [Hz]	Currently supplied output frequency
	1	Speed [rpm]	Calculated speed
	2	Set point frequency [Hz]	Output frequency corresponding to the present setpoint. It does not need to match the current output frequency.
	3	Current [A]	Currently measured output current
	4	Torque current [A]	Torque-generating output current
	5	Voltage [V]	Current alternating voltage supplied at the device output.
	6	D.c. link voltage [V]	"DC link voltage" is the FI's internal DC voltage. It depends, among other things, on the level of the mains voltage.
	7	Cos Phi [-]	Calculated value of the current power factor
	8	Apparent power [kVA]	Calculated value of the current apparent power
	9	Real Power [kW]	Calculated value of the current real power
	10	Torque [%]	Calculated value of the current torque
	11	Field [%]	Calculated value of the current rotating field in the motor
	12	On-time [h]	Period during which mains voltage was present at the device
	13	Run-time [h]	"Runtime" is the time for which the device has been enabled.
	14	Analog input 1 [%]	Current value present at analogue input 1 of the device
	15	Analog input 2 [%]	Current value present at analogue input 2 of the device
	16	Reserved	Reserved for POSICON
	...		
	17		
	19	Temp. of heat sink [°C]	Current temperature of the heat sink
	20	Usage rate motor [%]	Average motor load based on the known motor data P201 ... P209
	21	Usage rate brakeres. [%]	"Usage rate braking resistor" is the average utilisation of the braking resistor based on the known resistance data P556 ... P557 .
	22	Inside inverter temp [°C]	Current interior temperature of the device
	23	Motor temperature [°C]	Measured via temperature sensor (KTY-84, PT100, PT1000)
	30	Cur. set value MP-S [Hz]	"Current motor potentiometer function setpoint with saving". P420 ... = 71/72 . With this function, the setpoint can be read or pre-set (without the drive running).
	40	PLC-Ctrlbox Value [-]	Visualisation mode for PLC communication
	50	Reserved	Reserved for POSICON
	...		
	54		
	60	R Stator Ident. [Ω]	Stator resistance determined by measurement (P220 = 1)
	61	R Rotor Ident. [Ω]	Rotor resistance determined by measurement (P220 = 2)

	62	L Scat. Stator Ident	[mH]	Leakage inductance determined by measurement (P220 = 2)
	63	L Stator Ident	[mH]	Inductance determined by measurement (P220 = 2)
	65	Reserved		---

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

P003	Supervisor-Code			
Setting range	0 ... 9999			
Factory setting	{ 1 }			
Description	The scope of the visible parameters can be influenced by setting the supervisor code.			
Note	Display via NORDCON If parameterisation is carried out with the NORDCON software, the settings 4 ... 9999 are similar to the 0 setting. The settings 1 and 2 are similar to the 3 setting.			
Setting values	Value Meaning			
	0	The supervisor parameter and the P3xx / P6xx groups are not visible, all others are.		
	1	All parameters are visible except for the P3xx and P6xx groups.		
	2	All parameters are visible except for the P6xx group.		
	3	All parameters are visible.		
	4	...9999, only P001 and P003 are visible		

5.2.3 Basic parameters

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

P101	Copy parameter set	S	
Setting range	0 ... 4		
Factory setting	{ 0 }		
Description	“Copy parameter set”. By confirmation with the OK key, the active parameter set (set in P100) is copied into the selected parameter set.		
Setting values	Value Meaning		
	0	No copy	Does not trigger a copy process.
	1	Copy to param. set 1	Copies the active parameter set into parameter set 1
	2	Copy to param. set 2	Copies the active parameter set into parameter set 2
	3	Copy to param. set 3	Copies the active parameter set into parameter set 3
	4	Copy to param. set 4	Copies the active parameter set into parameter set 4

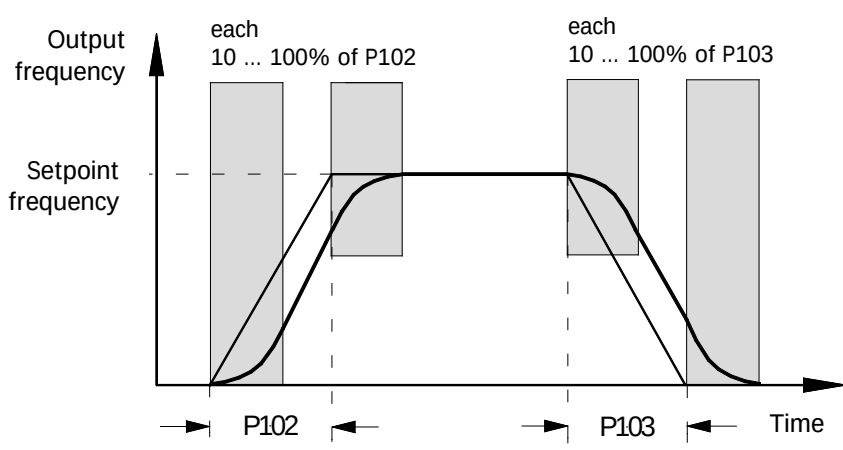
P102	Acceleration time	P
Setting range	0.00 ... 320.00 s	
Factory setting	{ 2.00 }	
Description	The acceleration time is the time which corresponds to the linear frequency increase from 0 Hz to the set maximum frequency P105. If an actual setpoint of < 100% is being used, the acceleration time is linearly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

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

P104	Minimum frequency		P
Setting range	0.0 ... 400.0 Hz		
Factory setting	{ 0.0 }		
Description	The minimum frequency is the frequency supplied by the FI as soon as it is enabled and no additional setpoint is set. In combination with other setpoints (e.g. analogue setpoint or fixed frequencies) these are added to the set minimum frequency. This frequency is undershot when • The drive is accelerated from standstill. • The FI is blocked. The frequency then reduces to the absolute minimum frequency P505 before it is blocked. • The FI reverses. Reversal of the rotation field takes place at the absolute minimum frequency P505. This frequency can be continuously undershot if the function “<i>Maintain the freq.</i>” (digital input function = 9) was executed during acceleration or deceleration.		

P105	Maximum frequency		P
Setting range	0.1 ... 400.0 Hz		
Factory setting	{ 50.0 }		
Description	The maximum frequency is the frequency supplied by the FI after being enabled and once the maximum setpoint is present (e. g. analogue setpoint according to P403, a correspondingly fixed frequency or maximum via a ParameterBox). This frequency can only be exceeded by the slip compensation P212, the function “<i>Maintain the freq.</i>” (Digit inputs function = 9) or the switch to another parameter set with lower maximum frequency. Maximum frequencies are subject to certain restrictions, e. g. • Restrictions in weak field operation, • Compliance with mechanically permissible speeds, • PMSM: Restriction of the maximum frequency to a value which is slightly above the nominal frequency. This value is calculated from the motor data and the input voltage.		

{ 50.0 } S1: DIP7 = off
{ 60.0 } S1: DIP7 = on
4.3.2.2 “DIP switches (S1)”

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 smooth, but dynamic speed variation 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, but values < 10% have no effect. The following applies to the entire acceleration or deceleration time, including ramp smoothing: $t_{Hg} = t_{P102} + t_{P102} \cdot \frac{P106}{100\%}$ t_{Hg}: Total acceleration time, including ramp smoothing $t_{Bg} = t_{P103} + t_{P103} \cdot \frac{P106}{100\%}$ t_{Bg}: Total deceleration time, including ramp smoothing 		
Note	Under the following conditions, ramp smoothing is switched off or replaced with a linear ramp with longer periods: • Acceleration values ($\pm$) less than 1 Hz s^{-1} • Acceleration values ($\pm$) greater than 1 Hz ms^{-1} • Smoothing values < 10%		

P107	Brake reaction time	P
Setting range	0 ... 2.50 s	
Factory setting	{ 0.00 }	
Description	Electromagnetic brakes have a physically-dependent delayed brake reaction time when actuated. This can result in the dropping of the load in lifting gear applications. The brake takes up the load after a delay. The reaction time must be taken into consideration by setting parameter P107. Within the adjustable reaction time, the FI supplies the set absolute minimum frequency P505 and so prevents movement against the brake and load drop when stopping. If a time > 0 is set in P107 or P114, at the moment the FI is switched on, the level of the excitation current (field current) is checked. If no excitation current is present, the FI remains in excitation mode and the motor brake is not released.	
Note	In order to achieve a switch-off and a fault message E016 in case of a too low excitation current, set parameter P539 = 2 or P539 = 3.	
	To control the electromechanical brake (especially for lifting gears), use one of the internal relays (P434 [-01] = 1 or P434 [-02] = 1). The absolute minimum frequency (P505) should never be less than 2.0 Hz.	
	Torque limitation during active setpoint delay (P107/P114) During an active setpoint delay, the torque is limited to a maximum of 160% of the nominal torque. This prevents excessive currents on the frequency inverter or breakdown of the motor, if - for brake application, the <i>brake reaction time</i> (P107) is set too long, or - for brake release, the <i>absolute minimum frequency</i> (P505) is set too high.	

Recommended parameterisation for the application:

Lifting gear with brake without speed feedback

P114 = 0.02 ... 0.4 s *

P107 = 0.02 ... 0.4 s *

P201 ... P208 = Motor data

P434 = 1 (ext. brake)

P505 = 2 ... 4 Hz

For safe starting

P112 = "Off"

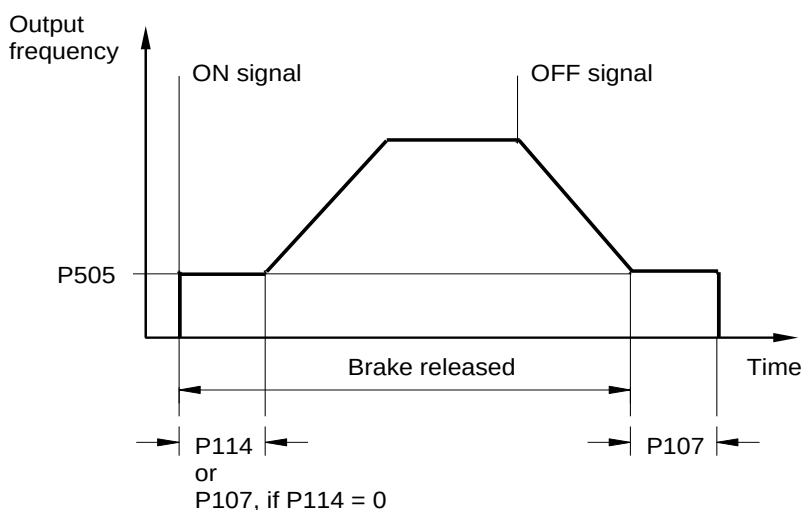
P536 = "Off"

P537 = Factory setting

P539 = Check of exciting current

Against load drops

P214 = 50 ... 100%
(precontrol)



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

P108	Disconnection mode		S	P
Setting range	0 ... 13			
Factory setting	{ 1 }			
Description	This parameter determines the way in which the output frequency is reduced after "Disable" (controller enable → Low).			
Setting values	Value Meaning			
	0	Voltage disable	The output signal is switched off without delay. The FI no longer supplies an output frequency. The motor is only decelerated by mechanical friction. Immediate switch-on of the FI may result in an error message.	
	1	Ramp down	The current output frequency is reduced with the remaining proportion of the deceleration time from P103/P105 . The DC run-on P559 follows the end of the ramp.	
	2	Delayed ramping	Same as P108 = 1 , but for generative operation, the deceleration ramp is extended, and for static operation, the output frequency is increased. Under certain conditions, this function can prevent overvoltage switch-off and reduce power dissipation on the braking resistor. Activating this function may result in error E13.2 . Note: This function must not be programmed if defined deceleration is required, for example with lifting gears.	
	3	Instant d.c. braking	The FI immediately switches to the selected direct current (DC) (P109). This DC is supplied for the remaining proportion of the "Time DC-brake on" (P110). The "Time DC-brake on" is shortened, depending on the current output frequency to maximum frequency (P105) ratio. The time taken for the motor to stop depends on the application. The time taken to stop depends on the load's moment of inertia, the friction and the direct current (P109). With this type of braking, no energy is fed back into the FI. Heat losses primarily occur in the rotor of the motor. Note: This function is not suitable for PMSM motors.	
	4	Const. brakedistance	"Constant braking distance" : Start of the deceleration ramp is delayed if operation is not at the maximum output frequency (P105). This results in an approximately equal braking distance for different current frequencies. Note: This function cannot be used as a positioning function. This function should not be combined with ramp smoothing (P106).	
	5	Combi. braking	"Combined braking" : Depending on the current DC link voltage, a high-frequency voltage is applied to the fundamental frequency (only for linear characteristic curves, P211 = 0 and P212 = 0). The deceleration time P103 is adhered to if possible. → Additional heating in the motor! Note: This function is not suitable for PMSM motors.	
	6	Quadratic Ramp	The deceleration ramp does not proceed on a linear course, but rather a decreasing quadratic one.	
	7	Quad.Ramp with delay	"Quadratic ramp with delay" : Combination of P108 = 2 and P108 = 6	
	8	Quad.Ramp w. braking	"Quadratic combined braking" : Combination of P108 = 5 and P108 = 6 Note: This function is not suitable for PMSM motors.	
	9	Constant accn.	"Constant acceleration power" : Only applies in the field weakening range. The drive is accelerated or decelerated with constant electrical power. The course of the ramps depends on the load.	
	10	Distance Calculator	Constant distance between current frequency/speed and the set minimum output frequency P104 (same as P108 = 4). P108 = 10 , however, only becomes active if the frequency setpoint undershoots the set minimum frequency. In this case, enabling must be retained.	
	11	Constant accn.delay	"Constant acceleration power with delay" : Combination of P108 = 2 and P108 = 9	
	12	Constant accn. Mode3	"Constant acceleration power mode 3" : Same as P108 = 11 , but with additional relief of the brake chopper	
	13	Switch off delay	"Ramp with switch-off delay" : Same as P108 = 1 , but the drive remains at the absolute minimum frequency P505 for the time specified in parameter P110 before the brake is applied. Application example: Re-positioning for crane control	

P109	DC brake current	S	P
Setting range	0 ... 250 %		
Factory setting	{ 100 }		
Description	Current setting for the functions of DC current braking (P108 = 3) and combined braking (P108 = 5). The correct setting value depends on the mechanical load and the required deceleration time. A higher setting brings large loads to a standstill more quickly. The 100 % setting corresponds to a current value as stored in the "Nominal motor current" parameter P203.		
Note	The DC current (0 Hz) which the FI can supply is limited. For this value, please refer to the table in Section 8.4.3 "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 period during which the direct current selected in P109 is applied to the motor. P108 = 3 must be selected. Depending on the ratio of the current output frequency to the max. frequency P105, the "Time DC-brake on" is shortened. The time starts running with the removal of the enable and can be interrupted by renewed enabling.		
Note	If P110 = 0 is set, the deceleration time set in P103 will be used as the "Time DC-brake on". The actual deceleration time t_{Bt} is extended by the time required to build up the necessary current in the motor. $t_{Bt} = P110 + 0.5 \text{ s}$ t_{Bt}: Actual deceleration time DC braking: Not for PMSM motors!		

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

P112	Torque current limit	S	P
Setting range	25 ... 400% / 401		
Factory setting	{ 401 }		
Description ASM	With this parameter, a limit value can be set for the torque-generating current. This can prevent mechanical overload of the drive. However, it cannot provide protection against mechanical blockages (moving on block). A slipping clutch acting as a safety device cannot be replaced. The torque current limit can also be continuously set via an analogue input. The maximum setpoint (cf. adjustment 100%, P403 [-01] ... P403 [-06]) then corresponds to the setting value in P112. The limit value 20% of torque current cannot be undershot even by a smaller analogue setpoint (P400 [-01] ... P400 [-09], setting 11 or 12). In servo mode P300 = 1, however, a limit value of 0% is possible with firmware version V1.3 and higher (older firmware versions: at least 10%).		
Description PMSM	In VFC and CFC open-loop modes of a PMSM, a torque limit is set by force, if none has been programmed in parameter P112, or if the set value is greater than the following limit values: VFC open-loop: Setting value from P210 + max. 30% CFC open-loop: Setting value from P210 + max. 50%		
Note	A torque limit is not permissible for lifting gear applications!		
Setting values	Value Meaning		
	401 OFF	The torque-generating current is not limited.	

P113	Jog frequency	S	P
Setting range	-400.0 ... 400.0 Hz		
Factory setting	{ 0.0 }		
Description	When using a parameterisation unit to control the frequency inverter, the jog frequency represents the initial value after enabling. Alternatively, if control is via the control terminals, the jog frequency can be triggered via one of the digital inputs. The jog frequency can either be set directly via this parameter or by pressing the OK key. The latter requires the frequency inverter to be enabled via the keyboard. The current output frequency is applied to parameter P113 and is available upon renewed enabling.		
Note	Setpoint specifications via the control terminals, such as the jog frequency, fixed frequencies or the analogue setpoint, are generally added with the correct sign. The set maximum frequency P105 cannot be exceeded and the minimum frequency P104 cannot be undershot.		

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

P120	Ext Control Units		S	P
Setting range	0 ... 2			
Arrays	[-01] = Bus option (ext1)		[-03] = 1.IOE (ext3)	
	[-02] = 2.IOE (ext2)		[-04] = Extension unit 4	
Factory setting	All { 1 }			
Description	Monitoring of communication at system bus level (in case of fault: error message E010.9)			
Note	If fault messages detected by the optional module (e.g. faults at field bus level) are not to result in a switch-off of the drive electronics, then parameter P513 = -0.1 must be set additionally.			
Setting values	Value Meaning			
	0	Control off	---	
	1	Auto	Communication relations are 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 one of the extensions establishes a communication relation to the device.	
	2	Control now active	"Monitoring active immediately". The device starts monitoring the corresponding module immediately after switching on the mains. If the module is not detected after switching on the mains, the device remains in "Not ready for switch-on" state for 5 seconds and then triggers an error.	

5.2.4 Motor data / characteristic curve parameters

P200	Motor list	P
Setting range	0 ... 148	
Factory setting	{ 0 }	
Description	The factory settings for the motor data can be changed with this parameter. A 4-pole IE1 asynchronous standard motor is factory-set in parameters P201 ... P209 to match the nominal power of the FI. By selecting one of the possible setting values and pressing the OK key, all motor parameters P201 ... P209, P240, P241, P243, P244 and P246 are matched to the selected motor power. IE5 motor models must be set via P200, as the motor type data is based on the inductance characteristic curve and is insufficient.	
Note	After confirmation of the selection, the value "0" is displayed again in P200. P205 can be used to check if the nominal motor power has been applied. IE2/IE3motors If IE2/IE3 motors are used, after selecting a IE1 motor, the motor data in P201 ... P209 must be matched to the data on the motor name plate.	
Setting values	Value Meaning	
	0	No change
	1	No motor
		In this setting, the FI operates without current control, slip compensation and flux delay, 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 / $\cos \varphi = 0.90$ / Star / $R_s 0.01 \Omega$ / $I_{LEER} 6.5 A$

IE1

2	0,25 kW 230V 71SP/4	33	5,0 PS/hp 230V 112MP/4	64	110,0 kW 400V 315SP/4
3	0,33 PS/hp 230V 71SP/4	34	4,0 kW 400V 112MP/4	65	150,0 PS/hp 460V 315SP/4
4	0,25 kW 400V 71SP/4	35	5,0 PS/hp 460V 112MP/4	66	132,0 kW 400V 315MP/4
5	0,33 PS/hp 460V 71SP/4	36	5,5 kW 230V 132SP/4	67	180,0 PS/hp 460V 316MP/4
6	0,37 kW 230V 71LP/4	37	7,5 PS/hp 230V 132SP/4	68	160,0 kW 400V 315RP/4
7	0,5 PS/hp 230V 71LP/4	38	5,5 kW 400V 132SP/4	69	220,0 PS/hp 460V 315RP/4
8	0,37 kW 400V 71LP/4	39	7,5 PS/hp 460V 132SP/4	70	200,0 kW 400V
9	0,5 PS/hp 460V 71LP/4	40	7,5 kW 230V 132MP/4	71	270,0 PS/hp 460V
10	0,55 kW 230V 80SP/4	41	10,0 PS/hp 230V 132MP/4	72	250,0 kW 400V
11	0,75 PS/hp 230V 80SP/4	42	7,5 kW 400V 132MP/4	73	340,0 PS/hp 460V
12	0,55 kW 400V 80SP/4	43	10,0 PS/hp 460V 132MP/4	74	11,00 kW 230V 160MP/4
13	0,75 PS/hp 460V 80SP/4	44	11,0 kW 400V 160MP/4	75	15,00 PS/hp 230V 160MP/4
14	0,75 kW 230V 80LP/4	45	15,0 PS/hp 460V 160MP/4	76	15,00 kW 230V 160LP/4
15	1,0 PS/hp 230V 80LP/4	46	15,0 kW 400V 160LP/4	77	20,00 PS/hp 230V 160LP/4
16	0,75 kW 400V 80LP/4	47	20,0 PS/hp 460V 160LP/4	78	18,50 kW 230V 180MP/4
17	1,0 PS/hp 460V 80LP/4	48	18,5 kW 400V 180MP/4	79	25,00 PS/hp 230V 180MP/4
18	1,1 kW 230V 90SP/4	49	25,0 PS/hp 460V 180MP/4	80	22,00 kW 230V 180LP/4
19	1,5 PS/hp 230V 90SP/4	50	22,0 kW 400V 180LP/4	81	30,00 PS/hp 230V 180LP/4
20	1,1 kW 400V 90SP/4	51	30,0 PS/hp 460V 180LP/4	82	30,00 kW 230V 225RP/4
21	1,5 PS/hp 460V 90SP/4	52	30,0 kW 400V 225RP/4	83	40,00 PS/hp 230V 225RP/4
22	1,5 kW 230V 90LP/4	53	40,0 PS/hp 460V 225RP/4	84	37,00 kW 230V 225SP/4
23	2,0 PS/hp 230V 90LP/4	54	37,0 kW 400V 225SP/4	85	50,00 PS/hp 230V 225SP/4
24	1,5 kW 400V 90LP/4	55	50,0 PS/hp 460V	86	0,12 kW 115V
25	2,0 PS/hp 460V 90LP/4	56	45,0 kW 400V 225MP/4	87	0,18 kW 115V
26	2,2 kW 230V 100LP/4	57	60,0 PS/hp 460V 225SP/4	88	0,25 kW 115V
27	3,0 PS/hp 230V 100LP/4	58	55,0 kW 400V 250WP/4	89	0,37 kW 115V
28	2,2 kW 400V 100LP/4	59	75,0 PS/hp 460V 250WP/4	90	0,55 kW 115V
29	3,0 PS/hp 460V 100LP/4	60	75,0 kW 400V 280SP/4	91	0,75 kW 115V

30	3,0 kW 230V 100AP/4	61	100,0 PS/hp 460V 280SP/4	92	1,10 kW 115V
31	3,0 kW 400V 100AP/4	62	90,0 kW 400V 280MP/4	93	4,00 PS/hp 230V
32	4,0 kW 230V 112MP/4	63	120,0 PS/hp 460V 280MP/4	94	4,00 PS/hp 460V

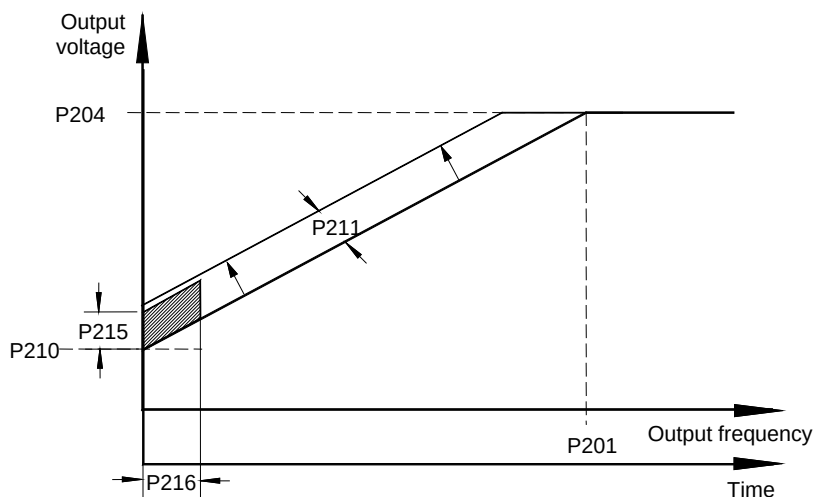
IE4

95	0,75 kW 230V 80T1/4	102	1,50 kW 400V 80T1/4	109	3,00 kW 400V 100T2/4
96	1,10 kW 230V 90T1/4	103	2,20 kW 230V 100T2/4	110	3,00 kW 400V 90T3/4
97	1,10 kW 230V 80T1/4	104	2,20 kW 230V 90T3/4	111	4,00 kW 230V 100T5/4
98	1,10 kW 400V 80T1/4	105	2,20 kW 400V 90T3/4	112	4,00 kW 400V 100T5/4
99	1,50 kW 230V 90T3/4	106	2,20 kW 400V 90T1/4	113	4,00 kW 400V 100T2/4
100	1,50 kW 230V 90T1/4	107	3,00 kW 230V 100T5/4	114	5,50 kW 400V 100T5/4
101	1,50 kW 400V 90T1/4	108	3,00 kW 230V 100T2/4		

IE5

117	0,35 kW 400V 71N1/8	127	2,20 kW 400V 90N3/8	137	0,70 kW 230V 71N2/8
118	0,50 kW 400V 71F1/8	128	2,20 kW 400V 90F2/8	138	-
119	0,70 kW 400V 71N2/8	129	3,00 kW 400V 90F3/8	139	1,05 kW 230V 71N3/8
120	1,00 kW 400V 71F2/8	130	3,70 kW 400V 90F4/8	140	1,10 kW 230V 90N1/8
121	1,05 kW 400V 71N3/8	131	4,00 kW 400V 112F1/8	141	-
122	1,10 kW 400V 71N1/8	132	5,50 kW 400V 112F2/8	142	-
123	1,50 kW 400V 71F3/8	133	7,50 kW 400V 112F3/8	143	1,50 kW 230V 90N2/8
124	1,50 kW 400V 90N2/8	134	11,0 kW 400V 112F4/8	144	-
125	1,50 kW 400V 90F1/8	135	0,35 kW 230V 71N1/8	145	2,20 kW 230V 90N3/8
126	2,20 kW 400V 71F4/8	136	-		

P201 ... P216 Control/characteristic curve parameters



NOTE:

"typical"

Settings for the...

Current vector control (factory setting)

P201 to P209 = Motor data

- P210 = 100%
- P211 = 100%
- P212 = 100%
- P213 = 100%
- P214 = 0%
- P215 = No significance
- P216 = No significance

Linear V/f characteristic curve

P201 to P209 = Motor data

- P210 = 100%)
- P211 = 0%
- P212 = 0%
- P213 = No significance
- P214 = No significance
- P215 = 0%)
- P216 = 0 s

P201	Nominal frequency		S	P
Setting range	10.0 ... 399.9 Hz			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	The nominal motor frequency determines the V/f break point at which the frequency inverter supplies the nominal voltage (P204) at the output.			
P202	Nominal speed		S	P
Setting range	150 ... 24000 rpm			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	The nominal motor speed is important for correct calculation and control of the motor slip and the speed display (P001 = 1).			
P203	Nominal current		S	P
Setting range	0.1 ... 1000.0 A			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	The nominal motor current is a decisive parameter for current vector control.			
P204	Nominal voltage		S	P
Setting range	100 ... 800 V			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	This parameter sets the nominal motor voltage. The combination with the nominal frequency results in the voltage/frequency characteristic curve.			
P205	Nominal power			P
Setting range	0.00 ... 250.00 kW			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	This parameter is used to set the nominal motor power.			
P206	Cos phi		S	P
Setting range	0.50 ... 0.98			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	The motor cos ϕ is a decisive parameter for current vector control.			
P207	Star Delta con.		S	P
Setting range	0 ... 1			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	The motor circuit is decisive for stator resistance measurement (P220) and therefore for current vector control.			
Setting values	Value Meaning			
	0	Star	Star circuit	
	1	Delta	Star-delta circuit	

P208		Stator resistance	S	P
Setting range	0.00 ... 300.00 Ω			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	Motor stator resistance → Resistance of a phase in a three-phase motor. The stator resistance has a direct influence on the current control of the frequency inverter. A value that is too high can lead to overcurrent; a value that is too low can lead to low motor torque. The result of the stator resistance measurement (see P220) is shown in P208. However, this value can also be overwritten here.			
Note	For optimum function of the current vector control, the stator resistance should be measured automatically by the frequency inverter.			

P209		No Load Current	S	P
Setting range	0.0 ... 1000.0 A			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Description	This value is always calculated automatically from the motor data if there is a change in parameters P206 “Cos phi” and P203 “Nominal current”.			
Note	If the value is to be entered directly, it must be set as the last value of the motor data. This is the only way to ensure that the value will not be overwritten.			

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

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

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

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

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

P215	Boost precontrol	S	P
Setting range	0 ... 200%		
Factory setting	{ 0 }		
Description	Only advisable with linear characteristic curve (P211 = 0% and P212 = 0%). For drives which require a high starting torque, this parameter provides an option for switching in an additional electric current during the start phase. The application time is limited and can be selected in parameter P216 "Boost precontrol". All current and torque current limits that may have been set P112, P536, P537 are deactivated during the boost precontrol.		
Note	With active ISD control (P211 and / or P212 ≠ 0%), parameterisation of P215 ≠ 0 results in incorrect control.		
P216	Time boost prectrl.	S	P
Setting range	0.0 ... 10.0 s		
Factory setting	{ 0.0 }		
Description	This parameter is used for 3 functionalities: 1. Time limit for the boost precontrol: Application time for the increased starting current. Only with linear characteristic curve (P211 = 0% and P212 = 0%). 2. Time limit for suppression of pulse disconnection P537: enables start-up under heavy load. 3. Time limit for suppression of error switch-off in parameter P401, function "0 ... 10 V with error switch-off 2".		
P217	Oscillation damping	S	
Setting range	0 ... 400%		
Factory setting	{ 10 }		
Description	The parameter is a measure of the damping power. Oscillations caused by idling resonance 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. It is amplified with P217, inverted and applied to the output frequency. The limit for the applied value 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 is applied. At 400% in P217, this corresponds to ±1.8 Hz.		
Note	This function is not active with control method "CFC closed-loop" (servo mode) P300 = 1 .		
P218	Modulation depth	S	
Setting range	50 ... 110 %		
Factory setting	{ 100 }		
Description	This setting influences the maximum possible output voltage of the FI in relation to the mains voltage. Values <100% reduce the voltage to values which are less than the mains voltage. Values >100 % increase the output voltage to the motor. resulting in increased harmonics in the current, which may cause "hunting", i.e. fluctuating speed in some motors. The parameter should normally be set to 100%.		

P219	Auto.magn.adjustment		S
Setting range	25 ... 100% / 101		
Factory setting	{ 100 }		
Description	<i>“Automatic magnetisation adjustment”</i>. With this parameter, the magnetisation of the motor can be automatically adjusted to the motor load, so that the energy consumption is reduced to the amount which is actually required. P219 is the limit value, to which the field in the motor can be reduced. Reduction of the field is performed with a time constant of 7.5 s. If the load increases, the field is increased with a time constant of approx. 300 ms. The field is reduced so that the excitation current and the torque current are approximately equal, i.e. the motor is operated with “optimum efficiency”. This function is suitable for applications with relatively constant torque (e.g. pump and fan applications). Its effect therefore replaces a quadratic characteristic curve, as it adapts the voltage to the load.		
Note	For applications with rapid torque fluctuations (e.g. lifting gears), this parameter should be left at the factory setting (100%). Otherwise, rapid load changes may cause overcurrent switch-off or “breakdown” of the motor.		
	For the operation of synchronous machines, this parameter is without function.		
Setting values	Value Meaning		
	100	Function deactivated	
	101	Automatic	Activation of automatic excitation current control. The ISD control then operates with a subordinate flux controller, which improves the slippage calculation, especially at higher loads. The rise times are considerably faster than with normal ISD control P219 = 100 .

P220	Par.-identification			P
Setting range	0 ... 2			
Factory setting	{ 0 }			
Description	<i>“Parameter identification”</i>. For devices with an output up to 22 kW, the motor data is determined automatically by the device via this parameter. Do not switch off the mains voltage during parameter identification. Better drive behaviour is often achieved with calibrated motor data. If an unusual drive behaviour occurs after the parameter identification, set parameters P201 ... P208 manually (name plate).			
Note	- Carry out parameter identification only when the motor is cold (15 ... 25 °C) Motor heating during operation is taken into account. - The frequency inverter must be in “Ready for operation” state. 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 frequency inverter. - For reliable parameter identification, the motor cable must not exceed the maximum cable length of 20 m. - Ensure that the connection to the motor is not interrupted during the measuring process. - Before starting the parameter identification, the following motor data must be entered according to the name plate: - Nominal motor frequency in P201 - Nominal motor speed in P202 - Nominal motor current in P203 - Nominal motor voltage in P204 - Nominal motor power in P205 - Star Delta connection in P207 - When using synchronous motors, parameters P241, P243, P244 and P246 must also be parameterised. - After successful parameter identification, P220 is = 0 again. - If the parameter identification cannot be completed successfully, error message E019 is generated. - Do not make any changes to the parameters while the measurement is in process.			
Setting values	Value Meaning			
	0	No identification	The motor parameters are not identified.	
	1	Identification Rs	The stator resistance (display in P208) is determined by multiple measurements.	
	2	Identification motor	This function can only be used with devices up to 22 kW. ASM: All motor parameters (P202, P203, P206, P208, P209) are determined. PMSM: The stator resistance P208 and the inductance P241 are determined.	
P221	Missing angleCFC-Inj			S P
Setting range	-90 ... 90°			
Factory setting	{ 0 }			
Scope of application				
Description	<i>“Shift angle CFC injection”</i>; compensation of the load-dependent phase shift angle of the rotor position of a PMSM.			
Note	The parameter is only relevant for sensorless control with injection signal (P300 = 3). When using NORD motors, the value is automatically set by selecting the motor via the motor list (P200).			

P240	EMF voltage PMSM		S	P										
Setting range	0 ... 800 V													
Factory setting	The factory setting depends on the nominal power of the frequency inverter.													
Scope of application														
Description	The EMF voltage PMSM describes the mutual induction voltage of the motor. It can be calculated if the EMF constant (K_E) and the nominal speed (n_N) of the motor are known. Example: <table><tr><td>K_E (EMF constant, see name plate):</td><td>89 mV min</td></tr><tr><td>n_N (nominal motor speed):</td><td>2100 rpm</td></tr></table> <table><tr><td>Value in P240</td><td>P240 = $K_E \times n_N \times 10^{-3}$</td></tr><tr><td></td><td>P240 = 89 mV min $\times$ 2100 rpm $\times 10^{-3}$</td></tr><tr><td></td><td>P240 = 187 V</td></tr></table>				K_E (EMF constant, see name plate):	89 mV min	n_N (nominal motor speed):	2100 rpm	Value in P240	P240 = $K_E \times n_N \times 10^{-3}$		P240 = 89 mV min $\times$ 2100 rpm $\times 10^{-3}$		P240 = 187 V
K_E (EMF constant, see name plate):	89 mV min													
n_N (nominal motor speed):	2100 rpm													
Value in P240	P240 = $K_E \times n_N \times 10^{-3}$													
	P240 = 89 mV min $\times$ 2100 rpm $\times 10^{-3}$													
	P240 = 187 V													
Setting values	Value Meaning													
	0	ASM in use	"Asynchronous machine is used". No compensation.											

P241	Inductivity PMSM		S	P
Setting range	0.1 ... 200.0 mH			
Arrays	[-01] = L_d		[-04] = unsaturated L_q	
	[-02] = L_q		[-05] = saturated L_d	
	[-03] = unsaturated L_d		[-06] = saturated L_q	
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Scope of application				
Description	The stator inductance of the d or q component of a permanently excited synchronous motor (PMSM). The stator inductances can be calibrated by the frequency inverter (P220).			
Note	Parameter settings are only taken into account if an IE5+ motor is used and the setting in P240 does not equal "0".			

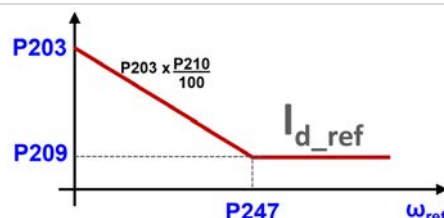
P243	Reluct. angle IPMSM		S	P
Setting range	0 ... 30°			
Factory setting	The factory setting depends on the nominal power of the frequency inverter.			
Scope of application				
Description	"Reluctance angle IPMSM"; in addition to the synchronous torque, synchronous machines with embedded magnets (IPMSM) also have a reluctance torque. This is due to the anisotropy (imbalance) between the inductance in the d and the q direction. Due to the superimposition of these two torque components, the optimum efficiency is not at a load angle of 90° as with SPMSMs, but rather at larger values. This additional angle is taken into account with this parameter. The smaller the angle, the smaller the reluctance proportion. The specific reluctance angle for the motor can be determined as follows: - Run the drive with a constant load (> 0.5 M_N) in CFC mode (P300 $\geq$ 1) - Gradually increase the reluctance angle P243 until the current P719 reaches its minimum			
Note	Parameter settings are only taken into account if an IE5+ motor is used and the setting in P240 does not equal "0".			

P244	Peak current PMSM	S	P
Setting range	-20.0 ... 1000.0 A		
Arrays	[-01] = Peak current PMSM [-02] = I_{max} unsaturated Ld [-03] = I_{max} unsaturated Lq [-04] = I_{min} saturated Ld [-05] = I_{min} saturated Lq		
Factory setting	The factory setting depends on the nominal power of the frequency inverter.		
Scope of application			
Description	For PMSMs with non-linear characteristic induction curves, the linearity limits can be entered with parameter P244 [-02] ... P244 [-05] . For NORD PMSMs (IE4 and IE5+ motors), the necessary data is stored if the motor is selected in P200 .		
Note	Parameter settings are only taken into account if an IE5+ motor is used and the setting in P240 does not equal "0".		

P245	Osc damping PMSM VFC	S	P
Setting range	5 ... 250%		
Factory setting	{ 25 }		
Scope of application			
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.		
Note	Parameter settings are only taken into account if an IE5+ motor is used and the setting in P240 does not equal "0".		

P246	Mass Inertia PMSM	S	P
Setting range	0.0 ... 1000.0 kg cm ²		
Factory setting	The factory setting depends on the nominal power of the frequency inverter.		
Description	The mass inertia of the drive system can be entered in this parameter. The factory setting is sufficient for most applications, but, for highly dynamic systems, the actual value should ideally be entered. The values for the motors can be obtained from the technical data. The proportion of the external centrifugal mass (gear unit, machine) must be calculated or determined experimentally.		

P247	Switch freq VFC PMSM	S	P
Setting range	1 ... 100%		
Factory setting	{ 25 }		
Scope of application			
Description	"Switchover frequency VFC PMSM". In order to immediately provide a minimum torque in case of spontaneous load changes, in particular for small frequencies, in VFC mode the setpoint of I_d (excitation current) is controlled depending on the frequency (field increase mode). The value of this additional field current is determined by parameter P210. It decreases linearly to "zero", which is reached at the frequency that is specified by P247. 100% corresponds to the nominal frequency from P201.		
Note	Parameter settings are only taken into account if an IE5+ motor is used and the setting in P240 does not equal "0".		



5.2.5 Speed control

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

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

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

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

Information

Operation of a synchronous motor with P300 = 1

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

P301	Incremental encoder	S
Setting range	0 ... 19	
Factory setting	{ 6 }	
Description	"Encoder resolution". Input of the number of pulses per revolution of the connected incremental encoder. If the encoder's direction of rotation is not the same as the frequency inverter's (depending on installation and wiring), this can be taken into account by selecting the corresponding negative pulse numbers.	
Note	P301 is also significant for positioning control via incremental encoders. If an incremental encoder is used for positioning (P604 = 0), the setting of the pulse number is made here (see supplementary POSICON manual).	
Setting values	Value Meaning	
	0	500 pulses
	1	512 pulses
	2	1000 pulses
	3	1024 pulses
	4	2000 pulses
	5	2048 pulses
	6	4096 pulses
	7	5000 pulses
	8	-500 pulses
	9	-512 pulses
	10	-1000 pulses
	11	-1024 pulses
	12	-2000 pulses
	13	-2048 pulses
	14	-4096 pulses
	15	-5000 pulses
	16	-8192 pulses
	17	8192 pulses
	18	1024 SLCA ¹
	19	-1024 SLCA ¹

¹ The settings 18 and 19 are specially intended for use of a Contelec magnetic encoder with 1024 pulses per encoder revolution.

P310 Speed Ctrl P		S	P
Setting range	0 ... 3200%		
Factory setting	{ 100 }		
Description	P component of the speed controller (proportional gain). Gain factor, by which the speed difference between the setpoint and the actual frequency is multiplied. A value of 100% means that a speed difference of 10% results in a setpoint of 10%. Values that are too high can cause the output speed to oscillate.		
P311 Speed Ctrl I		S	P
Setting range	0 ... 800% ms ⁻¹		
Factory setting	{ 20 }		
Description	I component of the speed controller (integration component). The integration component of the controller enables complete elimination of any control deviation. The value indicates how large the setpoint change is per millisecond. Values that are too small cause the controller to slow down (reset time is too long).		
P312 Torque curr. ctrl. P		S	P
Setting range	0 ... 1000 %		
Factory setting	{ 400 }		
Description	Current controller for the torque current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. At low frequencies, excessively high values of P312 generally result in high frequency oscillations. On the other hand, excessively high values of P313 usually cause low frequency oscillations over the entire speed range. If the value "Zero" is set in P312 and P313 , the torque current control is switched off. In this case, only the lead time for the motor model is used.		
P313 Torque curr. ctrl. I		S	P
Setting range	0 ... 800% ms ⁻¹		
Factory setting	{ 50 }		
Description	I component of the torque current controller (see P312 "Torque curr. ctrl. P").		
P314 Torq curr ctrl limit		S	P
Setting range	0 ... 400 V		
Factory setting	{ 400 }		
Description	"Torque curr. Ctrl. limit". Determines the maximum voltage increase of the torque current controller. The higher the value, the greater the maximum effect that can be exercised by the torque current controller. Excessive values in P314 can specifically lead to instability during transition to the field weakening range (see P320). The values for P314 and P317 should always be set approximately the same, so that the field and torque current controllers are balanced.		

P315	Field curr. ctrl. P		S	P
Setting range	0 ... 1000 %			
Factory setting	{ 400 }			
Description	Current controller for the field current. The higher the current controller parameters are set, the more precisely the current setpoint is maintained. At low frequencies, excessively high values of P315 generally result in high frequency oscillations. On the other hand, excessively high values of P316 usually cause low frequency oscillations over the entire speed range The field current controller is switched off if the value "Zero" is entered in P315 and P316. In this case, only the lead time for the motor model is used.			
P316	Field curr. ctrl. I		S	P
Setting range	0 ... 800% ms ⁻¹			
Factory setting	{ 50 }			
Description	I component of the field current controller (see P315 "Field current controller P").			
P317	Field curr ctrl lim		S	P
Setting range	0 ... 400 V			
Factory setting	{ 400 }			
Description	"Field curr. ctrl. limit". Determines the maximum voltage increase of the field current controller. The higher the value, the greater the maximum effect of the field current controller. Excessive values in P317 can specifically lead to instability during transition to the field weakening range (see P320). The values for P314 and P317 should always be set approximately the same, so that the field and torque current controllers are balanced.			
P318	P weak		S	P
Setting range	0 ... 800 %			
Factory setting	{ 150 }			
Description	The field weakening controller reduces the field setpoint if the synchronous speed is exceeded. In the basic speed range, the field weakening controller has no function; for this reason, the field weakening controller only needs to be set if speeds above the nominal motor speed are set. Excessive values for P318 / P319 cause controller oscillations. The field is not weakened sufficiently if the values are too small, or during dynamic acceleration and/or delay times. The downstream current controller can no longer read the current setpoint.			
P319	I-Weak		S	P
Setting range	0 ... 800% ms ⁻¹			
Factory setting	{ 20 }			
Description	Only affects the field weakening range (see P318 "P-Weak").			
P320	Weak border		S	P
Setting range	0 ... 110 %			
Factory setting	{ 100 }			
Description	The field weakening limit determines the speed /current at which the controller begins to weaken the field. At a set value of 100 % the controller begins to weaken the field at approximately the synchronous speed. If values much larger than the standard values have been set in P314 and/or P317, the field weakening limit should be correspondingly reduced, so that the control range is actually available to the current controller.			

P321	Speedctr.l brake off	S	P
Setting range	0 ... 4		
Factory setting	{ 0 }		
Scope of application			
Description	<i>"Release time of speed controller l"</i> . During the brake release time P107 / P114 , the l component of the speed controller is increased. This leads to better load take-up, especially with overhanging loads.		
Setting values	Value Meaning		
	0	P311 Speedctr.l *1	3 P311 Speedctr.l *8
	1	P311 Speedctr.l *2	4 P311 Speedctr.l *16
	2	P311 Speedctr.l *4	

P325	Function encoder	S
Setting range	0 ... 4	
Factory setting	{ 0 }	
Description	The actual speed value supplied by an incremental encoder can be used for various functions in the FI.	
Setting values	Value Meaning	
	0	CFC closed-loop <i>"Servo mode speed measurement"</i> : The actual motor speed value is used for speed control with encoder feedback. The ISD control cannot be switched off in this function.
	1	PID actual frequency The actual speed value of a system is used for speed control. This function can also be used for controlling a motor with a linear characteristic curve. It is also possible to evaluate an incremental encoder for speed control that is not mounted directly on the motor. P413 ... P416 determine the control.
	2	Frequency addition The determined speed is added to the current setpoint.
	3	Freq. subtraction The determined speed is subtracted from the current setpoint.
	4	Maximum frequency The maximum possible output frequency / speed is limited by the speed of the encoder.

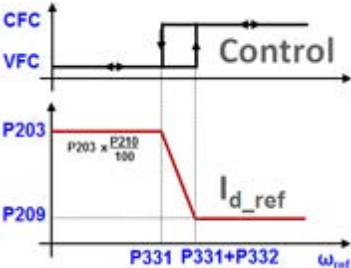
P326	Ratio encoder	S
Setting range	0.01 ... 100.00	
Factory setting	{ 1.00 }	
Description	<i>"Ratio encoder"</i> . If the incremental encoder is not mounted directly onto the motor shaft, the correct speed ratio of motor speed to encoder speed must be set. $P326 = \frac{n_M}{n_G}$ n_M: Number of motor revolutions n_G: Number of encoder revolutions	
Note	Not for P325 = 0.	

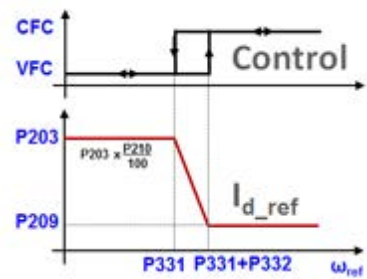
P327	Speed slip error	S	P
Setting range	0 ... 3000 rpm		
Factory setting	{ 0 }		
Description	“<i>Slip error speed controller</i>”. The limit value for a permissible maximum slip error can be set. If this value is reached, the FI switches off with an error message: Limit value has been exceeded during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

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

P330	Ident startrotor pos	S	P
Setting range	0 ... 6		
Factory setting	{ 0 }		
Scope of application			
Description	“<i>Rotor starting position detection</i> “. Selection of the method for determination of the starting position of the rotor (initial value of the rotor position) of a PMSM (Permanent Magnet Synchronous Motor). The parameter is only relevant for the control method “CFC closed-loop” (P300 = 1).		
Setting values	Value Meaning		
	0 Voltage-controlled: With the first start of the machine, a voltage indicator is applied to ensure that the rotor of the machine is set to rotor position “zero”. This type of rotor starting position determination can only be used if there is no counter-torque from the machine at frequency “zero” (e.g. flywheel drives). If this condition is met, this method for rotor position determination is very accurate (<1° electrical). This method is unsuitable for lifting gears, as there is always a counter-torque. The following applies to operation without encoder: Up to the switch-over frequency P331, the motor (with the nominal current applied) is operated under voltage control. Once the switch-over frequency has been reached, the method for determining the rotor position is switched over to the EMF method. If the frequency – taking into account the hysteresis (P332) – drops below the value in P331, the frequency inverter switches back from the EMF method to voltage-controlled operation.		
	1 Testsignal principle: The starting position of the rotor is determined by a test signal. If this method is also to be used at a standstill with the brake applied, a PMSM with sufficient anisotropy between the inductance of the d and q axes is required. The greater this anisotropy is, the greater the precision of the method. The voltage level of the test signal can be changed with parameter P212, and the rotor position controller can be adjusted with parameter P333. For motors which are suitable for use with the test signal principle, a rotor position accuracy of 5°...10° electrical can be achieved (depending on the motor and the anisotropy). The conditions for activating the test signal principle can be selected with P336. Note: The voltage level of the test signal principle for P300 = 1 can be adjusted via P338 if necessary. With control type P300 = 3, the voltage level of the test signal principle can be adjusted via P212 if necessary.		

3	Value CANopen enc., “Value from CANopen encoder”: This method determines the rotor starting position from the absolute position of a CANopen absolute encoder. The CANopen absolute encoder type is set in parameter P604. The CANopen absolute encoder should be located on the motor axis. For this position information to be unique, it must be known (or determined) how this rotor position relates to the absolute position of the CANopen absolute encoder. This ratio must be stored in parameter P334 “Encoder offset PMSM”. If this offset value is not available on the motor, it can also be determined with parameter P330 = 0 and P330 = 1. After the first start, the determined offset value is available in parameter P334. This value is volatile, i.e. it is only stored in the RAM. In order to save it in EEPROM, it must be briefly changed and then set back to the determined value. After this, fine tuning can be carried out with the idling motor. For this, the drive is operated in closed-loop mode (P300 = 1) at as high a speed as possible but below the field weakening point. From the starting point, the offset is gradually adjusted so that the value of the voltage component U_d (P723) is as close as possible to zero. A balance between the positive and negative direction of rotation should be sought. In general, the value “zero” cannot be completely achieved, as the drive has a slight load at high speeds due to the motor's fan wheel.
4	voltage control cycl “Voltage control, cyclically”. Same as P330 = 0, but taking into account the zero track of the encoder. Evaluation of the zero track is activated via P420 “Digit inputs”. With incremental encoders acting as encoders with zero track, the position of the zero track is aligned with the magnet position “0” of the motor during the production of NORD motors. After the zero pulse has been reached for the first time, the inverter therefore adopts this value as a reference value and thus achieves a high precision. This achieves optimum use of current per torque or optimum motor efficiency. Whether the zero track is only to be evaluated once or after each enable can be set via P420.
5	Testsignal cycl.: Same as P330 = 1, but taking into account the zero track of the encoder. Evaluation of the zero track is activated via P420 “Digit inputs”.
6	value CANopen.cycl, “Value from CANopen encoder, cyclically”: Same as P330 = 4, but the starting position of the rotor is determined with each enable.

P331	Switch over freq.	S	P
Setting range	5.0 ... 100.0%		
Factory setting	{ 15.0 }		
Description	“Switchover frequency CFC open-loop”: For P300 = 2: Definition of the frequency above which, in operation without encoder, the control method is activated according to P300.		
Note	100% corresponds to the nominal frequency from P201. - The parameter is only relevant for: P300 = 2 ... 3.		

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

P333	Flux feedb.fact.PMSM	S	P
Setting range	5 ... 400%		
Factory setting	{ 25 }		
Description	<i>"Flux feedback CFC open-loop"</i>. This parameter is necessary for the position monitor in CFC open-loop mode. The higher the value selected, the lower the flux error from the rotor position monitor. Higher values, however, also limit the lower limit frequency of the position monitor. The larger the feedback amplification selected, the higher the limit frequency and thus the higher the values to be set in P331 and P332. This conflict of objectives can therefore not be resolved simultaneously for both optimisation objectives.		
Note	The factory setting is selected so that it typically does not need to be adjusted for synchronous motors from NORD.		
P334	Encoder offset PMSM	S	P
Setting range	-0.500 ... 0.500 rev		
Factory setting	{ 0.000 }		
Scope of application			
Description	Evaluation of the zero track is necessary for closed-loop operation with incremental encoders of PMSMs (Permanent Magnet Synchronous Motors). The zero pulse is then used for synchronisation of the rotor position. The value to be set for parameter P334 (offset between zero pulse and actual rotor position "zero") must be determined experimentally or included with the motor. Enter the electrical angle here. The mechanical angle can be calculated as follows: $\alpha = \frac{\mathbf{P334} * 360^\circ}{p}$ α: Mechanical angle p: Number of pole pairs		
Note	Upon the delivery of NORD motors, the encoder's zero pulse corresponds to the zero pole position of the motor. In case of deviation, this can be obtained from an adhesive label on the motor.		
	The zero track is connected via digital input 1. Set P420 [-01] = 43 to evaluate the pulses of the zero track.		

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

Functional relation between P336 and P342

In addition to the functions described directly in the parameters, parameters **P336** and **P342** are also directly related to each other.

Control	Setting		Remark
	P336	P342	
CFC closed-loop (P300 = 1) - Voltage control (P330 = 0) or Test signal principle (P330 = 1) - Absolute encoder	0	No function	- Start of drive: no delay - Offsetting I²t motor integrator upon first enable after "Power ON"
	1, 2	No function	- Start of drive: no delay - Offsetting I²t motor integrator according to P336 - Synchronous start of the drives
CFC open-loop-inje (P300 = 3)	1, 2	0 ... 5	- Start of drive: delay according to P342 - Offsetting according to P336
	0	0	- Start of drive: no delay - Offsetting I²t motor integrator upon first enable after "Power ON"
	0	≠ 0	- Start of drive: delay according to P342 - Offsetting I²t motor integrator upon "Power ON"

P337	Switch time CFC-Inj		S	P
Setting range	0.3 ... 100.0 ms			
Factory setting	{ 25.0 }			
Scope of application				
Description	<i>"CFC injection switchover time"</i>: P337 defines how long the transition from injection-based speed control to observer-based speed control will take. The transition range starts with a frequency from P331 + P332. By increasing the switchover time (P337), potential vibrations can be reduced during the transition between both control methods. Increased settings, however, are to the disadvantage of dynamics.			
Note	The parameter is only relevant for the "CFC open-loop-inje" control method (P300 = 3) and only while starting and not while braking.			
P338	Voltage CFC-Inj		S	P
Setting range	1 ... 1000%			
Factory setting	{ 100 }			
Scope of application				
Description	<i>"Voltage CFC injection"</i>: Adjustment of the injection voltage. The higher the selected voltage, the greater the precision. In addition, the noise development increases during the identification process.			
Note	- The factory setting (100%) for the voltage required for the drive is automatically calculated and results from the motor data and the frequency inverter used - Parameter P338 only has an influence if: P300 = 3 or P300 = 1 and P330 = Selection of a test signal principle (e.g. P330 = 1)			
P339	ReinforcePLL CFC-Inj		S	P
Setting range	5 ... 2000%			
Factory setting	{ 100 }			
Scope of application				
Description	<i>"PLL CFC injection reinforcement"</i>: Adjustment of the gain factor of the rotor position tracking speed for injection-based speed control (P300 = 3). High gain results in higher angular precision. However, this increases sensitivity to faults.			
P340	CurrentfilterCFC-Inj		S	P
Setting range	1.0 ... 100.0% ms ⁻¹			
Factory setting	{ 6.0 }			
Scope of application				
Description	<i>"Current filter CFC injection"</i> Adjustment of the filter for the injection signal of the injection-based speed control (P300 = 3). With highly dynamic systems, the adjustment of the filter may be required.			
Note	When using the injection-based control (P300 = 3), an incorrectly set filter may result in a deterioration of the speed precision.			

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

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

Functional relation between P336 and P342

In addition to the functions described directly in the parameters, parameters **P336** and **P342** are also directly related to each other.

Control	Setting		Remark
	P336	P342	
CFC closed-loop (P300 = 1) • Voltage control (P330 = 0) or Test signal principle (P330 = 1) • Absolute encoder	0	No function	• Start of drive: no delay • Offsetting I ² t motor integrator upon first enable after "Power ON"
	1, 2	No function	• Start of drive: no delay • Offsetting I ² t motor integrator according to P336

Control	Setting		Remark
	P336	P342	
			Synchronous start of the drives
CFC open-loop-inje (P300 = 3)	1, 2	0 ... 5	- Start of drive: delay according to P342 - Offsetting according to P336
	0	0	- Start of drive: no delay - Offsetting I²t motor integrator upon first enable after "Power ON"
	0	≠ 0	- Start of drive: delay according to P342 - Offsetting I²t motor integrator upon "Power ON"

P350	PLC Functionality		S
Setting range	0 ... 1		
Factory setting	{ 0 }		
Description	Activation of the integrated PLC		
Setting values	Value Meaning		
	0	Off	The PLC is not active; the device is controlled via parameters P509 and P510 .
	1	On	The PLC is active; the frequency inverter is controlled via the PLC depending on P351 . The main setpoints must thus be defined in parameter P553 . Auxiliary setpoints (P510 [-02]) can still be defined via P546 .

P351	PLC set val. select.		S
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	Selection of the source for the control word (CTW) and the main setpoint (MSW) with active PLC functionality (P350 = 1). With the settings P351 = 0 and P351 = 1 , the main setpoints are defined via P553 , but the definition of the auxiliary setpoints still takes place via P546 . This parameter is only applied if the frequency inverter is in "Ready for switch-on" state.		
Setting values	Value Meaning		
	0	CTW & MSW = PLC	The PLC provides the control word (CTW) and the main setpoint (MSW). Parameters P509 and P510 [-01] have no function.
	1	Controlword =P509	The PLC provides the main setpoint (MSW). The control word source (CTW) corresponds to the setting in parameter P509 .
	2	Main setval.=P510[1]	The PLC provides 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		S
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	This parameter decides how the control word for the master function and the status word of the frequency inverter are further processed by the PLC.		
Setting values	Value Meaning		
	0	Off	Control word for the master function P503 ≠ 0 and the status word continue to be processed by the PLC.
	1	CTW for broadcast	The control word for the master value function P503 ≠ 0 is set by the PLC. For this purpose, the control word must be redefined in the PLC using process value "34_PLC_Busmaster_Control_word".
	2	STW for bus	The status word of the frequency inverter is set by the PLC. For this purpose, the status word must be redefined in the PLC using process value "28_PLC_status_word".
	3	CTW broadcast&STWbus	See P353 = 1 and P353 = 2

P355	PLC Integer setvalue		S
Setting range	-32 768 ... 32 767		
Arrays	[-01] ... [-10]		
Factory setting	All { 0 }		
Description	Data can be exchanged with the PLC via this INT array. This data can be used by the corresponding process variables in the PLC.		

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

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

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

5.2.6 Control terminals

P400	Setpoint I/P Funct		P
Setting range	0 ... 36		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter (SK 220E and SK 230E, not for sizes 1 ... 3)	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter	
	[-03] = Ext. Analogue in 1	"External analogue input 1": Analogue input 1 of the first I/O extension (SK xU4-IOE)	
	[-04] = Ext. Analogue in 2	"External analogue input 2": Analogue input 2 of the first I/O extension (SK xU4-IOE)	
	[-05] = Setpoint module	---	
	[-06] = Potentiometer 1	Function of potentiometer 1 integrated into the FI. The DIP switches 4/5 must be "off" so that the function can be influenced with this parameter setting (4.3.2.2 "DIP switches (S1)"). (Only SK 2x0E, size 4)	
	[-07] = Digital input 3	The input can be set to pulse signal evaluation via P420 [-03] = 26 or P420 [-03] = 27 . According to the function set here, the pulses can then be evaluated as an analogue signal in the FI. (Only SK 2x0E, sizes 1 ... 3)	
	Potentiometer 2	Same as potentiometer 1 (Only SK 2x0E, size 4)	
	[-08] = Ext.AI 1 2.IOE	"External analogue input 1, 2nd IOE". Analogue input 1 of the second I/O extension (SK xU4-IOE) (= analogue input 3).	
	[-09] = Ext.AI 2 2.IOE	"External analogue input 2, 2nd IOE". Analogue input 2 of the second I/O extension (SK xU4-IOE) (= analogue input 4).	
Factory setting	[-01], [-05], [-07] = { 1 }		All others { 0 }
Scope of application	SK 2x0E		
Description	"Setpoint input function". Assignment of analogue functions to internal analogue inputs or the analogue inputs of optional modules.		
Setting values	Value Meaning		
	0	Off	The analogue input has no function. After the frequency inverter has been enabled via the control terminals, it supplies the set minimum frequency P104 .
	1	Set point frequency	The specified analogue range (matching of analogue input P402 / P403) varies the output frequency between the set minimum and maximum frequencies P104 / P105 .
	2	Frequency addition ¹	The supplied frequency value is added to the setpoint.
	3	Frequency subtract. ¹	"Frequency subtraction". The supplied frequency value is subtracted from the setpoint.
	4	Minimum frequency ¹	The minimum frequency of the frequency inverter is varied. 0% corresponds to the setting in parameter P410 . The values for the minimum outputs frequency P104 cannot be undershot. The lower limit value is 1 Hz.
	5	Maximum frequency ¹	The maximum frequency of the frequency inverter is varied. 100% corresponds to the setting in parameter P411 . The values for the maximum output frequency P105 cannot be exceeded. The lower limit value is 2 Hz.
	6	Cur.val process ctrl ²	Activates the process controller. The analogue input is connected to the actual value encoder (compensator, pressurised can, flow volume meter, etc.). The mode (0 ... 10 V or 0 / 4 ... 20 mA) is set via DIP switches of the I/O extension or set in P401 .

7	Nom.val process ctrl ²	"Process controller setpoint". Same as P400 = 6 , but the setpoint of the process controller is specified (e.g. by a potentiometer). The actual value must be specified using another input.
8	PI current freq. ²	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 controlled variables P413 ... P414). Change in the direction of rotation possible.
9	PI ltd.current.freq ²	"PI limited current frequency". Same as P400 = 8 , but the value for the min./max. output frequency P104 / P105 cannot be undershot/exceeded. No change in the direction of rotation possible.
10	PI suprvsd.cur.freq ²	"Current PI frequency supervised". Same as P400 = 8 , but the frequency inverter switches the output frequency off if the value for the min./max. output frequency P104 / P105 is reached.
11	Torque current limit	"Limiting torque current limit". Based on the set torque current limit P112 , it can be changed via the bus setpoint. 100% setpoint corresponds to the set torque current limit P112 . Reaching the set limit value results in an output frequency reduction on the torque current limit.
12	Torqu.curr.limit off	"Switching-off torque current limit". Same as P400 = 11 , but reaching the set limit value results in switch-off with error E012.3 .
13	Current limit	"Limiting current limit". Based on the set current limit P536 , it can be changed via an analogue input. 100% setpoint corresponds to the set current limit P536 . Reaching the set limit value results in an output voltage reduction to limit the output current.
14	Current limit off	"Switching-off current limit". Same as P400 = 13 , but reaching the set limit value results in switch-off with error E012.4 .
15	Ramp time	The analogue input specifies the acceleration and deceleration time. The function is normally only used in conjunction with a potentiometer. Lower limit value: 50 ms Scaling: $T_{\text{Ramp time}} = 10 \text{ s} \times U_{\text{Pot}} / 10 \text{ V}$ (U_{Pot} = Potentiometer voltage in volts)
16	Pre-tension Torque	This function enables a value for the torque requirement to be applied in the controller in advance (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring (P214).
17	Multiplication	The setpoint is multiplied by the specified analogue value. Here, the analogue value adjusted to 100% corresponds to a multiplication factor of 1.
18	Curve control	The master receives the current speed from the slave via the external analogue input P400 [-03] or P400 [-04] , or via a bus system P546 [-01] ... P546 [-03] . From its own speed, the speed of the slave and the master speed, the master calculates the current setpoint speed so that neither of the two drives travels faster than the master speed in the curve.
19	Servo-Mode Torque	In the "CFC closed-loop" control method (P300 = 1), the motor torque can be set/limited with this function. Here, the speed controller is switched off and a torque control is activated. In this case, the analogue input is the setpoint source. In the open-loop method (P300 ≠ 1), this function can be used with reduced control quality. In VFC mode, the function enables a torque mode without encoder, suitable for simple tension control, for example.
25	Reserved	Reserved for POSICON.
26	Reserved	Reserved for POSICON.
30	Motor temperature	Motor temperature measurement with temperature sensor (e.g. KTY-84), see 0 "Connection examples" for details
33	Setval.torque p.reg.	"Setpoint Torque Process controller". The analogue input specifies the torque setpoint for the process controller. For the even distribution of torques to coupled drives (e.g. S-roller drive). This function is also possible when using the ISD control.
34	d-corr. F Process	Diameter correction for the frequency of the PI process controller.
35	d-corr. Torque	Diameter correction for the torque of the PI process controller.
36	d-corr. F+Torque	Diameter correction for the frequency and the torque of the PI process controller.

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

2 Process controller details: 8.2 "Process controller".

P400	Setpoint I/P Funct			P
Setting range	0 ... 36			
Arrays	[-01] = Potentiometer 1	Potentiometer 1 integrated into the device. The DIP switches 4/5 must be "off" so that the function can be influenced with this parameter setting.		
	[-02] = Potentiometer 2	Same as potentiometer 1		
	[-03] = Ext. Analogue in 1	"External analogue input 1": Analogue input 1 of the first I/O extension (SK xU4-IOE)		
	[-04] = Ext. Analogue in 2	"External analogue input 2": Analogue input 2 of the first I/O extension (SK xU4-IOE)		
	[-05] = Setpoint module	---		
	[-07] = Digital input 3	The input can be set to pulse signal evaluation via P420 [-03] = 26 or P420 [-03] = 27 . According to the function set here, the pulses can then be evaluated as an analogue signal in the FI.		
	[-08] = Ext.AI 1 2.IOE	"External analogue input 1, 2nd IOE". Analogue input 1 of the second I/O extension (SK xU4-IOE) (= analogue input 3).		
	[-09] = Ext.AI 2 2.IOE	"External analogue input 2, 2nd IOE". Analogue input 2 of the second I/O extension (SK xU4-IOE) (= analogue input 4).		
Factory setting	[-01], [-05], [-07] = { 1 }	[-02] = { 15 }	All others { 0 }	
Scope of application	SK 2x5E			
Description	"Setpoint input function". Assignment of analogue functions to internal analogue inputs or the analogue inputs of optional modules.			
Note	The basic equipment of the SK 2x5E devices does not feature an analogue input. An analogue function can only be used by using options (array [-01] ... [-05] and [-08] ... [-09]) or digital input 2 or 3 (array [-06] ... [-07]).			
Setting values	Value Meaning			
	0	Off	The analogue input has no function. After the frequency inverter has been enabled via the control terminals, it supplies the set minimum frequency P104 .	
	1	Set point frequency	The specified analogue range (matching of analogue input P402 / P403) varies the output frequency between the set minimum and maximum frequencies P104 / P105 .	
	2	Frequency addition ¹	The supplied frequency value is added to the setpoint.	
	3	Frequency subtract. ¹	"Frequency subtraction". The supplied frequency value is subtracted from the setpoint.	
	4	Minimum frequency ¹	The minimum frequency of the frequency inverter is varied. 0% corresponds to the setting in parameter P410 . The values for the minimum outputs frequency P104 cannot be undershot. The lower limit value is 1 Hz.	
	5	Maximum frequency ¹	The maximum frequency of the frequency inverter is varied. 100% corresponds to the setting in parameter P411 . The values for the maximum output frequency P105 cannot be exceeded. The lower limit value is 2 Hz.	
	6	Cur.val process ctrl ²	Activates the process controller. The analogue input is connected to the actual value encoder (compensator, pressurised can, flow volume meter, etc.). The mode (0 ... 10 V or 0 / 4 ... 20 mA) is set via DIP switches of the I/O extension or set in P401 .	
	7	Nom.val process ctrl ²	"Process controller setpoint". Same as P400 = 6 , but the setpoint of the process controller is specified (e.g. by a potentiometer). The actual value must be specified using another input.	
	8	PI current freq. ²	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 controlled variables P413 ... P414). Change in the direction of rotation possible.	

9	PI ltd.current.freq ²	"PI limited current frequency". Same as P400 = 8 , but the value for the min./max. output frequency P104 / P105 cannot be undershot/exceeded. No change in the direction of rotation possible.
10	PI suprvsd.cur.freq ²	"Current PI frequency supervised". Same as P400 = 8 , but the frequency inverter switches the output frequency off if the value for the min./max. output frequency P104 / P105 is reached.
11	Torque current limit	"Limiting torque current limit". Based on the set torque current limit P112 , it can be changed via the bus setpoint. 100% setpoint corresponds to the set torque current limit P112 . Reaching the set limit value results in an output frequency reduction on the torque current limit.
12	Torqu.curr.limit off	"Switching-off torque current limit". Same as P400 = 11 , but reaching the set limit value results in switch-off with error E012.3 .
13	Current limit	"Limiting current limit". Based on the set current limit P536 , it can be changed via an analogue input. 100% setpoint corresponds to the set current limit P536 . Reaching the set limit value results in an output voltage reduction to limit the output current.
14	Current limit off	"Switching-off current limit". Same as P400 = 13 , but reaching the set limit value results in switch-off with error E012.4 .
15	Ramp time	The analogue input specifies the acceleration and deceleration time. The function is normally only used in conjunction with a potentiometer. Lower limit value: 50 ms Scaling: $T_{\text{Ramp time}} = 10 \text{ s} \times U_{\text{Pot}} / 10 \text{ V}$ (U_{Pot} = Potentiometer voltage in volts)
16	Pre-tension Torque	This function enables a value for the torque requirement to be applied in the controller in advance (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring (P214).
17	Multiplication	The setpoint is multiplied by the specified analogue value. Here, the analogue value adjusted to 100% corresponds to a multiplication factor of 1.
18	Curve control	The master receives the current speed from the slave via the external analogue input P400 [-03] or P400 [-04] , or via a bus system P546 [-01] ... P546 [-03] . From its own speed, the speed of the slave and the master speed, the master calculates the current setpoint speed so that neither of the two drives travels faster than the master speed in the curve.
19	Servo-Mode Torque	In the "CFC closed-loop" control method (P300 = 1), the motor torque can be set/limited with this function. Here, the speed controller is switched off and a torque control is activated. In this case, the analogue input is the setpoint source. In the open-loop method (P300 ≠ 1), this function can be used with reduced control quality. In VFC mode, the function enables a torque mode without encoder, suitable for simple tension control, for example.
25	Reserved	Reserved for POSICON.
26	Reserved	Reserved for POSICON.
30	Motor temperature	Motor temperature measurement with temperature sensor (e.g. KTY-84), see 4.4 "Temperature sensors" for details
33	Setval.torque p.reg.	"Setpoint Torque Process controller". The analogue input specifies the torque setpoint for the process controller. For the even distribution of torques to coupled drives (e.g. S-roller drive). This function is also possible when using the ISD control.
34	d-corr. F Process	Diameter correction for the frequency of the PI process controller.
35	d-corr. Torque	Diameter correction for the torque of the PI process controller.
36	d-corr. F+Torque	Diameter correction for the frequency and the torque of the PI process controller.

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

2 Process controller details: 8.2 "Process controller".

P401	Mode analog in		S
Setting range	0 ... 5		
Arrays	[-01] =	Ext. Analogue in 1	AIN1 of the first I/O extension
	[-02] =	Ext. Analogue in 2	AIN2 of the first I/O extension
	[-03] =	Ext.AI 1 2.IOE	"External analogue input 1, 2nd IOE", AIN1 of the second I/O extension
	[-04] =	Ext.AI 2 2.IOE	"External analogue input 2, 2nd IOE", AIN2 of the second I/O extension
	[-05] =	Analog input 1	Analogue input 1 of the frequency inverter (Size 1... size 3 only SK 200E, SK 210E and size 4)
	[-06] =	Analog input 2	Analogue input 2 of the frequency inverter (SK 2x0E only)
Factory setting	All { 0 }		
Description	"Analogue input mode". This parameter determines how the frequency inverter is to respond to an analogue signal which undershoots the 0% adjustment (P402).		
Setting values	Value Meaning		
	0	0 - 10 V limited	An analogue setpoint smaller than the programmed 0% adjustment (P402) does not result in undershooting of the programmed minimum frequency P104, i.e. it does not result in a rotation direction reversal.
	1	0 - 10 V	If a setpoint smaller than the programmed adjustment 0% (P402) is present, then this may result in a rotation direction reversal. This allows a rotation direction reversal using a simple voltage source and potentiometer. For example, internal setpoint with rotation direction reversal: P402 = 5 V, P104 = 0 Hz, potentiometer 0 ... 10 V → Rotation direction reversal 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 less than the absolute minimum frequency P505. A brake that is controlled by the FI will be applied in the hysteresis range. If the minimum frequency P104 is greater than the absolute minimum frequency P505, the drive reverses when the minimum frequency is reached. In the hysteresis range ± P104, the FI supplies the minimum frequency P104; a brake controlled by the FI is not applied.
	2	0 - 10 V controlled	If the minimum adjusted setpoint P402 is undershot by 10% of the difference from P403 and P402, the FI output switches off. Once the setpoint is greater than P402 - (10% × (P403 - P402)), it will deliver an output signal. Note: A function for the relevant input must be assigned in P400. f / Hz P105 (fmax) OFF = 2.0 V - 10% * 8.0 V = 1.2 V P402 = 20% P104 (fmin) P403 = 100% = 8.0 V UV For example setpoint 4 ... 20 mA: P402: Adjustment 0% = 1 V; P403: Adjustment 100% = 5 V; -10% corresponds to -0.4 V; i.e. 1 ... 5 V (4 ... 20 mA) normal operating range, 0.6 ... 1 V = minimum frequency setpoint, below 0.6 V (2.4 mA) the output is switched off.

3	-10V - 10V	If a setpoint smaller than the programmed "Adjust: 0%" (P402) is present, this may result in a rotation direction reversal. This allows a rotation direction reversal using a simple voltage source and potentiometer. For example, internal setpoint with rotation direction reversal: P402 = 5 V, P104 = 0 Hz, potentiometer 0 ... 10 V → Rotation direction reversal 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 less than the absolute minimum frequency P505. A brake which is controlled by the FI has not been applied in the hysteresis range. If the minimum frequency P104 is greater than the absolute minimum frequency P505, the drive reverses when the minimum frequency is reached. In the hysteresis range ± P104, the FI supplies the minimum frequency P104; a brake controlled by the FI is not applied. NOTE: The function -10 V ... 10 V is a description of the method of function and not a reference to a physical bipolar signal (see example above).
4	0-10V with error 1	"0 - 10 V with error switch-off 1": Undershooting the 0% adjustment value in P402 activates error message E12.8 "AI minimum undershot". Exceeding the 100% adjustment value in P403 activates error message E12.9 "AI maximum exceeded". Even if the analogue value is outside the limits defined in P402 and P403, the setpoint is limited to 0 ... 100%. The monitoring function only becomes active if an enable signal is present and the analogue value has reached the valid range (≥ P402 or ≤ P403) for the first time (e.g. pressure build-up after switching on a pump). Once the function has been activated, it also operates if control takes place via a field bus, for example, and the analogue input is not controlled.
5	0-10V with error 2	"0 - 10 V with error switch-off 2": See P401 = 4, however: In this setting the monitoring function only becomes active if an enable signal is present and the time during which the error monitoring is suppressed has elapsed. This suppression time is set in parameter P216.

P402	Adjust: 0%	S
Setting range	-50.00 ... 50.00 V	
Arrays	[-01] = Ext. Analogue in 1	AIN1 of the first I/O extension
	[-02] = Ext. Analogue in 2	AIN2 of the first I/O extension
	[-03] = Ext.AI 1 2.IOE	"External analogue input 1, 2nd IOE", AIN1 of the second I/O extension
	[-04] = Ext. A. in.1 2.IOE	"External analogue input 2, 2nd IOE", AIN2 of the second I/O extension
	[-05] = Analogue input 1	Analogue input 1 of the frequency inverter (Size 1 ... 3: only SK 200E, SK 210E; size 4: only SK 2x0E)
	[-06] = Analogue input 2	Analogue input 2 of the frequency inverter (SK 2x0E only)
Factory setting	All { 0.00 }	
Description	This parameter sets the voltage that should correspond with the minimum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint), this value corresponds to the setpoint that is set in P104 "Minimum frequency".	
Note	When using the SK xU4-IOE, scaling to typical signals, such as 0(2) ... 10 V or 0(4) ... 20 mA, is carried out via DIP switches on the I/O extension module. Additional adjustment of parameters P402 and P403 is therefore not required for these cases.	

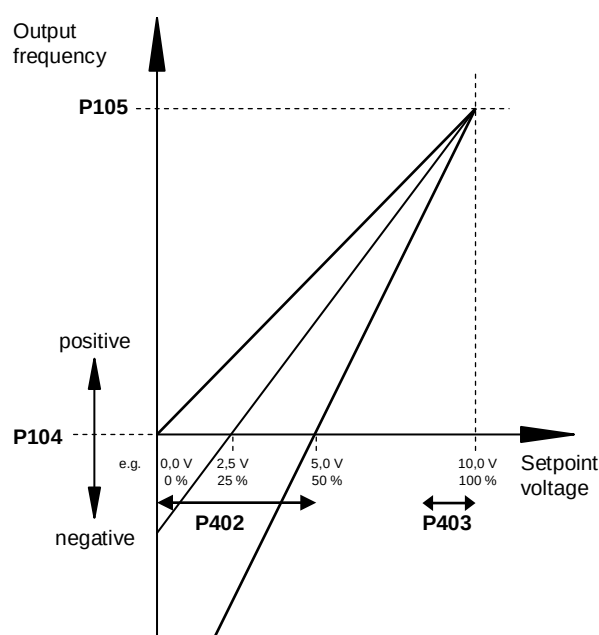
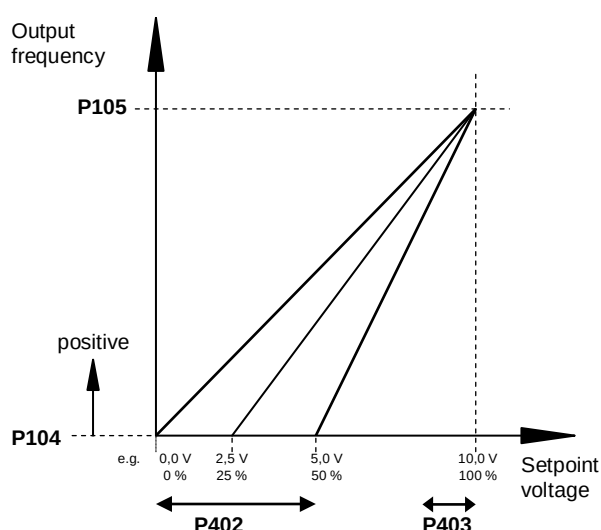
P403	Adjust: 100%	S
Setting range	-50.00 ... 50.00 V	
Arrays	[-01] = Ext. Analogue in 1	AIN1 of the first I/O extension
	[-02] = Ext. Analogue in 2	AIN2 of the first I/O extension
	[-03] = Ext.AI 1 2.IOE	"External analogue input 1, 2nd IOE", AIN1 of the second I/O extension
	[-04] = Ext. A. in.1 2.IOE	"External analogue input 2, 2nd IOE", AIN2 of the second I/O extension
	[-05] = Analogue input 1	Analogue input 1 of the frequency inverter (Size 1 ... 3: only SK 200E, SK 210E; size 4: only SK 2x0E)
	[-06] = Analogue input 2	Analogue input 2 of the frequency inverter (SK 2x0E only)
Factory setting	All { 10.00 }	
Description	This parameter sets the voltage that should correspond with the maximum value of the selected function for the analogue input 1 or 2. In the factory setting (setpoint), this values corresponds to the setpoint that is set in P105 "Maximum frequency".	
Note	When using the SK xU4-IOE, scaling to typical signals, such as 0(2) ... 10 V or 0(4) ... 20 mA, is carried out via DIP switches on the I/O extension module. Additional adjustment of parameters P402 and P403 is therefore not required for these cases.	

P404	Analog input filter		S
Setting range	10 ... 400 ms		
Arrays	[-01] = Analog input 1	Analogue input 1 of the frequency inverter (Size 1 ... 3: only SK 200E, SK 210E; size 4: only SK 2x0E)	
	[-02] = Analog input 2	Analogue input 2 of the frequency inverter (SK 2x0E only)	
Factory setting	All { 100 }		
Description	Adjustable digital low-pass filter for the analogue signal. Interference peaks are hidden, the response time is extended.		
Note	The filter time of the analogue inputs of the optional, external IO extension modules is set in the parameter set of the respective module P161 .		

P400 ... P403

P401 = 0 → 0 – 100 % limited

P401 = 1 → 0 – 100 %



P410	Min. freq. aux. setpoint	P
Setting range	-400.0 ... 400.0 Hz	
Factory setting	{ 0.0 }	
Description	"Minimum frequency auxiliary setpoints". The minimum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: • Actual frequency PID • Frequency addition • Frequency subtraction • Auxiliary setpoints via BUS • Process controller • Min. frequency via analogue setpoint (potentiometer)	

P411	Max. freq. a-in 1/2			P
Setting range	-400.0 ... 400.0 Hz			
Factory setting	{ 50.0 }			
Description	"Maximum frequency auxiliary setpoints". The maximum frequency that can act on the setpoint via the auxiliary setpoints. Auxiliary setpoints are all frequencies that are additionally delivered for further functions in the FI: • Actual frequency PID • Frequency addition • Frequency subtraction • Auxiliary setpoints via BUS • Process controller • Max. frequency via analogue setpoint (potentiometer)			

P412	Nom.val process ctrl		S	P
Setting range	-10.0 ... 10.0 V			
Factory setting	{ 5 }			
Description	P412 can be used for fixed entry of a setpoint for the process controller. P412 is not active if the {7} "Nom.val process ctrl" or {33} "Setval.torque p.reg." function is used in P400, P546 or P553. (see chapter 8.2 "Process controller").			

P413	PI-control P comp.		S	P
Setting range	0.0 ... 400.0%			
Factory setting	{ 10.0 }			
Description	This parameter is only effective when the function "PI current freq." is selected. The P-component of the PI controller determines the frequency jump if there is a control deviation based on the control difference. E.g.: At a setting of P413 = 10% and a controller deviation of 50%, 5% is added to the actual setpoint.			

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

P415	Processcontrol Limit		S	P
Setting range	0.0 ... 400.0%			
Factory setting	{ 10.0 }			
Description	If one of the analogue inputs (P400) or bus setpoints (P546 / P553) is set to function {6} "Cur.val process ctrl", this parameter determines the controller limitation (%) after the PI controller. For further details see 8.2 "Process controller"			

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

P417	Offset analog output		S	P
Setting range	-10.0 ... 10.0 V			
	[-01] = IOE-1	“External analogue output of the 1 st IOE”. Analogue output of the first IO extension		
	[-02] = IOE-2	“External analogue output of the 2 nd IOE”. Analogue output of the second IO extension		
Factory setting	All { 0.0 }			
Scope of application	Only in connection with SK CU4-IOE or SK TU4-IOE			
Description	In the “Offset analog output” function, an offset can be set in order to simplify processing of the analogue signal in further devices. If the analogue output has been programmed with a digital function, the difference between the switch-on point and the switch-off point (hysteresis) can be set in this parameter.			

P418	Analog output func.			P
Setting range	0 ... 60			
	[-01] = IOE-1	“External analogue output of the 1 st IOE”. Analogue output of the first IO extension		
	[-02] = IOE-2	“External analogue output of the 2 nd IOE”. Analogue output of the second IO extension		
Factory setting	All { 0 }			
Scope of application	Only in connection with SK CU4-IOE or SK TU4-IOE			
Description	“Analogue output function”. (Max. load: 5 mA analogue, 20 mA digital): An analogue voltage (0 ... 10 V) can be obtained at the control terminals (max. 5 mA). Various functions are available, where the following basically applies: 0 V analogue voltage always corresponds to 0% of the selected value. 10 V always corresponds to the nominal motor value (unless otherwise stated) multiplied by the P419 scaling factor, e.g.: $10\text{ V} = \frac{\text{Nominal motor speed} * \mathbf{P419}}{100\%}$			
Note	For analogue functions, the maximum load is 5 mA.			
Setting values	Value Meaning			
	0	No function	No output signal at the terminals.	
	1	Actual frequency ¹	The analogue voltage is proportional to the device output frequency. (100% = P201)	
	2	Actual speed ¹	The synchronous speed calculated by the device based on the present setpoint. Load-dependent speed fluctuations are not taken into account. If servo mode is used, the measured speed will be output via this function. (100% = P202)	
	3	Current ¹	The effective value of the output current supplied by the device. (100% = P203)	
	4	Torque current ¹	Displays the motor load torque calculated by the device. (100% = P112).	
	5	Voltage ¹	The output voltage supplied by the device. (100% = P204)	
	6	D.c. link voltage	“Link voltage”. The DC voltage in the device. This is not based on the nominal motor data. 10 V with 100% scaling, corresponds to 450 V DC (230 V mains) or 850 V DC (480 V mains)!	
	7	Value of P542	The analogue output can be set independently of the current operating state of the device using parameter P542 . With bus	

		control, for example an analogue value from the control can be directly tunnelled to the analogue output of the device.
8	Apparent power ¹	The motor's current apparent power calculated by the device. (100% = $P_{203} \cdot P_{204}$ or = $P_{203} \cdot P_{204} \cdot \sqrt{3}$)
9	Real Power ¹	The current effective power calculated by the device. (100% = $P_{203} \cdot P_{204} \cdot P_{206}$ or = $P_{203} \cdot P_{204} \cdot P_{206} \cdot \sqrt{3}$)
10	Torque [%] ¹	The current torque calculated by the device. (100% = nominal motor torque)
11	Field [%] ¹	The current field in the motor calculated by the device.
12	Actual frequency+/- ¹	The analogue voltage is proportional to the output frequency of the device, whereby the zero point has been shifted to 5 V. For CW direction of rotation, values from 5 V to 10 V are output, and for CCW direction of rotation, values from 5 V to 0 V.
13	Speed +/- ¹	The synchronous speed calculated by the device based on the present setpoint, whereby the zero point has been shifted to 5 V. For CW direction of rotation, values from 5 V to 10 V are output, and for CCW direction of rotation, values of 5 V to 0 V. The measured speed is output via this function if servo mode is used.
14	Torque [%]+/- ¹	The current torque calculated by the device, whereby the zero point has been shifted to 5 V. For motor torques, values from 5 V to 10 V are output, and for generator torques, values from 5 V to 0 V.
29	Reserved	Reserved for POSICON
30	Set freq. befor ramp	"Setpoint frequency before ramp". Displays the frequency produced by any upstream controllers (ISD, PID, etc.). This is then the setpoint frequency for the power level after it has been adjusted by the acceleration or deceleration ramp P102 , P103 .
31	Output via Bus PZD	The analogue output is controlled via a bus system. The process data is transferred directly (P546 = 32).
33	Set freq Motorpot	"Motor potentiometer setpoint frequency"
60	Value of PLC	The analogue output is set by the integrated PLC, independently of the current operating state of the FI.

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

P419	Analog output scal.	S	P
Setting range	-500 ... 500%		
	[-01] = IOE-1	"External analogue output of the 1 st IOE". Analogue output of the first IO extension	
	[-02] = IOE-2	"External analogue output of the 2 nd IOE". Analogue output of the second IO extension	
Factory setting	All { 100 }		
Description	"Scaling of analogue output". Analogue functions P418 (= 0 ... 6 and 8 ... 14, 30) Using this parameter, the analogue output can be adjusted to the selected operating range. The maximum analogue output (10 V) corresponds to the scaled value of the appropriate selection. Therefore, if this parameter is raised from 100% to 200% at a constant operating point, the analogue output voltage is halved. 10 V output signal then corresponds to twice the nominal value. For negative values the logic is reversed. An actual value of 0% will then produce 10 V at the output and -100% will produce 0 V.		

P420	Digit inputs																																																																							
Setting range	0 ... 80																																																																							
Arrays	[-01] = Digital input 1		Digital input 1 of the frequency inverter																																																																					
	[-02] = Digital input 2		Digital input 2 of the frequency inverter																																																																					
	[-03] = Digital input 3		Digital input 3 of the frequency inverter																																																																					
	[-04] = Digital input 4		Digital input 4 of the frequency inverter																																																																					
Factory setting	[-01] = { 1 }	[-02] = { 2 }	[-03] = { 4 }	[-04] = { 5 }																																																																				
Scope of application	SK 2xxE																																																																							
Description	Due to an “OR” linking between the parameterised functionalities and the encoder evaluation, which is always active in the inverter, it is absolutely necessary that the digital inputs DIN2 and DIN3 are deactivated when using an encoder (parameter P420 [-02], [-03]). The additional digital inputs of the I/O extensions (SK xU4-IOE) are managed via parameter “Bus I/O In Bit (4...7)” - (P480 [-05] ... [-08]) for the first I/O extension and via parameter “Bus I/O In Bit (0...3)” - (P480 [-01] ... [-04]) for the second I/O extension.																																																																							
Note	SK 21xE and SK 23xE: - Digital input 4 is not physically present in the device. - Recommendation: If “Safe Stop” is used, parameterise DIN4 as follows: Parameterise P420 [-04] = 10 (“Voltage disable” function). This suppresses error message E018.0 when triggering the “Safe Stop”.																																																																							
Setting values	Value Meaning Signal																																																																							
<table><tr><td>0</td><td>No function</td><td>Input is switched off.</td><td>Low</td></tr><tr><td colspan="4">Note Select this function for digital inputs DIN2 and DIN3 if an incremental encoder is connected to an SK 2xxE(-FDS) 2.5.1 “Incremental encoders”.</td></tr><tr><td>1</td><td>Enable right</td><td>The device delivers an output signal with the rotating field “right”, if a positive setpoint is applied. 0 → 1 edge (P428 = 0)</td><td>High</td></tr><tr><td>2</td><td>Enable left</td><td>The device delivers an output signal with the rotating field “left”, if a positive setpoint is applied. 0 → 1 edge (P428 = 0)</td><td>High</td></tr><tr><td colspan="4">Note If the drive is to start up automatically when the mains voltage is switched on (P428 = 1), a permanent High level for enabling must be provided. If the functions “Enable right” and “Enable left” are controlled simultaneously, the device is blocked. If the device is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a 1 → 0 edge.</td></tr><tr><td>3</td><td>Phase seq. reversal</td><td>Causes the rotating field to change direction in combination with “Enable right” and “Enable left”.</td><td>High</td></tr><tr><td>4</td><td>Fixed frequency 1 ¹</td><td>The frequency from P465 [-01] is added to the current setpoint.</td><td>High</td></tr><tr><td>5</td><td>Fixed frequency 2 ¹</td><td>The frequency from P465 [-02] is added to the current setpoint.</td><td>High</td></tr><tr><td>6</td><td>Fixed frequency 3 ¹</td><td>The frequency from P465 [-03] is added to the current setpoint.</td><td>High</td></tr><tr><td>7</td><td>Fixed frequency 4 ¹</td><td>The frequency from P465 [-04] is added to the current setpoint.</td><td>High</td></tr><tr><td colspan="4">Note If several fixed frequencies are controlled simultaneously, they are added with the correct sign. In addition, the analogue setpoint (P400) and, if necessary, the minimum frequency (P104) are added.</td></tr><tr><td>8</td><td>Param. set switching ⁶</td><td>“Parameter set switching 1”: First bit of the parameter set switching; selection of the active parameter set 1 ... 4 (P100)</td><td>High</td></tr><tr><td>9</td><td>Maintain the freq.</td><td>During the acceleration or deceleration phase, a Low level will cause the current output frequency to be “maintained”. A High level allows the ramp to continue.</td><td>Low</td></tr><tr><td>10</td><td>Voltage disable ²</td><td>The output voltage is switched off; the motor decelerates freely.</td><td>Low</td></tr><tr><td>11</td><td>Quick stop ²</td><td>The device reduces the frequency according to the quick stop time from P426.</td><td>Low</td></tr><tr><td>12</td><td>Fault acknowledgem. ²</td><td>Fault acknowledgement with an external signal. If this function is not programmed, a fault can also be acknowledged by setting enable to Low (P506).</td><td>0→1 edge</td></tr><tr><td>13</td><td>PTC resistor input ²</td><td>Analogue evaluation of the signal applied. Switching threshold approx. 2.5 V, switch-off delay = 2 s, warning after 1 s. There are separate connections on terminals 38 and 39 which cannot be disabled. If the motor is not equipped with a PTC</td><td>Low</td></tr></table>					0	No function	Input is switched off.	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Low	10	Voltage disable ²	The output voltage is switched off; the motor decelerates freely.	Low	11	Quick stop ²	The device reduces the frequency according to the quick stop time from P426 .	Low	12	Fault acknowledgem. ²	Fault acknowledgement with an external signal. If this function is not programmed, a fault can also be acknowledged by setting enable to Low (P506).	0→1 edge	13	PTC resistor input ²	Analogue evaluation of the signal applied. Switching threshold approx. 2.5 V, switch-off delay = 2 s, warning after 1 s. There are separate connections on terminals 38 and 39 which cannot be disabled. If the motor is not equipped with a PTC	Low
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		resistor, both terminals must be bridged in order to deactivate the function (delivery state).																								
14	Remote control ^{2, 5}	With bus system control, a Low level causes a switch to control via 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	Same as P420 = 09 , but the frequency is not maintained below the minimum frequency (P104) and above the maximum frequency (P105).	Low																							
17	ParaSetSwitching ^{2 6}	Second bit of the parameter set switching; selection of the active parameter set 1 ... 4 (P100)	High																							
18	Watchdog ²	The input must cyclically (P460) see a High edge, otherwise error E012 will cause a switch-off. The function starts with the 1 st High edge.	0→1 edge																							
19	Setpoint 1 on / off	Switch-on and switch-off of analogue input 1/2 (High = ON) The Low signal sets the analogue input to 0%, which does not result in shutdown when the minimum frequency P104 > absolute minimum frequency P505 .	High																							
20	Setpoint 2 on / off		High																							
22 ... 25	Reserved	Reserved for POSICON.	---																							
Note The functions { 26 } ... { 27 } can only be used for digital input DIN3 (P420 [-03])!																										
26	Analog fct. Dig 3	With this setting, pulses that are proportional to an analogue signal can be evaluated using DIN3 . The function of this signal is determined in parameter P400 [-06] or P400 [-07] . The conversion of 0 ... 10 V to pulses can be carried out via customer unit SK CU/TU4-24V-... Among other things, this module provides an analogue input and a pulse output (ADC). With the { 28 } setting, the direction of rotation is reversed with an analogue value < 5 V.	Pulses ≈ 1.6–16 kHz																							
27	A.fct.2-10V Dig.3																									
28	A.fct.5-10V Dig.3																									
29	Enable SK SSX-box	The enable signal is delivered by the <i>Simple Setpoint Box</i> SK SSX-3A. The box must be operated in IO-S mode. (BU0040)	---																							
30	Inhibit PID	Switches the PID controller/process controller function on or off (High = PID ON)	Low																							
31	Inhibit turn right ^{2,7}	Blocks "Enable right/left" via a digital input or bus control. Does not relate to the motor's actual direction of rotation (e.g. after negated setpoint).	Low																							
32	Inhibit turn left ^{2,7}		Low																							
33	Enable jog right ³	Parameterisation of the corresponding inputs with these functions determines the enable jog frequency and the enable direction.	High																							
34	Enable jog left ³		High																							
36	Jog freq selection ³		High																							
		<table border="1"> <thead> <tr> <th colspan="3">Function</th><th rowspan="2">Resulting function</th></tr> <tr> <th>33</th><th>34</th><th>36</th></tr> </thead> <tbody> <tr> <td>x</td><td>-</td><td>-</td><td>Enable right, jog frequency 1 (P113 [-01])</td></tr> <tr> <td>x</td><td>-</td><td>x</td><td>Enable right, jog frequency 2 (P113 [-02])</td></tr> <tr> <td>-</td><td>x</td><td>-</td><td>Enable left, jog frequency 1 (P113 [-01])</td></tr> <tr> <td>-</td><td>x</td><td>x</td><td>Enable left, jog frequency 2 (P113 [-02])</td></tr> </tbody> </table>	Function			Resulting function	33	34	36	x	-	-	Enable right, jog frequency 1 (P113 [-01])	x	-	x	Enable right, jog frequency 2 (P113 [-02])	-	x	-	Enable left, jog frequency 1 (P113 [-01])	-	x	x	Enable left, jog frequency 2 (P113 [-02])	
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-	x	x	Enable left, jog frequency 2 (P113 [-02])																							
35	2nd jog freq	Frequency value from (P113 [-02]) If the device is operated with jog frequency, any active bus control is disabled.	High																							
37	Manual control ^{2, 5}	With bus system control, High level switches to control via control terminals.	High																							
42	0-track HTL cycl DI1	Activates the evaluation of the zero track of an encoder. Synchronisation to zero pulse after each enabling.	High																							
43	0-pulse HTL enc. DI1	Activates the evaluation of the zero track of an encoder. Synchronisation to zero pulse after first enabling after "Power ON".	High																							
44	3-Wire-Direction	"3-wire control". This control function provides an alternative to "Enable right"/"Enable left" {1, 2}, for which permanently applied levels are required.	0→1 edge																							
45	3-W-Ctrl.Start-Right	Here, only one control pulse is required to trigger the function. The device can therefore be controlled entirely via switches.	0→1 edge																							
46	3-W-Ctrl.Start-Left	A pulse on the function "Phase seq. reversal" (see function 65) inverts the present phase sequence. This function is reset with	0→1 edge																							

49	3-Wire-Ctrl.Stop	a "Stop signal" or by activating a switch for the functions {45, 46, 49}.	0→1 edge
47	Motorpot. Freq. +	In combination with "Enable right"/"Enable left", the output frequency can be continuously varied. To save a current value in P113 , both inputs must be at a High potential for 1.5 s. This value is then used as the next starting value for the same direction preselection ("Enable right"/"Enable left"); otherwise start at f_{MIN} . Values from other setpoint sources (example: fixed frequencies) are not taken into account.	High
48	Motorpot. Freq. -		High
50	Bit0 fixedfreq.Array	Fixed frequency array. Binary-coded digital inputs to generate up to 15 fixed frequencies. P465 [-01] ... P465 [-15]	High
51	Bit1 fixedfreq.Array		High
52	Bit2 fixedfreq.Array		High
53	Bit3 fixedfreq.Array		High
55	Reserved	Reserved for POSICON.	---
...			
64			
65	Brake man/auto rel. ²	The brake is automatically released by the frequency inverter (automatic brake control) or if the digital input parameterised with this function is set.	High
66	Brake man Release ²	The brake is only released if the digital input parameterised with this function is set.	High
67	Dig.out man/auto set	Set digital output 1: manually or via the set function in (P434)	High
68	Dig.out manual set	Set digital output 1: manually	High
69	Speed meas.with ini.	Simple speed measurement (pulse measurement) with initiator at DIN3 .	Pulses
70	Evacuation mode ⁸	This provides the option of operation with a very low link voltage (e.g. from batteries). With this function, the charging relay is energised and the existing monitoring functions are disabled. NOTICE! There is no overload monitoring! (e.g. lifting gear). This feature requires external 24 V voltage supply for the control board. It is not available on SK 2x0 devices in sizes 1 ... 3. NOTE: The voltage required to control an electromagnetic brake (terminals 38/39) is generated from the AC mains voltage (L1/L2) via a half-wave rectifier. If required, check the voltage at terminals 38/39.	High
71	Motorpot.F+ and Save ⁴	"Motor potentiometer function frequency +/- with automatic saving". With this motor potentiometer function, a setpoint (amount) is set and saved via the digital inputs. With controller enable right/left, this is then travelled to in the corresponding enable direction of rotation. The frequency is retained on change of direction. Simultaneous activation of the +/- functions causes the frequency setpoint to be set to zero.	High
72	Motorpot.F- and Save ⁴	The frequency setpoint can also be displayed in the operating value display (P001 = 30 , 'Cur. set value MP-S') or in P718 , and can be pre-set in the "Ready for switch-on" operating state. A set minimum frequency P104 is still effective. Other setpoints, for example analogue or fixed frequencies, can be added or subtracted. Adjustment of the frequency setpoint is performed with the ramps from P102 / 103 .	High
73	Inhibit right+quick ^{2, 7}	Same as P420 = 31 , but coupled to the "Quick stop" function.	Low
74	Inhibit left + quick ^{2, 7}	Same as P420 = 32 , but coupled to the "Quick stop" function.	Low
 Information Use for evaluation of limit switches The inhibit is active for functions {31}, {32}, {73} and {74} as long as the signal is Low. If, for example, the drive overruns the limit switch (speed too high, deceleration too slow or delayed) and the signal is High again, the inhibit is lifted and the drive accelerates to the setpoint speed.			
75	DO 2 man/auto set	Set digital output 2: manually or via the set function in (P434)	High
76	DO 2 man. set	Set digital output 2: manually	High
77	Reserved	Reserved for POSICON.	---
...			
78			

79	Rotorpos. Ident	<i>"Rotor position identification"</i>. Precise knowledge of the rotor position is essential for PMSM operation. Rotor position identification is performed if the following conditions are met: - The frequency inverter is in "Ready for switch-on" state - The rotor position is not known (see P434 = 28, P481 = 28) P336 = 2 is selected	0→1 edge
80	PLC stop	The program execution of the internal PLC is stopped for as long as the signal is present.	High

- 1 If no digital input is parameterised to "Enable right" or "Enable left" and with devices from SK 270E-FDS and higher, all ASi-relevant Bus In Bits (**P480**) are deactivated, the control of a fixed frequency or the jog frequency enables the frequency inverter.
The jog frequency function does not depend on **P509**, whereas the fixed frequency function does.
For devices from SK 22xE (ASi devices), the Bus In Bits must be deactivated, as they are regarded as digital inputs.
The rotating field direction depends on the sign of the setpoint.
- 2 Also effective for control via bus (RS-232, RS-485, CANopen or AS-Interface)
- 3 SK 2x0E-FDS only
- 4 For devices without an integrated power supply (integrated power supply: option "-HVS"), the frequency inverter's control unit must be supplied with power for a further 5 minutes after the last change to the motor potentiometer in order to permanently save the data.
- 5 Function cannot be selected via BusIO In Bits
- 6 The operating parameter set is selected via correspondingly parameterised digital inputs or the bus control. Switching can take place during operation (online). Coding is binary according to the following pattern.
When enabled via the keyboard (SimpleBox or ParameterBox), the operating parameter set will match the setting in **P100**.

Setting	Digital input	Digital input
0 = Parameter set 1	Low	Low
1 = Parameter set 2	High	Low
2 = Parameter set 3	Low	High
3 = Parameter set 4	High	High
- 7 **Notice!** When using this function for limit switch monitoring, it must be ensured that the limit switch cannot be overrun, because as soon as the limit switch has been left, the blocking of the phase sequence is automatically cancelled. The frequency inverter therefore accelerates again when the enable signal is applied.
- 8 SK 2x0E, size 4; SK 2x5E and SK 2x0E-FDS only (device without internal 24 V switched-mode power supply)

P425	Function PTC input		
Setting range	0 ... 1		
Factory setting	{ 1 }		
Scope of application			
Description	A connected PTC resistor is evaluated by the device. This function must be disabled if no PTC resistor is connected. Otherwise, the device will enter a fault state with an overtemperature message (E002.0).		
Note	If monitoring is deactivated, the device no longer provides direct overtemperature protection for the motor.		
Setting values	Value Meaning		
	0	Off	Thermistor input not monitored.
	1	On	Thermistor input monitoring active

P426	Quick stop time		S	P
Setting range	0.00 ... 320.00 s			
Factory setting	{ 0.10 }			
Description	Setting of the braking time for the “Quick stop” function which can be triggered via a digital input, the bus control, the keyboard or automatically in case of a fault. The quick stop time is the time that is taken for the linear frequency reduction from the set maximum frequency P105 to 0 Hz. If a current setpoint < 100% is used, the quick stop time is reduced accordingly.			

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

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

P434	Digital out function			
Setting range	0 ... 61			
	[-01] = Digital out 1	Digital output 1 of the frequency inverter		
	[-02] = Digital out 2	Digital output 2 of the frequency inverter (SK 2x0E only)		
Factory setting	All { 7 }			
Scope of application	SK 2xxE			
Description	“Digital output function”. Up to two digital outputs are available, which can be freely programmed with digital functions. These can be found in the following table.			
Note	Please note that using the digital input functions “DO 1 man. set” and “DO 2 man. set” in P420/P480 overrides the digital output function P434 of the corresponding output! “Low” active settings / functions If the frequency inverter is not in operation, i.e. no mains or control voltage is connected, all outputs are without function (“Low”). Compare an evaluation of the output signals by, for example, a PLC with the operational readiness of the frequency inverter! This behaviour can be inverted with a negative value in P435.			
Setting values	Value Meaning Signal			
	0	No function	Output is switched off.	low
	1	External brake	For control of a mechanical brake on the motor. The relay switches at a programmed absolute minimum frequency P505 . For typical brakes, a setpoint delay of 0.2 ... 0.3 s (see P107) should be programmed. Direct AC switching of a mechanical brake is permissible. (Note the technical specification of the relay contact!)	low
	2	Inverter is working	The closed relay contact indicates voltage at the inverter output (U – V – W) (as well as DC run-on P559).	high
	3	Current limit	Based on the nominal motor current setting in P203 . This value can be adjusted via scaling P435 . Hysteresis = 10%	high
	4	Torque current limit	Based on the motor data settings in P203 and P206 . Indicates a corresponding torque load on the motor. This value can be adjusted via scaling P435 . Hysteresis = 10%	high
	5	Frequency limit	Based on the nominal motor frequency setting in P201 . This value can be adjusted via scaling P435 . Hysteresis = 10%	high
	6	Level with setpoint	Indicates that the device has completed the frequency increase or decrease. Setpoint frequency = Actual frequency! From a difference of 1 Hz → Setpoint not reached, signal Low.	high
	7	Fault	General fault message; fault is active or not yet acknowledged. Fault: Contact opens, ready for operation: Contact closes.	low
	8	Warning	General warning. A limit value was reached, which may result in a later switch-off of the device.	low
	9	Overcurrent warning	At least 130% of the nominal device current were supplied for 30 s.	low
	10	Mot.overtemp.warning	“Motor overtemperature (warning)”. The motor temperature is evaluated via the PTC resistor input or a digital input. → Motor is too hot. The warning is issued immediately; overtemperature switch-off after 2 s.	low
	11	Torque current limit	“Torque current limit/current limit active (warning)”. The limit value in P112 or P536 was reached. A negative value in P435 inverts the behaviour. Hysteresis = 10%	low
	12	Value of P541	The output can be controlled using parameter P541 , irrespective of the current operating state of the device.	high
	13	Torq.curr. limit gen	Limit value in P112 was reached in the generator range. Hysteresis = 10%	high
	16	Comparison val. AIN1	Setpoint AIN1 of the FI is compared with the value in (P435 [-01] or P435 [-02]).	high
	17	Comparison val. AIN2	Setpoint AIN2 of the FI is compared with the value in (P435 [-01] or P435 [-02]).	high
	18	Inverter ready	The device is ready for operation. After being enabled, it delivers an output signal.	high

19	Mains voltage ok ¹	Mains voltage is present.	high
20	Reserved	Reserved for POSICON.	---
...			
27			
28	Rotorpos PMSM ok	The PMSM rotor position is known.	high
30	Status dig in 1	A signal is present at digital input 1.	high
...	...	...	...
34	Status dig in 5 ¹	A signal is present at digital input 5.	high
35	State isolator swtch ¹	Maintenance switch H3 is active.	high
36	Remote control ¹	High = Remote control active, Low = Manual control active	high
37	Fault or manual mode ¹	Manual mode is active and no fault is present.	high
38	Value Bus Setpoint	Value from bus setpoint (P546 ...)	high
39	STO inactive	The relay/bit drops, if STO or the safe stop is active.	high
40	Output via PLC	The output is set by the integrated PLC.	high
61	Init. I ² t Motor ok	Initialisation of the I ² t motor functionality completed after frequency inverter restart. If the I ² t functionality is activated (P535 > 0), there may be a delay in the motor's initial start-up. After switch-on (depending on P336), the frequency inverter determines the motor temperature using the winding resistance. The duration of the delay depends on the motor type. The function outputs a High signal when the motor temperature has been determined and no start-up delay is expected.	high

¹ SK 2x0E-FDS

P435	Dig. out scaling				P
Setting range	-400 ... 400%				
	[-01] = Digital out 1	Digital output 1 of the frequency inverter			
	[-02] = Digital out 2	Digital output 2 of the frequency inverter (SK 2x0E only)			
Factory setting	All { 100 }				
Description	“<i>Digital output scaling</i>”. Adjustment of the limit values of the digital functions. With a negative value, the output function is output in negated form. Reference to the following values: Current limit (P434 = 3) = x [%] × P203 Torque current limit (P434 = 4) = x [%] × P203 × P206 (calculated nominal motor torque) Frequency limit (P434 = 5) = x [%] × P201				
Note	If the function “Value of P541” is set for the respective output, inversion does not take place.				

P436	Dig.out. hysteresis		S	P
Setting range	1 ... 100%			
	[-01] = Digital out 1	Digital output 1 in the frequency inverter		
	[-02] = Digital out 2	Digital output 2 in the frequency inverter (SK 2x0E only)		
Factory setting	All { 10 }			
Description	“Digital output hysteresis”. Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

P460	Watchdog time		S
Setting range	-250.0 ... 250.0 s		
Factory setting	{ 10.0 }		
Setting values	Value Meaning		
	0.1 ... 250.0	The time interval between the expected watchdog signals (programmable function of the digital inputs P420). If this time interval elapses without a pulse being registered, a switch-off occurs with error message E012 .	
	0.0	External Trip: As soon as a High-Low edge or a Low signal is registered on a digital input (function 18), the FI switches off with error message E012 .	
	-0.1 ... -250.0	Rotor Watchdog: In this setting, the rotor run watchdog becomes active. The time is defined by the set value. There is no watchdog message when the device 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 frequency setpoints are to be processed.		
Note	The highest active fixed frequency is added to the motor potentiometer setpoint if function 71 or 72 has been selected for two digital inputs.		
Setting values	Value Meaning		
	0	Add to main setvalue	Fixed frequencies and the fixed frequency array are additive to each other. That means, they are added to one another or to an analogue setpoint within the limits assigned according to P104 and P105 .
	1	Equal main setvalue	Fixed frequencies are not added – neither to one another nor to analogue main setpoints. If, for example, a fixed frequency is switched in to a present analogue setpoint, the analogue setpoint will no longer be considered. Programmed frequency addition or subtraction to one of the analogue inputs or bus setpoints is still possible and valid, as is the addition to the setpoint of a motor potentiometer function (digital inputs function: 71/72). If several fixed frequencies are selected simultaneously, the frequency with the highest value has priority (for example: 20 > 10 or 20 > -30).

P465	Fixed freq. Array							
Setting range	-400.0 ... 400.0 Hz							
Arrays	[-01] = Fixed freq. Array [1]							
	[-02] = Fixed freq. Array [2]							
								
	[-15] = Fixed freq. Array [15]							
Factory setting	[-01] = { 5.0 }	[-02] = { 10.0 }	[-03] = { 20.0 }	[-04] = { 35.0 }	[-05] = { 50.0 }			
	[-06] = { 70.0 }	[-07] = { 100.0 }	[-08] = { 0.0 }	[-09] = { -5.0 }	[-10] = { -10.0 }			
	[-11] = { -20.0 }	[-12] = { -35.0 }	[-13] = { -50.0 }	[-14] = { -70.0 }	[-15] = { -100.0 }			
Description	You can set up to 15 different fixed frequencies, which in turn can be selected with the functions 50 ... 53 in binary code for the digital inputs.							

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

P475	Delay on/off switch						S	
Setting range	-30.000 ... 30.000 s							
Arrays	[-01] = Digital input 1	Digital input 1 (DI1) integrated into the device						
	[-02] = Digital input 2	Digital input 2 (DI2) integrated into the device						
	[-03] = Digital input 3	Digital input 3 (DI3) integrated into the device						
	[-04] = Digital input 4	Digital input 4 (DI4) integrated into the device						
Factory setting	All { 0.000 }							
Description	<i>"Digital function switch-on/switch-off delay"</i> . Adjustable switch-on/switch-off delay for the digital inputs and digital functions of the analogue inputs. Use as a switch-on filter or simple process control is possible.							
Setting values	Value Meaning							
	Positive values				Switch-on delayed			
	Negative values				Switch-off delayed			

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

P481	Funct-BusIO Out Bits				S
Setting range	0 ... 61				
Arrays	[-01] = Bus / AS-i Dig Out1		BusIO Out Bit 0 + ASi 1		
	[-02] = Bus / AS-i Dig Out2		BusIO Out Bit 1 + ASi 2		
	[-03] = Bus / AS-i Dig Out3		BusIO Out Bit 2 + ASi 3		
	[-04] = Bus / AS-i Dig Out4		BusIO Out Bit 3 + ASi 4		
	[-05] = Bus / 1.IOE Dig Out1		BusIO Out Bit 4 + ASi 5 + DO 1 of the first SK xU4-IOE (DigOut 02)		
	[-06] = Bus / 1.IOE Dig Out2		BusIO Out Bit 5 + ASi 6 + DO 2 of the first SK xU4-IOE (DigOut 03)		
	[-07] = Bus / 2.IOE Dig Out1		Marker 1 ¹ + DO 1 of the second SK xU4-IOE (DigOut 04)		
	[-08] = Bus / 2.IOE Dig Out2		Marker 2 ¹ + DO 2 of the second SK xU4-IOE (DigOut 05)		
	[-09] = Bus statusword Bit10		Assignment of a function for Bit 10 or Bit 13 of the status word.		
	[-10] = Bus statusword Bit13				
Factory setting	[-01] = { 18 }	[-02] = { 8 }	[-03] = { 30 }	[-04] = { 31 }	All others { 0 }
Scope of application	SK 2xxE				
Description	<i>"BusIO Out Bits function"</i> . The BusIO Out Bits are considered to be digital outputs (P434). They can be set to the same functions. For devices with integrated AS-Interface, these IO Bits can also be used by the AS-Interface itself, or in conjunction with IO extensions (SK xU4-IOE).				
Note	The possible functions of the BusIO Out Bits can be found in the table of functions for the digital outputs (P434).				

1 Marker function only possible for control via control terminals.

P480 ... P481 Use of markers

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

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

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

Example:

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

This is to ensure that the load on the motor drops and the temperature can stabilise again, and that the drive systematically reduces its speed to a defined amount before a fault switch-off occurs.

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

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

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

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

5.2.7 Additional parameters

P501	Inverter name			
Setting range	0 ... 20			
Factory setting	{ 0 }			
Description	Free input of a designation (name) for the device (max. 20 characters). This allows the frequency inverter to be clearly identified during processing with the NORDCON software or within a network.			

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

0	Off	17	Value Analog In 1 SK 2x0E: P400 [-01] SK 2x5E: P400 [-03]
1	Actual frequency		
2	Actual speed		
3	Current	18	Value Analog In 2 SK 2x0E: P400 [-02] SK 2x5E: P400 [-04]
4	Torque current (100% = P112)		
5	State digital-IO		
6	Reserved for POSICON.	19	Freq. Master Value; "Setpoint frequency master value"
...			
7		20	Set Freq. After Ramp; "Setpoint frequency after ramp master value"
		21	Act. Freq. w/o Slip; "Actual frequency without slip master value"
8	Set point frequency	22	Speed encoder
9	Error code	23	Act. freq. With slip "Actual frequency with slip"
10	Reserved for POSICON.	24	Lead.act.freq.+slip "Master value Actual frequency with slip"
...			
11		53	Actual value 1 PLC
		54	Actual value 2 PLC
12	BusIO Out Bits 0-7	55	Actual value 3 PLC
13	Reserved for POSICON.	56	Actual value 4 PLC
...		57	Actual value 5 PLC
16			

Digital input assignments ("State digital-IO")

Bit 0	DIN 1 (FI)	Bit 8	DIN 5 (DI1 (1 st SK xU4-IOE))
Bit 1	DIN 2 (FI)	Bit 9	DIN 6 (DI2 (1 st SK xU4-IOE))
Bit 2	DIN 3 (FI)	Bit 10	DIN 7 (DI3 (1 st SK xU4-IOE))
Bit 3	DIN 4 (FI)	Bit 11	DIN 8 (DI4 (1 st SK xU4-IOE))
Bit 4	PTC input (FI)	Bit 12	DOUT 1 (FI)
Bit 5	Reserved	Bit 13	Mechanic. Brake (FI)
Bit 6	DOUT 3 (DO1 (1 st SK xU4-IOE))	Bit 14	DOUT 2 (FI) (only SK 2x0E)
Bit 7	DOUT 4 (DO2 (1 st SK xU4-IOE))	Bit 15	Reserved

P503	Leading func. output	S
Setting range	0 ... 3	
Factory setting	{ 0 }	
Description	For master-slave applications, this parameter defines the bus system to which the master should output its control word and the master values P502 for the slave. On the slave, parameters P509 , P510 , P546 define the source from which the slave obtains the control word and the master values from the master and how these are to be processed by the slave.	
Setting values	Value Meaning	
	0	Off No output of CTW and master values. If not a single bus option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox/NORDCON is visible.
	1	CANopen systembus Output of CTW and master values to the system bus. If not a single bus option (e.g. SK xU4-IOE) is connected to the system bus, only the device directly connected to the ParameterBox/NORDCON is visible.
	2	Systembus active No output of CTW and master values, but all participants, which are set to "Systembus active" are visible via the ParameterBox or NORDCON. This also applies if no bus option is connected.
	3	CANop+Systbus active Output of CTW and master values to the system bus. All participants that are set to "Systembus active" are visible via the ParameterBox or NORDCON. This also applies if no bus option is connected.

P504	Pulse frequency	S
Setting range	3.0 ... 16.0 kHz / 16.1 ... 16.4	
Factory setting	{ 6.0 }	
Description	With this parameter, the internal pulse frequency for controlling the power unit can be changed. A high setting value reduces motor noise, but increases EMC emissions and reduces the possible motor torque.	
Note	The best possible radio interference suppression level indicated for the device is adhered to by using the default value and observing the wiring directives. Raising the pulse frequency leads to a reduction of the possible output current, depending on the time (I^2t characteristic curve). When the temperature warning limit C001 is reached, the pulse frequency is gradually lowered to the default value (see also P537). If the frequency inverter temperature drops by a sufficient amount, the pulse frequency is increased to the original value. With setting P300 = 3, a constant pulse frequency (6 kHz) is used in the lower speed range (injection mode). Setting values > 16.0 do not define a frequency value but map a function (see "Setting values"). If a sinusoidal filter is used, the pulse frequency must not change. Otherwise, "Module errors" (E004.0) may be triggered. For this, see P504 = 16.2 and P504 = 16.3.	
Setting values	Value Meaning	

min. ... 16.0	Pulse frequency min.... 16.0 kHz	The set value is used as the standard pulse frequency. With increasing overload, the frequency inverter automatically and gradually reduces the pulse frequency to the factory setting.
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 6.0 kHz	Fixed pulse frequency setting. This value remains constant even in case of overload (suitable for operation with a sinusoidal filter). Note: With these settings, short circuits at the output which occur before enabling may possibly no longer be detected correctly.
16.3	Pulse frequency 8.0 kHz	
16.4	Automatic load adjustment	The pulse frequency is set automatically and load-dependently between a minimum value (highest load reserve) and a maximum value (lowest load reserve). During an acceleration phase and with high power requirements ($\geq$ nominal power), the minimum value is set. With constant speed and power requirements $\leq 80\%$ of the nominal power, the high pulse frequency is set.

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

P506	Automatic acknowledged.		S
Setting range	0 ... 7		
Factory setting	{ 0 }		
Description	“Automatic fault acknowledgement”. In addition to the manual fault acknowledgement, an automatic one can also be selected.		
Note	Automatic fault acknowledgement is performed 3 s after the fault can be acknowledged.		
	NOTICE! Parameter must not be set to P506 = 6 if P428 = 1 is set. Otherwise, after an active fault (e.g. earth fault/short circuit), the device continually switches on again. This can endanger persons and the system and destroy the device.		
Setting values	Value Meaning		
	0	Off: There is no automatic fault acknowledgement.	When using the control terminals to control the FI, the error message is acknowledged by removing the enabling signal.
	1	Number of permissible automatic fault acknowledgements within one mains-on cycle. After switching the mains off and on again, the full amount is available again.	
	...		
	5		
	6	Always: A fault message will always be acknowledged automatically if the cause of the error is no longer present, see note.	
	7	Quit disable: Acknowledgement is only possible using the OK / ENTER key or by switching off the mains. No acknowledgement is implemented by removing the enable!	

P509	Source control word			
Setting range	0 ... 4			
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 bus: Set P509 and, if necessary, P899 to the relevant bus system.			
Setting values	Value Meaning			

0	Contr.term. or keyb. ¹	"Control terminals or keyboard control". Control is via SimpleBox (if P510 = 0), ParameterBox, digital and analogue inputs or BusIO Bits.
1	Contr. terminal only ²	Control is via the digital and analogue inputs or via BusIO Bits.
2	USS / Modbus RTU ²	The control word is expected via the RS-232/RS-485 interface.
3	Systembus ^{2,3}	Setting for control by master via a bus interface.
4	Systembus broadcast ²	Setting for control by a master drive in master-slave mode (e.g. for synchronous applications).

- 1 With keyboard control: In case of a communication fault (timeout 0.5 s), the frequency inverter is disabled without an error message.
- 2 Keyboard control via SimpleBox and ParameterBox is disabled; parameterisation is still possible.
- 3 As an alternative to parameter setting, it is also possible to switch to the system bus using DIP switch S1:3 in position "I" (on) (for the current status of the DIP switch S1, see **P749**).
Note: DIP switch S1 has priority over the parameter setting.

P510	Source Setpoints		S
Setting range	0 ... 4		
Arrays	Selection of setpoint source [-01] = Source main setvalue [-02] = Source 2nd setpoint		
Factory setting	All { 0 }		
Description	Selection of the interface via which the frequency inverter receives its setpoints.		
Setting values	Value Meaning		

0	Auto (= P509)	The setpoint source corresponds to that of the control word (P509).
1	Contr. terminal only	Digital and analogue inputs control the frequency, including fixed frequencies.
2	USS / Modbus RTU	The setpoint is expected via the RS-232/RS-485 interface.
3	Systembus ¹	The setpoint is expected via the system bus interface.
4	Systembus broadcast	The setpoint is expected via the system bus interface.

- 1 As an alternative to parameter setting, it is also possible to switch to the system bus using DIP switch S1:3 in position "I" (on) (for the current status of the DIP switch S1, see **P749**).
Note: DIP switch S1 has priority over the parameter setting.

P511	USS baud rate		S
Setting range	0 ... 3		
Factory setting	{ 3 }		
Description	Setting of the transfer rate (transfer speed) via the RS-485 interface. The same baud rate must be set for all bus participants.		
Setting values	Value Meaning		

0	4800 baud	2	19200 baud
1	9600 baud	3	38400 baud

P513	Telegram time-out			S
Setting range	-0.1 ... 100.0 s			
Factory setting	{ 0.0 }			
Description	Monitoring function of the active bus interface. Following the receipt of a valid telegram, the next telegram must arrive within the set period. Otherwise, the frequency inverter reports a fault and switches off with error message E010 "Bus Time Out". A communication failure during remote control with NORDCON shuts down the frequency inverter without triggering an error.			
Note	The parameter should normally be left in the factory setting { 0.0 }. Parameter (P513) should only be set to { -0.1 } if errors detected on the optional module side (e.g. communication errors at field bus level) are not to result in a switch-off of the drive. The process data channels for USS / Modbus RTU, CAN / CANopen und CAN / CANopen Broadcast are monitored independently of each other. The decision about which channel is monitored is made by the setting in parameter P509 or P510 . This makes it possible, for example, to register the failure of CAN Broadcast communication, although the frequency inverter 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.	
	0.0	Off	Monitoring is switched off.	
	0.1 ... 100.0	---	Setting of telegram downtime	

P514	CAN bus baud rate					
Setting range	0 ... 7					
Factory setting	{ 5 }					
Description	Setting of the transfer rate (transfer speed) via the CAN bus interface. All bus participants must be set to the same baud rate.					
Note	Optional modules of the SK CU4-... or SK TU4-... series exclusively work with a transfer rate of 250 kbaud. If the frequency inverter is connected to such a module, the factory setting (250 kbaud) must be retained.					
Setting values	Value Meaning					
	0	10 kbaud	3	100 kbaud	6	500 kbaud
	1	20 kbaud	4	125 kbaud	7	1 Mbaud ¹ (Only for test purposes)
	2	50 kbaud	5	250 kbaud		
	1 Reliable operation is not guaranteed.					

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

P516	Skip frequency 1		S	P
Setting range	0.0 ... 400.0 Hz			
Factory setting	{ 0.0 }			
Description	The output frequency around the frequency in the range between +P517 and -P517 set here is not displayed. This range is transmitted with the set deceleration and acceleration ramp; it cannot be continuously supplied to the output.			
Note	Frequencies below the absolute minimum frequency should not be set.			
Setting values	0.0 Skip frequency inactive			
P517	Skip freq. area 1		S	P
Setting range	0.0 ... 50.0 Hz			
Factory setting	{ 2.0 }			
Description	Skip range for "Skip freq. area 1" P516. This frequency value is added and subtracted from the skip frequency. Skip range 1: (P516 - P517) ... (P516) ... (P516 + P517)			
P518	Skip frequency 2		S	P
Setting range	0.0 ... 400.0 Hz			
Factory setting	{ 0.0 }			
Description	The output frequency around the set frequency in the range between +P519 and -P519 set here is not displayed. This range is transmitted with the set deceleration and acceleration ramp; it cannot be continuously supplied to the output.			
Note	Frequencies below the absolute minimum frequency should not be set.			
Setting values	0.0 Skip frequency inactive			
P519	Skip range 2		S	P
Setting range	0.0 ... 50.0 Hz			
Factory setting	{ 2.0 }			
Description	Skip range for "Skip frequency 2" P518. This frequency value is added to and subtracted from the skip frequency. Skip range 2: (P518 - P519) ... (P518) ... (P518 + P519)			

P520	Flying start	S	P
Setting range	0 ... 4		
Factory setting	{ 0 }		
Description	This function is required to actuate the FI to already rotating motors, for example for fan drives.		
Note	For physical reasons, flying start only operates above 1/10 of the nominal frequency P201 , but not below <u>10 Hz</u> .		
		Example 1	Example 2
	P201	50 Hz	200 Hz
	f = 1/10 × P201	F = 5 Hz	F = 20 Hz
	Result × f_{Fang} =	The flying start operates from f _{Fang} = 10 Hz upwards.	The flying start operates from f _{Fang} = 20 Hz upwards.
	ASM: With motor frequencies > 100 Hz, the flying start function only acts in speed-controlled mode (P300 = 1). PMSM: The flying start function automatically determines the direction of rotation. Therefore, with P520 = 2, the device behaves identically to P520 = 1. With P520 = 4, the device behaves identically to P520 = 3. PMSM: In CFC closed-loop mode, flying start can only be executed if the rotor position is known in relation to the incremental encoder. For this purpose, the motor must not initially rotate when it is switched on for the first time after a "Mains on" of the device. This restriction does not apply if the zero track of the incremental encoder is used. PMSM: The flying start does not work if P504 = 16.2 or P504 = 16.3 is used.		
Setting values	Value Meaning		
	0	Switched off	No flying start
	1	Both directions	The FI searches for a speed in both directions.
	2	Directio.of setpoint	Search only in the direction of the present setpoint.
	3	Both dir.after fault	"Both directions after fault"; same as P520 = 1 , but only after a mains failure and fault.
	4	Dir.of set. a. fault	"Direction of setpoint after fault"; same as P520 = 2 , but only after a mains failure and fault.
P521	Flying start Resolution	S	P
Setting range	0.02 ... 2.50 Hz		
Factory setting	{ 0.05 }		
Description	<i>"Flying start resolution"</i> . 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	<i>"Flying start offset"</i> . 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	By selecting the and activating the relevant value, the selected parameter range is set to factory setting. Once this setting is made, the parameter value automatically changes back to 0.			
Note	If an external EEPROM ("memory module") is installed, the commands ("factory setting ...") will only affect this module. If no "memory module" is installed, the selected command ("factory setting ...") is applied to the internal EEPROM. Up to firmware version V 2.2 R0, the parameters relevant for PMSM operation (P240 ... P246) have also been reset.			
Setting values	Value Meaning			
	0	No change	Does not change the parameterisation.	
	1	Load factory setting	"Load factory setting". The entire parameterisation of the FI is reset to the factory setting. All originally parameterised data is lost.	
	2	Fact.setng.w.out bus	"Load factory setting without bus". All parameters of the FI, <i>except for the bus parameters</i> , are reset to the factory setting.	
	3	Fact set w/o motor	"Load factory setting without motor parameter". All parameters of the FI, <i>except for the motor data</i> (P105, P201 ... P209, P240 ... P246, P411), are reset to the factory setting.	

P525	Load monitoring max				S	P
Setting range	1 ... 400 % / 401					
Arrays	Selection of up to 3 auxiliary values:					
	[-01] =	Auxiliary value 1	[-02] =	Auxiliary value 2	[-03] =	Auxiliary value 3
Factory setting	All { 401 }					
Description	"Load monitoring maximum value". Setting of the upper limit of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01] , [-02] and [-03] of parameters P525 ... P527 , or the entries which are made there always belong together.					
Note	Setting 401 = Off → Monitoring is not performed.					

P526	Load monitoring min.				S	P
Setting range	0 / 1 ... 400 %					
Arrays	Selection of up to 3 auxiliary values:					
	[-01] =	Auxiliary value 1	[-02] =	Auxiliary value 2	[-03] =	Auxiliary value 3
Factory setting	All { 0 }					
Description	"Load monitoring, minimum value" Setting of the lower limit value of load monitoring. Up to 3 values can be specified. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01] , [-02] and [-03] of parameters P525 ... P527 , or the entries which are made there always belong together.					
Note	Setting 0 = Off → Monitoring is not performed.					

P527	Load control freq.	S	P
Setting range	0.0 ... 400.0 Hz		
Arrays	Selection of up to 3 auxiliary values:		
	[-01] = Auxiliary value 1 [-02] = Auxiliary value 2 [-03] = Auxiliary value 3		
Factory setting	All { 25.0 }		
Description	“<i>Load control frequency</i>” Definition of up to 3 frequency points, which define the monitoring range for load control. The auxiliary frequency values do not need to be entered in order of size. Prefixes are not taken into account, only the integer values are processed (motor / generator torque, right/left rotation). The array elements [-01], [-02] and [-03] of parameters P525 ... P527, or the entries which are made there always belong together.		

P528	Load control delay	S	P
Setting range	0.10 ... 320.00 s		
Factory setting	{ 2.00 }		
Description	“<i>Load control delay</i>”. Parameter P528 defines the delay time in seconds with which an error message E012.5 is suppressed if the defined control range P525 ... P527 is infringed. A warning C012.5 is triggered after half of this time has elapsed. According to the selected control mode P529, a fault message can also be generally suppressed.		

P529	Mode Load control	S	P
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	Specifies the response on infringement of the monitoring range (P525 ... P527).		
Setting values	Value Meaning		
	0	Fault & Warning	After the time defined in P528 has elapsed, infringement of the monitoring range generates fault E012.5 . Warning C012.5 is triggered after half of the time has elapsed.
	1	Warning	After half of the time defined in P528 has elapsed, infringement of the monitoring range generates warning C012.5 .
	2	Fault&Warn.const.mov	“ <i>Fault and warning during constant movement</i> ”. Same as P529 = 0 , but monitoring is inactive during acceleration phases.
	3	Warning Const. Move	“ <i>Warning only during constant movement</i> ”. Same as P529 = 1 , but monitoring is inactive during acceleration phases.

P525 ... P529	Load control
	With load control, a range can be specified within which the load torque may change depending on the output frequency. There are three auxiliary values for the maximum permissible torque and three auxiliary values for the minimum permissible torque. A frequency is assigned to each of these three auxiliary values. No control is carried out below the first and above the third frequency. In addition, control can be deactivated for minimum and maximum values. As standard, control is deactivated.
	The graph illustrates the load torque I_{sq} as a function of the output frequency f_{sol}. The green shaded area represents the maximum permissible torque, and the yellow shaded area represents the minimum permissible torque. The boundaries are defined by the parameters P525, P526, and P527. The x-axis shows the frequency range from P527 [-01] to P527 [-03]. The y-axis shows the torque range from P526 [-01] to P525 [-01].
	The time after which a fault is triggered can be set with a parameter (P528). If the permissible range is exceeded (<i>Example diagram: Infringement of the area marked in yellow or green</i>), the error message E012.5 is generated if parameter P529 does not suppress error triggering.
	A warning C012.5 is always issued after the elapse of half of the set error triggering time P528. This also applies if a mode is selected for which no fault is generated. If only a maximum or minimum value is to be controlled, the other limit must be deactivated or must remain deactivated. The torque current and not the calculated torque is used as the reference value. This has the advantage that control outside of the "field weakening range" without servo mode is usually more accurate. Naturally however, it cannot map more than the physical torque in the field weakening range.
	All parameters depend on parameter sets. No differentiation is made between motor and generator torque; therefore the amount of the torque is considered. As well as this, there is no differentiation between "left-hand" and "right-hand" rotation. The control is therefore independent of the sign of the frequency. There are four different load control modes P529.
	The frequencies and the minimum and maximum values belong together within the various array elements. The frequencies do not need to be sorted according to their magnitude in elements 0, 1 and 2. This is performed automatically by the frequency inverter.

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

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

P535	I ² t motor																																																																
Setting range	0 ... 24																																																																
Factory setting	{ 0 }																																																																
Description	The motor temperature is calculated depending on the output current, the time and the output frequency (cooling). If the temperature limit value is reached, switch-off occurs with error message E002.1. Possible positive or negative ambient conditions are not taken into account. Eight characteristic curves with trigger times < 60 s, 120 s and 240 s are available for the function I²t motor. The triggering times are based on classes 5, 10 and 20 for semiconductor switching devices. The recommended setting for standard applications is P535 = 5. All characteristic curves run from 0 Hz to half of the nominal frequency P201. The full nominal current is always available from above half of the nominal frequency. <table><tr><th colspan="2">Switch-off class 5, 60 s at (1.5 × I_N × P533)</th><th colspan="2">Switch-off class 10, 120 s at (1.5 × I_N × P533)</th><th colspan="2">Switch-off class 20, 240 s at (1.5 × I_N × P533)</th></tr><tr><th>I_N at 0 Hz</th><th>P535</th><th>I_N at 0 Hz</th><th>P535</th><th>I_N at 0 Hz</th><th>P535</th></tr><tr><td>100%</td><td>1</td><td>100%</td><td>9</td><td>100%</td><td>17</td></tr><tr><td>90%</td><td>2</td><td>90%</td><td>10</td><td>90%</td><td>18</td></tr><tr><td>80%</td><td>3</td><td>80%</td><td>11</td><td>80%</td><td>19</td></tr><tr><td>70%</td><td>4</td><td>70%</td><td>12</td><td>70%</td><td>20</td></tr><tr><td>60%</td><td>5</td><td>60%</td><td>13</td><td>60%</td><td>21</td></tr><tr><td>50%</td><td>6</td><td>50%</td><td>14</td><td>50%</td><td>22</td></tr><tr><td>40%</td><td>7</td><td>40%</td><td>15</td><td>40%</td><td>23</td></tr><tr><td>30%</td><td>8</td><td>30%</td><td>16</td><td>30%</td><td>24</td></tr></table>					Switch-off class 5, 60 s at (1.5 × I _N × P533)		Switch-off class 10, 120 s at (1.5 × I _N × P533)		Switch-off class 20, 240 s at (1.5 × I _N × P533)		I _N at 0 Hz	P535	I _N at 0 Hz	P535	I _N at 0 Hz	P535	100%	1	100%	9	100%	17	90%	2	90%	10	90%	18	80%	3	80%	11	80%	19	70%	4	70%	12	70%	20	60%	5	60%	13	60%	21	50%	6	50%	14	50%	22	40%	7	40%	15	40%	23	30%	8	30%	16	30%	24
Switch-off class 5, 60 s at (1.5 × I _N × P533)		Switch-off class 10, 120 s at (1.5 × I _N × P533)		Switch-off class 20, 240 s at (1.5 × I _N × P533)																																																													
I _N at 0 Hz	P535	I _N at 0 Hz	P535	I _N at 0 Hz	P535																																																												
100%	1	100%	9	100%	17																																																												
90%	2	90%	10	90%	18																																																												
80%	3	80%	11	80%	19																																																												
70%	4	70%	12	70%	20																																																												
60%	5	60%	13	60%	21																																																												
50%	6	50%	14	50%	22																																																												
40%	7	40%	15	40%	23																																																												
30%	8	30%	16	30%	24																																																												
Note	Switch-off classes 10 and 20 are provided for applications with heavy starting. When using these switch-off classes, it must be ensured that the FI has a sufficiently high overload capacity. Disable control for multiple motor operation. P535 = 0 → No control performed. With P535 ≠ 0, the determination of the approximate motor start temperature is activated at the same time (see chapter 8.12 "Motor temperature monitoring"). Depending on the parameterisation in parameter P336, this can lead to a delay in motor start-up of approx. 0.2 s after enabling.																																																																

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

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

P539	Check output voltage	S	P
Setting range	0 ... 3		
Factory setting	{ 0 }		
Description	The output current at the U-V-W terminals is monitored and checked for plausibility. In case of error, error message E016 is issued.		
Note	This function can be used as an additional protective function for lifting gear applications, but is not permissible as sole personal protection.		
Setting values	Value Meaning		
	0	Off	No monitoring of output voltage.
	1	Motor Phases only	The output current is measured and checked for symmetry. If an asymmetry is present, the frequency inverter switches off with error message E016.0 .
	2	Magnetisation only	When the frequency inverter is switched on, the level of the excitation current (field current) is checked. If insufficient excitation current is present, the frequency inverter switches off with error message E016.0 . A motor brake is not released in this phase. Note: This setting has no effect if PMSMs are used.
	3	Motor Phas.+Magnet.	Combination of settings {1} and {2}: Phase and magnetisation errors result in error message E016.0 . Note: When using PMSMs, only the motor phases are monitored with this setting.

P540	Mode phase sequence	S	P
Setting range	0 ... 7		
Factory setting	{ 0 }		
Description	For safety reasons, this parameter can be used to prevent a phase sequence reversal and therefore prevent an incorrect phase sequence.		
Note	This function influences the functions of the position control (P600 ≠ 0).		
Setting values	Value Meaning		
	0	No limitation	No limitation of the phase sequence
	1	Disable phaseseq.key	The phase sequence key of the ControlBox is disabled.
	2	To the right only ¹	Only phase sequence "right" is possible. Selection of the "incorrect" phase sequence results in the output of the minimum frequency P104 with the rotating field R.
	3	To the left only ¹	Only phase sequence "left" is possible. Selection of the "incorrect" phase sequence results in the output of the minimum frequency P104 with the rotating field L.
	4	Enabl. Direct. only	Phase sequence is only possible according to the enable signal, otherwise 0 Hz is supplied.
	5	Right Orient. Contr. ¹	"Only right orientation controlled". Only phase sequence "right" is possible. Selection of the "incorrect" phase sequence leads to frequency inverter switch-off (controller block). If necessary, an adequately large setpoint (> f _{min}) must be observed.
	6	Left Orient. Contr. ¹	"Only left orientation controlled". Only phase sequence "left" is possible. Selection of the "incorrect" phase sequence leads to frequency inverter switch-off (controller block). If necessary, an adequately large setpoint (> f _{min}) must be observed.
	7	Enab. Direct. Contr.	"Only enable direction controlled" Phase sequence is only possible according to the enable signal; otherwise, the frequency inverter is switched off.

¹ Applies to the control via control terminals and keyboard. In addition, the phase sequence key of the ControlBox is disabled.

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

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

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

0	Off	17	Value Analog In 1 SK 2x0E: P400 [-01] SK 2x5E: P400 [-03]
1	Actual frequency		
2	Actual speed		
3	Current	18	Value Analog In 2 SK 2x0E: P400 [-02] SK 2x5E: P400 [-04]
4	Torque current (100% = P112)		
5	State digital-IO		
6	Reserved for POSICON.	19	Freq. Master Value; "Setpoint frequency master value"
...			
7		20	Set Freq. After Ramp; "Setpoint frequency after ramp master value"
		21	Act. Freq. w/o Slip; "Actual frequency without slip master value"
8	Set point frequency	22	Speed encoder
9	Error code	23	Act. freq. With slip "Actual frequency with slip"
10	Reserved for POSICON.	24	Lead.act.freq.+slip "Master value Actual frequency with slip"
...			
11		53	Actual value 1 PLC
		54	Actual value 2 PLC
12	BusIO Out Bits 0-7	55	Actual value 3 PLC
13	Reserved for POSICON.	56	Actual value 4 PLC
...		57	Actual value 5 PLC
16			

Digital input assignments ("State digital-IO")

Bit 0	DIN 1 (FI)	Bit 8	DIN 5 (DI1 (1 st SK xU4-IOE))
Bit 1	DIN 2 (FI)	Bit 9	DIN 6 (DI2 (1 st SK xU4-IOE))
Bit 2	DIN 3 (FI)	Bit 10	DIN 7 (DI3 (1 st SK xU4-IOE))
Bit 3	DIN 4 (FI)	Bit 11	DIN 8 (DI4 (1 st SK xU4-IOE))
Bit 4	PTC input (FI)	Bit 12	DOUT 1 (FI)
Bit 5	Reserved	Bit 13	Mechanic. Brake (FI)
Bit 6	DOUT 3 (DO1 (1 st SK xU4-IOE))	Bit 14	DOUT 2 (FI) (only SK 2x0E)
Bit 7	DOUT 4 (DO2 (1 st SK xU4-IOE))	Bit 15	Reserved

P546	Func. bus-setpoint	S	P
Setting range	0 ... 36		
Arrays	[-01] = Bus-setpoint 1 [-02] = Bus-setpoint 2 [-03] = Bus-setpoint 3		
Factory setting	[-01] = { 1 } All others { 0 }		
Description	Assignment of a function to a bus setpoint.		
Note	Further details can be found in the respective supplementary bus manual or in the description for P400 . (Values from 0% ... 100% correspond to 0000h ... 4000h) With regard to scaling of setpoints: 8.10 "Scaling of set-/actual values".		
Setting values	Value Meaning		
	0 Off		The bus setpoint has no function.
	1 Set point frequency		The specified bus setpoint varies the output frequency between the set minimum and maximum frequencies P104/P105 .
	2 Frequency addition ¹		The supplied frequency value is added to the setpoint.
	3 Frequency subtract. ¹		" <i>Frequency subtraction</i> ". The supplied frequency value is subtracted from the setpoint.
	4 Minimum frequency ¹		The minimum frequency of the frequency inverter is varied. 0% corresponds to the setting in parameter P410 . The values for the minimum output frequency (P104) cannot be undershot. The lower limit value is 1 Hz.
	5 Maximum frequency ¹		The maximum frequency of the frequency inverter is varied. 100% corresponds to the setting in parameter P411 . The values for the maximum output frequency (P105) cannot be exceeded. The lower limit value is 2 Hz.
	6 Cur.val process ctrl ²		Activates the process controller. The bus setpoint is connected via the bus to the process controller's actual value encoder (compensator, pressurised can, flow volume meter, etc.).
	7 Nom.val process ctrl ²		" <i>Process controller setpoint</i> ". Same as function {6}, but the setpoint of the process controller is specified. The actual value must be specified using another input.
	8 PI current freq. ²		Needed to set up a control loop. The bus actual value is compared with the setpoint. The output frequency is adjusted as far as possible until the actual value equals the setpoint. (See controlled variables P413 ... P414). Change in the direction of rotation possible.
	9 PI ltd.current.freq ²		" <i>PI-limited actual frequency</i> ". Same as function {8}, but the value for the min./max. output frequency (P104/P105) cannot be undershot/exceeded. No change in the direction of rotation possible.
	10 PI suprvsd.cur.freq ²		" <i>PI-supervised actual frequency</i> ". Same as function {8}, but the frequency inverter switches the output frequency off if the value for the min./max. output frequency (P104/P105) is reached.
	11 Torque current limit		" <i>Limiting torque current limit</i> ". Based on the set current limit (P112), it can be changed via the bus setpoint. 100% setpoint corresponds to the set torque current limit (P112). Reaching the set limit value results in an output frequency reduction on the torque current limit.
	12 Torqu.curr.limit off		" <i>Switching-off torque current limit</i> ". Same as function {11}, but reaching the set limit value results in switch-off with error E012.3 .
	13 Current limit		" <i>Limiting current limit</i> ". Based on the set current limit (P536), it can be changed via the bus setpoint. 100% setpoint corresponds to the set current limit (P536). Reaching the set limit value results in an output voltage reduction to limit the output current.
	14 Current limit off		" <i>Switching-off current limit</i> ". Same as function {13}, but reaching the set limit value results in switch-off with error E012.4 .
	15 Ramp time		The bus setpoint specifies the acceleration and deceleration time.

16	Pre-tension Torque	This function enables a value for the torque requirement to be applied in the controller in advance (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring (P214).
17	Multiplication	The setpoint is multiplied by the specified bus setpoint. 100% the bus setpoint corresponds to a multiplication factor of 1.
18	Curve control	The master receives the current speed from the slave via the bus system (P546 [-01] ... [-03]). From its own speed, the speed of the slave and the master speed, the master calculates the current setpoint speed so that neither of the two drives travels faster than the master speed in the curve.
19	Servo-Mode Torque	In the "CFC closed-loop" (P300 = 1) control method, the motor torque can be set/limited via the bus setpoint. Here, the speed controller is switched off and a torque control is activated. In this case, the bus setpoint input is the setpoint source. In the open-loop method (P300 ≠ 1), this function can be used with reduced control quality. In VFC mode, the function enables a torque mode without encoder, suitable for simple tension control, for example.
20	BusIO In Bits 0-7	Specification of the BusIO-In Bits via the bus setpoint.
21	Reserved	Reserved for POSICON.
...		
25		
27	Acceleration time	The bus setpoint specifies the acceleration time. 0% is the shortest time possible, 100% $\triangleq$ P102 .
28	Deceleration time	The bus setpoint specifies the deceleration time. 0% is the shortest time possible, 100% $\triangleq$ P103 .
31	Digital output IOE	This function can be used to set P541 via bus control.
32	Analog output IOE	This function can be used to set P542 via bus control. Condition: P418 = 31 . The value must be between 0 and 100 (00h and 64h). Otherwise, the minimum value is output at the analogue output.
33	Setval.torque p.reg. ²	"Setpoint Torque Process controller". The bus setpoint specifies the torque setpoint for the process controller. For the even distribution of torques to coupled drives (e.g. S-roller drive). This function is also possible when using the ISD control.
34	d-corr. F Process	Diameter correction for the frequency of the PI process controller.
35	d-corr. Torque	Diameter correction for the torque of the PI process controller.
36	d-corr. F+Torque	Diameter correction for the frequency and the torque of the PI process controller.

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

2 Process controller details: **P400** and 8.2 "Process controller".

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

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

P552	CAN master circle			S
Setting range	0 ... 100 ms			
Arrays	[-01] = CAN master function, CAN master circle 1 [-02] = CANopen abs. encoder, CANopen absolute encoder, CAN master circle 2			
Factory setting	All { 0 }			
Description	This parameter is used to set the cycle time in CAN/CANopen master mode and to the CANopen encoder (see P503 , P514 , P515). Depending on the set baud rate, there are different minimum values for the actual cycle time.			
	Baud rate	Minimum value t_z	Default CAN master	Default CANopen abs.
	10 kbaud	10 ms	50 ms	20 ms
	20 kbaud	10 ms	25 ms	20 ms
	50 kbaud	5 ms	10 ms	10 ms
	100 kbaud	2 ms	5 ms	5 ms
	125 kbaud	2 ms	5 ms	5 ms
	250 kbaud	1 ms	5 ms	2 ms
	500 kbaud	1 ms	5 ms	2 ms
	1000 kbaud	1 ms	5 ms	2 ms
Note	The range of values which can be set is between 0 and 100 ms. With P552 = 0 “Auto”, the default value (see table) is used. In this setting, the monitoring function for the CANopen absolute encoder is no longer triggered at 50 ms but at 150 ms.			

P553	PLC set values			S
Setting range	0 ... 36			
Arrays	[-01] = PLC setpoint 1 [-02] = PLC setpoint 2 [-03] = PLC setpoint 3 [-04] = PLC setpoint 4 [-05] = PLC setpoint 5			
Factory setting	[-01] = { 1 } All others { 0 }			
Description	Assignment of functions for the various PLC control bits.			
Note	Prerequisite: P350 = 1 and P351 = 0 or 1 . With regard to scaling of setpoints: 8.10 “Scaling of set-/actual values”.			
Setting values	Value Meaning			

0	Off	The bus setpoint has no function.
1	Set point frequency	The specified bus setpoint varies the output frequency between the set minimum and maximum frequencies P104/P105 .
2	Frequency addition ¹	The supplied frequency value is added to the setpoint.
3	Frequency subtract. ¹	" <i>Frequency subtraction</i> ". The supplied frequency value is subtracted from the setpoint.
4	Minimum frequency ¹	The minimum frequency of the frequency inverter is varied. 0% corresponds to the setting in parameter P410 . The values for the minimum output frequency (P104) cannot be undershot. The lower limit value is 1 Hz.
5	Maximum frequency ¹	The maximum frequency of the frequency inverter is varied. 100% corresponds to the setting in parameter P411 . The values for the maximum output frequency (P105) cannot be exceeded. The lower limit value is 2 Hz.
6	Cur.val process ctrl ²	Activates the process controller. The bus setpoint is connected via the bus to the process controller's actual value encoder (compensator, pressurised can, flow volume meter, etc.).
7	Nom.val process ctrl ²	" <i>Process controller setpoint</i> ". Same as function {6}, but the setpoint of the process controller is specified. The actual value must be specified using another input.
8	PI current freq. ²	Needed to set up a control loop. The bus actual value is compared with the setpoint. The output frequency is adjusted as far as possible until the actual value equals the setpoint. (See controlled variables P413 ... P414). Change in the direction of rotation possible.
9	PI ltd.current.freq ²	" <i>PI-limited actual frequency</i> ". Same as function {8}, but the value for the min./max. output frequency (P104/P105) cannot be undershot/exceeded. No change in the direction of rotation possible.
10	PI suprvsd.cur.freq ²	" <i>PI-supervised actual frequency</i> ". Same as function {8}, but the frequency inverter switches the output frequency off if the value for the min./max. output frequency (P104/P105) is reached.
11	Torque current limit	" <i>Limiting torque current limit</i> ". Based on the set current limit (P112), it can be changed via the bus setpoint. 100% setpoint corresponds to the set torque current limit (P112). Reaching the set limit value results in an output frequency reduction on the torque current limit.
12	Torqu.curr.limit off	" <i>Switching-off torque current limit</i> ". Same as function {11}, but reaching the set limit value results in switch-off with error E012.3 .
13	Current limit	" <i>Limiting current limit</i> ". Based on the set current limit (P536), it can be changed via the bus setpoint. 100% setpoint corresponds to the set current limit (P536). Reaching the set limit value results in an output voltage reduction to limit the output current.
14	Current limit off	" <i>Switching-off current limit</i> ". Same as function {13}, but reaching the set limit value results in switch-off with error E012.4 .
15	Ramp time	The bus setpoint specifies the acceleration and deceleration time.
16	Pre-tension Torque	This function enables a value for the torque requirement to be applied in the controller in advance (disturbance variable feedforward). This function can be used to improve the load take-up of lifting gears with separate load measuring (P214).
17	Multiplication	The setpoint is multiplied by the specified bus setpoint. 100% the bus setpoint corresponds to a multiplication factor of 1.
18	Curve control	The master receives the current speed from the slave via the bus system (P546 [-01] ... [-03]). From its own speed, the speed of the slave and the master speed, the master calculates the current setpoint speed so that neither of the two drives travels faster than the master speed in the curve.
19	Servo-Mode Torque	In the " <i>CFC closed-loop</i> " (P300 = 1) control method, the motor torque can be set/limited via the bus setpoint. Here, the speed controller is switched off and a torque control is activated. In this case, the bus setpoint input is the setpoint source. In the open-loop method (P300 ≠ 1), this function can be used with reduced control quality. In VFC mode, the function enables a torque mode without encoder, suitable for simple tension control, for example.
20	BusIO In Bits 0-7	Specification of the BusIO-In Bits via the bus setpoint.
21	Reserved	Reserved for POSICON.
...		
25		
27	Acceleration time	The bus setpoint specifies the acceleration time. 0% is the shortest

		time possible, 100% $\triangleq$ P102 .
28	Deceleration time	The bus setpoint specifies the deceleration time. 0% is the shortest time possible, 100% $\triangleq$ P103 .
31	Digital output IOE	This function can be used to set P541 via bus control.
32	Analog output IOE	This function can be used to set P542 via bus control. Condition: P418 = 31 . The value must be between 0 and 100 (00h and 64h). Otherwise, the minimum value is output at the analogue output.
33	Setval.torque p.reg. ²	"Setpoint Torque Process controller". The bus setpoint specifies the torque setpoint for the process controller. For the even distribution of torques to coupled drives (e.g. S-roller drive). This function is also possible when using the ISD control.
34	d-corr. F Process	Diameter correction for the frequency of the PI process controller.
35	d-corr. Torque	Diameter correction for the torque of the PI process controller.
36	d-corr. F+Torque	Diameter correction for the frequency and the torque of the PI process controller.

- 1 The limits of these values are set by parameter **P410** "Min. freq. a-in 1/2" and parameter **P411** "Max. freq. a-in 1/2".
- 2 Process controller details: **P400** and 8.2 "Process controller".

P554	Chopper min.	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 switch off of the device. For applications where pulsating energy is fed back (crank drives), the braking resistor power dissipation can be minimised by increasing this setting. In case of a device error, the brake chopper is generally disabled.	
Setting values	Value Meaning	
	65	Brake chopper switching threshold.
	...	
	100	
	101	In case of a device error, the brake chopper is always inactive. Monitoring is also active if the device is not enabled. Chopper activation at 65%, for example for an increase in the link voltage due to a mains fault.
	102	Chopper is always switched on, except for active chopper overcurrent (error E003.4).

P555	P-limit chopper	S																		
Setting range	5 ... 100%																			
Factory setting	{ 100 }																			
Description	"Chopper power limitation". With this parameter, it is possible to program a manual (peak) power limit for the braking resistor. The switch-on duration (modulation depth) for the brake chopper can only rise to the specified limit. Once this value is reached, the frequency inverter disconnects the resistor from the mains, irrespective of the level of the link voltage. The result would be an overvoltage switch-off of the frequency inverter.																			
Note	The correct percentage value is calculated as follows: $k = \frac{R * P_{BW \max}}{U_{\max}^2} * 100\%$ <table border="1"> <tr> <td>R</td><td colspan="2">Resistance of the braking resistor</td></tr> <tr> <td>$P_{BW \max}$</td><td colspan="2">Short-term peak power of the braking resistor</td></tr> <tr> <td>$U_{\max}$</td><td colspan="2">Chopper switching threshold of the frequency inverter</td></tr> <tr> <td></td><td>1~ 115/230 V</td><td>⇒ 440 V DC</td></tr> <tr> <td></td><td>3~ 230 V</td><td>⇒ 500 V DC</td></tr> <tr> <td></td><td>3~ 400 V</td><td>⇒ 1000 V DC</td></tr> </table>		R	Resistance of the braking resistor		$P_{BW \max}$	Short-term peak power of the braking resistor		$U_{\max}$	Chopper switching threshold of the frequency inverter			1~ 115/230 V	⇒ 440 V DC		3~ 230 V	⇒ 500 V DC		3~ 400 V	⇒ 1000 V DC
R	Resistance of the braking resistor																			
$P_{BW \max}$	Short-term peak power of the braking resistor																			
$U_{\max}$	Chopper switching threshold of the frequency inverter																			
	1~ 115/230 V	⇒ 440 V DC																		
	3~ 230 V	⇒ 500 V DC																		
	3~ 400 V	⇒ 1000 V DC																		
Note	- Use of an external braking resistor (2.3.2 "External braking resistor SK BRE4-... / SK BRW4-... / SK BREW4-..."): DIP switch S1:8 in position "0" (off). Set the parameter according to the braking resistor used. - Use of an internal braking resistor (2.3.1 "Internal brake resistor SK BRI4-..."): DIP switch S1:8 in position "I" (on). Settings in the parameter do not have any effect.																			

P556	Braking resistor	S
Setting range	20 ... 400 Ω	
Factory setting	{ 120 }	
Description	Value of the braking resistor for calculation of the maximum brake power in order to protect the resistor.	
Note	Once the maximum continuous power P557 including overload (200% for 60 s) is reached, an I ² t limit error E003.1 is triggered. For further details see P737 .	
Note	- Use of an external braking resistor (2.3.2 "External braking resistor SK BRE4-... / SK BRW4-... / SK BREW4-..."): DIP switch S1:8 in position "0" (off). Set the parameter according to the braking resistor used. - Use of an internal braking resistor (2.3.1 "Internal brake resistor SK BRI4-..."): DIP switch S1:8 in position "I" (on). Settings in the parameter do not have any effect.	

P557	Brake resistor type	S
Setting range	0.00 ... 20.00 kW	
Factory setting	{ 0.00 }	
Description	Continuous power (nominal power) of the resistor, to display the current utilisation in P737 . For a correctly calculated value, the correct value must be entered in P556 and P557 .	
Setting values	Value Meaning	
	0.00	Monitoring disabled
	0.01	Setting the continuous power (nominal power) of the resistor
	...	
	20.00	
Note	- Use of an external braking resistor (2.3.2 "External braking resistor SK BRE4-... / SK BRW4-... / SK BREW4-..."): DIP switch S1:8 in position "0" (off). Set the parameter according to the braking resistor used. - Use of an internal braking resistor (2.3.1 "Internal brake resistor SK BRI4-..."): DIP switch S1:8 in position "I" (on). Settings in the parameter do not have any effect.	

P558	Flux delay	S	P
Setting range	0 ... 5000 ms		
Factory setting	{ 1 }		
Description	ASM ISD control can only function correctly if there is a magnetic field in the motor. For this reason, a direct current is applied to the motor before starting to excite the stator winding. The duration depends on the size of the motor and is automatically set in the factory setting of the frequency inverter. For time-critical applications, the flux delay can be set and disabled. PMSM When used with PMSM, the dwell time can be set if parameter P330 is set to = 0. Total dwell duration = 5 × P558 [ms]		
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	Setting the flux delay	
	...		
	5000		

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

P560	Mode of param.save		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 ×) is not exceeded.		
Setting values	Value Meaning		
	0	RAM only	Changes to the parameter settings and the PLC program are not written to the EEPROM. All saved settings made before changing the saving mode remain stored even if the frequency inverter is disconnected from the mains.
	1	RAM and EEPROM	All parameter changes and changes to the PLC program are automatically written to the EEPROM and remain stored even if the frequency inverter is disconnected from the mains.
	2	Off	Saving in RAM <u>and</u> EEPROM not possible. (Parameter changes and changes to the PLC program will <u>not</u> be applied)

P583	Motor phase sequence		S	P
Setting range	0 ... 2			
Factory setting	{ 0 }			
Description	The motor phase control sequence (U - V - W) can be changed with this parameter. This enables the phase sequence of the motor to be changed without changing the motor connections.			
Note	If voltage is applied on the output terminals (U - V - W) (e.g. on enabling), the parameter setting must not be changed, and there must be no change to the parameter set, which may result in a change of the setting of parameter P583 . Otherwise, the device switches off with error message E016.2 .			
Setting values	Value Meaning			
	0	Normal	No change	
	1	Reversed	"Invert motor phase sequence" The phase sequence of the motor is changed. The counting direction of the encoder for speed detection (if present) remains unchanged.	
	2	With encod. reversed	Same as P583 = 1 , but the counting direction of the encoder is changed additionally.	

5.2.8 Positioning

Parameter group P6xx is used to adjust the POSICON positioning control. To make these parameters visible, the supervisor parameter **P003 = 3** must be set.

A detailed description of these parameters can be found in manual [BU0210](#).

5.2.9 Information

P700	Current operating state			
Display range	0.0 ... 25.4			
Arrays	[-01] =	Current fault	Currently active (unacknowledged) fault message	
	[-02] =	Actual warning	Current warning message	
	[-03] =	Reason FI blocked	Current reason for active switch-on inhibit	
Description	Display of current operating state messages			
Note	<i>SimpleBox/ControlBox</i> : The SimpleBox or ControlBox can be used to display the error numbers of the warning messages and faults.			
	<i>ParameterBox</i> : The ParameterBox can be used to display the messages in plain text. Furthermore, the reason for a potential switch-on inhibit can be displayed.			
	<i>Bus</i> : Bus-level error messages are displayed in decimal integer format. The displayed value must be divided by 10 to correspond to the correct format.			
	Example: Display: 20 → Error number: 2.0			
	The last warning since the frequency inverter was switched on is displayed in P766 .			
Display values	6.3 "Messages"			

P701	Last fault			
Display range	0.0 ... 25.4			
Arrays	[-01] ... [-05]			
Description	"Last fault 1 ... 5". This parameter stores the last 5 faults 0 "Fault messages".			
Note	With the SimpleBox or ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK or ENTER key to read the saved value.			

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

P703	Current. last error		S
Display range	0.0 ... 500.0 A		
Arrays	[-01] ... [-05]		
Description	"Current, last fault 1 ... 5". This parameter stores the output current that was supplied when the fault occurred. The values of the last 5 faults are stored.		
Note	With the SimpleBox or ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK or ENTER key to read the saved value.		

P704	Volt. last error	S
Display range	0 ... 500 V	
Arrays	[-01] ... [-05]	
Description	“ <i>Voltage, last fault 1 ... 5</i> ”. This parameter stores the output voltage that was supplied when the fault occurred. The values of the last 5 faults are stored.	
Note	With the SimpleBox or ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK or ENTER key to read the saved value.	

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

P706	P set last error		S
Display range	0 ... 3		
Arrays	[-01] ... [-05]		
Description	“Parameter set, last error 1 ... 5”. This parameter stores the parameter set code that was active when the error occurred. Data for the previous 5 errors is saved.		
Note	With the SimpleBox or ControlBox, the respective memory slot 1 ... 5 (array parameters) must be selected and confirmed with the OK or ENTER key to read the saved value.		
Display values	Value Meaning		
	0	Parameter set 1	Parameter set 1 was active.
	1	Parameter set 2	Parameter set 2 was active.
	2	Parameter set 3	Parameter set 3 was active.
	3	Parameter set 4	Parameter set 4 was active.

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

P708	State of digital in.	
Display range	0000h ... FFFFh	0000 0000 0000 0000b ... 1111 1111 1111 1111b
Description	Display of the digital inputs' signal state	
Display values	Value Meaning	
	Bit 0	Digital input 1
	...	...
	Bit 3	Digital input 4
	Bit 4	PTC resistor input
	Bit 8	Digit. input 1/1.IOE
	...	...
	Bit 11	Digit. input 4/1.IOE
	Bit 12	Digit. input 1/2.IOE
	...	...
	Bit 15	Digit. input 4/2.IOE
Note	SimpleBox:	The binary bits are displayed as hexadecimal values.
	ParameterBox:	The bits are displayed in ascending order from right to left (binary).

P709	Analog input voltage	
Display range	-100.0 ... 100.0%	
Arrays	[-01] = Analog input 1	Value of analogue input 1 integrated into the FI
	[-02] = Analog input 2	Value of analogue input 2 integrated into the FI
	[-03] = Ext. Analogue in 1	AIN1 of the first I/O extension SK xU4-IOE
	[-04] = Ext. Analogue in 2	AIN2 of the first I/O extension SK xU4-IOE
	[-05] = Setpoint module	SK SSX-3A, BU0040
	[-06] = Potentiometer 1	Value of potentiometer P1 integrated into the FI (SK 2x0E, size 4 only)
	[-07] = Analog fct. Dig. 3	Analogue function of FI digital input 3
	Potentiometer 2	Same as potentiometer 1 (SK 2x0E, size 4 only)
	[-08] = Ext.AI 1 2.IOE	"External analogue input 1 of 2 nd IOE". Analogue input 1 of the second I/O extension (SK xU4-IOE) (= analogue input 3).
Scope of application	[-09] = Ext.AI 2 2.IOE	"External analogue input 2 of 2 nd IOE". Analogue input 2 of the second I/O extension (SK xU4-IOE) (= analogue input 4).
	SK 2x0E	
Description	"Voltage of analogue inputs". Displays the measured analogue input value.	
Note	100.0% = 10.0 V or 20.0 mA	

P709	Analog input voltage		
Display range	-100.0 ... 100.0%		
Arrays	[-01] = Potentiometer 1	Value of analogue input 1 integrated into the FI	
	[-02] = Potentiometer 2	Value of analogue input 2 integrated into the FI	
	[-03] = Ext. Analogue in 1	AIN1 of the first I/O extension SK xU4-IOE	
	[-04] = Ext. Analogue in 2	AIN2 of the first I/O extension SK xU4-IOE	
	[-05] = Setpoint module	SK SSX-3A,  BU0040	
	[-07] = Analog fct. Dig. 3	Analogue function of FI digital input 3	
	[-08] = Ext.AI 1 2.IOE	“External analogue input 1 of 2 nd IOE”. Analogue input 1 of the second I/O extension (SK xU4-IOE) (= analogue input 3).	
	[-09] = Ext.AI 2 2.IOE	“External analogue input 2 of 2 nd IOE”. Analogue input 2 of the second I/O extension (SK xU4-IOE) (= analogue input 4).	
Scope of application	SK 2x5E		
Description	“Voltage of analogue inputs”. Displays the measured analogue input value.		
Note	100.0% = 10.0 V or 20.0 mA		

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

P711	State of digital out		
Display range	0000h ... FFFFh	0000 0000 0000 0000b ... 1111 1111 1111 1111b	
Description	Display of the digital outputs' signal state		
Display values	Value Meaning		
	Bit 0	Digital output 1	Signal state digital output 1
	Bit 1	Mechanical Brake	Signal state mechanical brake
	Bit 2	Digital output 2	Signal state digital output 2
	Bit 4	Digital out 1/1.IOE	Signal state 1 st IO extension digital output 1
	Bit 5	Digital out 2/1.IOE	Signal state 1 st IO extension digital output 2
	Bit 6	Digital out 1/2.IOE	Signal state 2 nd IO extension digital output 1
	Bit 7	Digital out 2/2.IOE	Signal state 1 st IO extension digital output 2
	Note	SimpleBox:	The binary bits are displayed as hexadecimal values.
ParameterBox:		The bits are displayed in ascending order from right to left (binary).	

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	<i>"Energy output via braking resistor"</i> . Displays the energy consumption of the braking resistor (cumulative energy consumption over the life of the device).			
P714	Operating time			
Display range	0.00 ... 19 999 999.99 h			
Description	Duration of the device's operational readiness and availability of mains voltage (cumulative value over the service life of the device).			
P715	Running time			
Display range	0.00 ... 19 999 999.99 h			
Description	Period of time during which the device was enabled and supplied power at the output (cumulative value over the service life of the device).			
P716	Actual frequency			
Display range	-400.0 ... 400.0 Hz			
Description	Displays the actual output frequency.			
P717	Actual speed			
Display range	-9999 ... 9999 rpm			
Description	Displays the actual motor speed calculated by the FI.			
P718	Current set freq.			
Display range	-400.0 ... 400.0 Hz			
Arrays	[-01] = Actual setpoint frequency from the setpoint source			
	[-02] = Actual setpoint frequency after processing in the FI status machine			
	[-03] = Actual setpoint frequency after frequency ramp			
Description	Displays the frequency specified by the setpoint.			
P719	Actual current			
Display range	0.0 ... 999.9 A			
Description	Displays the actual current at the output of the frequency inverter.			
P720	Act. torque current			
Display range	-999.9 ... 999.9 A			
Description	Displays the actual calculated torque-developing output current (active current). Basis for calculation is the motor data P201... P209 . - Negative values = generator - Positive values = motor			
P721	Actual field current			
Display range	-999.9 ... 999.9 A			
Description	Displays the actual calculated field current (reactive current). Basis for calculation is the motor data P201 ... P209 .			
P722	Actual voltage			
Display range	0 ... 500 V			
Description	Displays the actual AC voltage supplied by the FI output.			

P723	Voltage -d	S
Display range	-500 ... 500 V	
Description	"Actual voltage component U_d ". Displays the actual field voltage component.	
P724	Voltage -q	S
Display range	-500 ... 500 V	
Description	"Actual voltage component U_q ". 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 ... 99.99 kVA	
Description	Displays the currently calculated apparent power. Basis for calculation is the motor data P201 ... P209 .	
P727	Mechanical Power	
Display range	-99.99 ... 99.99 kW	
Description	Displays the currently calculated real power at the motor. Basis for calculation is the motor data P201 ... P209 .	
P728	Input voltage	
Display range	0 ... 1000 V	
Description	"Mains voltage". Displays the actual mains voltage at the FI input. This is directly determined from the amount of the intermediate circuit voltage	
Note	Display of static value For devices with separate 24 V supply, a static value is displayed if <i>no mains voltage</i> is applied (e.g.: for 1~ 230 V devices: P728 = 230 V). This value is used for internal initialisation purposes.	
P729	Torque	
Display range	-400 ... 400 %	
Description	Displays the actual calculated torque. Basis for calculation is the motor data P201 ... P209 .	
P730	Field	
Display range	0 ... 250%	
Description	Displays the current field in the motor calculated by the frequency inverter. Basis for calculation is the motor data in P201 ... P209 .	
P731	Parameter set	
Display range	0 ... 3	
Description	Displays the current operating parameter set.	
Display values	Value Meaning	

0	Parameter set 1	Parameter set 1 is active
1	Parameter set 2	Parameter set 2 is active
2	Parameter set 3	Parameter set 3 is active
3	Parameter set 4	Parameter set 4 is active

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

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

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

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

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

Information

Display of atypical value

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

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

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

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

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

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

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

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

P744	Configuration			
Display range	0000h ... FFFFh			
Description	The configurations integrated into the FI are displayed in this parameter. The display is in hexadecimal code (SimpleBox, bus system). When using the ParameterBox, the display is in plain text.			
Display values	Value Meaning			
	0200h	205E (standard)	SK 205E standard I/O	
	0201h	215E (STO)	SK 215E STO	
	0202h	225E (ASi)	SK 225E ASi	
	0203h	235E (STO/ASi)	SK 235E STO and ASi	
	0204h	200E (standard)	SK 200E standard I/O	
	0205h	210E (STO)	SK 210E STO	
	0206h	220E (ASi)	SK 220E ASi	
	0207h	230E (STO/ASi)	SK 230E STO and ASi	

P745	AS-i version			
Display range	0.0 ... 9999.9			
Scope of application	SK 270E-FDS, SK 280E-FDS			
Description	Displays the software version of the AS-Interface.			
Note	You should have this information ready in case of technical queries.			

P746	AS-i status		
Display range	0000h ... FFFFh	0 ... 65 535	
Description	Displays the current status (readiness, error, communication) of the AS-Interface.		
Scope of application	SK 270E-FDS, SK 280E-FDS		
Note	In the form described here, this parameter is only functional for ASi version 1.3 and higher (see P745). When using an older ASi version, the above description applies to this parameter.		

[-01] Current state (ready, error, communication) of the AS-Interface		
Bits 0-3:	Status of 2 nd slave	
Bits 4-6:	Reserved	
Bit 7:	Cyclic communication of 2 nd slave present	
Bits 8-11:	Status of 1 st slave	
Bits 12-14:	Reserved	
Bit 15:	Cyclic communication of 1 st slave present	
	During an ASi firmware update, Bits 14 and 15 = 1.	
	Value Bits 8 ... Bit 11	Status of 1 st slave
	0	ASi voltage from
	3	1 st slave chip not present
	4	Reset
	6	ADR = 0
	7	NODEX (No Data Exchange)
	8	DEX (Data Exchange)
	9	Reconfiguration active
	Value Bits 0 ... Bit 3	Status of 2 nd slave
	0	ASi voltage from
	3	2 nd slave chip not present
	4	Reset
	6	ADR = 0
	7	NODEX (No Data Exchange)
	8	DEX (Data Exchange)
	9	Reconfiguration active
[-02] Active ASi configuration (see P565).		
Bits 0-5:	Active ASi configuration	
Bits 6-15:	Reserved	
	Value	ASi mode
	1	4IO+CTT2=7.A.7+7.A.5, double slave in the extended address range
	2	4IO+4IO=7.A.7+7.A.7, double slave in the extended address range
	16	4IOStd=7.F, single slave in the standard address range
	32	4IOExt=7.A.7, single slave in the extended address range
[-03] Data from master to slave 1		
[-04] Data from master to slave 2		
[-05] Parameter bits slave 1 and slave 2		
Display of the parameter bits set by the ASi master. The meaning of the individual bits depends on the selected profile.		
Bits 0-3:	Parameter bits 0 to 3 of 2 nd slave	
Bits 4-7:	Reserved	
Bits 8-11:	Parameter bits 0 to 3 of 1 st slave	
Bits 12-15:	Reserved	

P747	Inverter Volt. Range			
Display range	0 ... 2			
Description	"Inverter voltage range". Indicates the mains voltage range for which this device is specified.			
Display values	Value Meaning			
	0	100V..120V		
	1	200V..240V		
	2	380V..480V		

P748	Status CANopen			S												
Display range	0000h ... FFFFh		0 ... 65 535													
Description	Displays the status of the system bus (CANopen)															
Display values	Value Designation Meaning															
	Bit 0	24 V bus supply	24 V supply (bus) is applied													
	Bit 1	Bus Warning	CANbus in "Bus Warning" state													
	Bit 2	Bus Off	CANbus in "Bus Off" state													
	Bit 3	System bus → Bus module online	External bus module (e.g. SK xU4-PBR) online													
	Bit 4	System bus → Additional module 1 online	External IO extension 1 (e.g. SK xU4-IOE) online													
	Bit 5	System bus → Additional module 2 online	External IO extension 2 (e.g. SK xU4-IOE) online													
	Bit 6	CAN module protocol	0 = CAN / 1 = CANopen													
	Bit 7	Reserved														
	Bit 8	Bootup message sent	Initialisation complete													
	Bit 9	CANopen NMT State	<table><tr><th>CANopen NMT State</th><th>Bit 10</th><th>Bit 9</th></tr><tr><td>Stopped =</td><td>0</td><td>0</td></tr><tr><td>Pre-Operational =</td><td>0</td><td>1</td></tr><tr><td>Operational =</td><td>1</td><td>0</td></tr></table>		CANopen NMT State	Bit 10	Bit 9	Stopped =	0	0	Pre-Operational =	0	1	Operational =	1	0
CANopen NMT State	Bit 10	Bit 9														
Stopped =	0	0														
Pre-Operational =	0	1														
Operational =	1	0														
	Bit 10	CANopen NMT State														

P749	Status Dip-switches																				
Display range	0000h ... FFFFh		0000 0000 0000 0000b ... 1111 1111 1111 1111b																		
Description	This parameter displays various internal configurations.																				
Display values	Value Meaning																				
	Bit 0	System bus address (Bit 0)	<table><tr><th>Address</th><th>Bit 1</th><th>Bit 0</th></tr><tr><td>32</td><td>0</td><td>0</td></tr><tr><td>34</td><td>0</td><td>1</td></tr><tr><td>36</td><td>1</td><td>0</td></tr><tr><td>38</td><td>1</td><td>1</td></tr></table>				Address	Bit 1	Bit 0	32	0	0	34	0	1	36	1	0	38	1	1
	Address	Bit 1					Bit 0														
	32	0					0														
	34	0					1														
	36	1					0														
	38	1	1																		
	Bit 1	System bus address (Bit 1)																			
Bit 2	Systembus active	-																			
Bit 8	EEPROM (memory module)	Bit 8 = 0: plugged / Bit 8 = 1: not plugged																			

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

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

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

P753	Stat. overtemperatur	S
Display range	0 ... 9999	
Description	Number of overtemperature faults during the operating time P714 .	
P754	Stat. parameter lost	S
Display range	0 ... 9999	
Description	Number of parameter losses during the operating time P714 .	
P755	Stat. system error	S
Display range	0 ... 9999	
Description	Number of system errors during the operating time P714 .	
P756	Stat. Timeout	S
Display range	0 ... 9999	
Description	Number of time-out errors during the operating time P714 .	
P757	Stat. Customer error	S
Display range	0 ... 9999	
Description	Number of customer watchdog errors during the operating time P714 .	
P760	Input current	S
Display range	0.0 ... 999.9 A	
Description	Displays the current input current.	
P765	Act. pulse frequency	S
Display range	0.0 ... 16.0 kHz	
Description	Displays the <i>actual pulse frequency</i> . It can deviate from the set pulse frequency (P504), depending on the load or if the frequency inverter is in derating.	
P766	Last warning	
Display range	0.0 ... 999.9	
Description	This parameter displays the last warning from P700 [-02] since the frequency inverter was switched on.	
Note	After restarting the device, the value "0.0" (no warning) is always displayed.	
P780	Device ID	
Display range	0 ... 9 and A ... Z	
Arrays	[-01] ... [-12]	
Description	Display of the serial number (12-digit) of the device.	
Note	- Display via NORDCON: as a contiguous serial number of the device - Display via bus: ASCII code (decimal). Each array must be read out separately.	
P799	Op.-time last error	
Display range	0.00 ... 19 999 999.99 h	
Arrays	[-01] ... [-05]	
Description	" <i>Operating time, last error</i> ". This parameter displays the actual on-time count (P714) at the time of the last error. Array [01] ... [05] corresponds to the last error 1 ... 5.	

6 Operating status messages

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

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

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

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

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

Warning messages → (P700 [-02])

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

Error messages → (P700 [-01])

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

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

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

6.1 Display of messages

LED indicators

The device status is indicated by integrated status LEDs that are visible from the outside in delivery state. Depending on the device type, this is either a dual-colour LED (DS = Device State) or two single-colour LEDs (DS = Device State, DE = Device Error).

Meaning:	Green indicates operational readiness and the presence of mains voltage. During operation, the degree of overload at the device output is indicated by a faster flashing code. Red indicates a pending error. The LED flashes with the frequency corresponding to the error group (for example E003 = 3x flashing).
-----------------	---

SimpleBox Display

The SimpleBox displays an error with its number and the prefix "E". In addition, the present fault can be displayed in array element [-01] of parameter (**P700**). The last error messages are stored in parameter (**P701**). Further information about the frequency inverter status at the moment of the fault can be obtained from parameters (**P702**) to (**P706**) / (**P799**)

If the cause of the error is no longer present, the error display in the SimpleBox flashes and the error can be acknowledged with the Enter key.

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

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

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

ParameterBox display

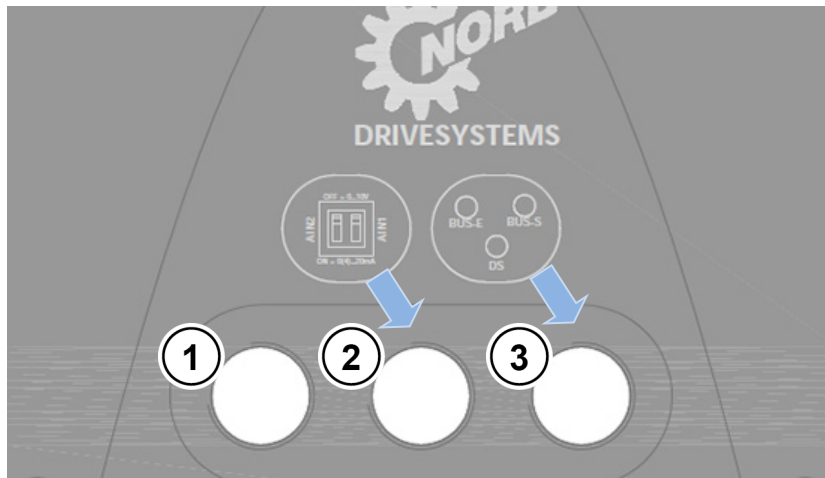
The ParameterBox displays the messages in plain text.

6.2 Diagnostic LEDs on device

The device generates operating status messages. These messages (warnings, errors, switching statuses, measurement data) can be displayed with parameterisation tools ( Section 0 "Connection of a control and parameterisation unit") (Parameter group **P7xx**).

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

6.2.1 Diagnosis LEDs on SK 2x0E (sizes 1 ... 3)



- 1 RJ12, RS-232, RS-485
- 2 DIP switch AIN1/2
- 3 Diagnosis LEDs

Figure 27: Diagnostic openings on SK 2x0E (sizes 1 ... 3)

Diagnosis LEDs

LED		Description	Signal state		Meaning
Name	Colour				
BUS-S	Green	System bus	Off		No process data communication
		Status	Flashing	4 Hz	"BUS warning"
			On		Process data communication active → Receipt of at least 1 telegram / s → SDO data transfer is not displayed
BUS-E	Red	System bus	Off		No error
		Error	Flashing	4 Hz	Monitoring error P120 or P513 → E10.0 / E10.9
			Flashing	1 Hz	Error in an external system bus module → Bus module → Timeout on the external BUS (E10.2) → System bus module has a module error (E10.3)
			On		System bus in "BUS off" state
DS	Dual Red/green	Status FI	Off		FI not ready for operation, → No mains voltage or control voltage
			Green on		FI is enabled (inverter is working)
			Green flashes	0.5 Hz	FI is ready for switch-on but not enabled
				4 Hz	FI is in switch-on inhibit
			Red/green Alternating	1 Hz	Charging error
				4 Hz	Warning
				1 ... 25 Hz	Overload level of the switched-on FI
			Red flashes		Error; flashing frequency → error number
			Green on + red flashes		FI not ready for operation, → STO voltage missing (DIN4)

6.2.2 Diagnosis LEDs on SK 2x0E (size 4) and SK 2x5E

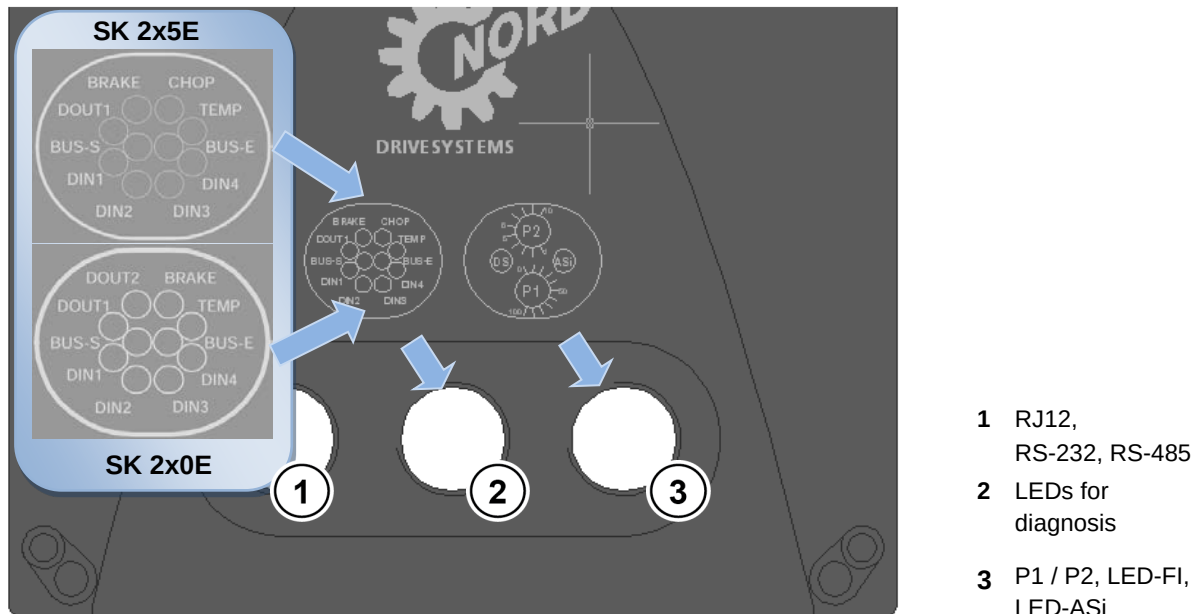


Figure 28: Diagnostic openings on SK 2x0E size 4 or SK 2x5E

Status LEDs

LED			Signal		
Name	Colour	Description	State		Meaning
DS	Dual Red/green	FI state	Off		FI not ready for operation, → No mains voltage or control voltage
			Green on		FI is enabled (inverter is working)
			Green	0.5 Hz	FI is ready for switch-on but not enabled
			Flashes	4 Hz	FI is in switch-on inhibit
			Red/green	4 Hz	Warning
			Alternating	1 ... 25 Hz	Overload level of the switched-on FI
			Green on + red flashes		FI not ready for operation, → Control voltage present but not mains voltage → STO voltage missing (DIN4)
			Red flashes		Error; flashing frequency → error number
ASi	Dual Red/green	ASi state			Details (📖 Section 4.5 "AS Interface (AS-i)")

Diagnosis LEDs

LED			Signal	
Name	Colour	Description	State	Meaning
DOUT 1	Yellow	Digital output 1	On	High signal is present
DIN 1	Yellow	Digital input 1	On	High signal is present
DIN 2	Yellow	Digital input 2	On	High signal is present
DIN 3	Yellow	Digital input 3	On	High signal is present
DIN 4	Yellow	Digital input 4	On	High signal is present
TEMP	Yellow	PTC resistor (motor)	On	Motor is overheating
CHOP	Yellow	Brake chopper	On	Brake chopper is active; brightness = utilisation (<i>SK 2x5E only</i>)
BRAKE	Yellow	Mech. brake	On	Mech. brake released
DOUT 2	Yellow	Digital output 2	On	High signal is present (<i>SK 2x0E only</i>)
BUS-S	Green	System bus Status	Off	No process data communication
			Flashing (4 Hz)	"BUS warning"
			On	Process data communication active → Receipt of at least 1 telegram / s → SDO data transfer is not displayed
BUS-E	Red	System bus Error	Off	No error
			Flashing (4 Hz)	Monitoring error P120 or P513 → E10.0 / E10.9
			Flashing (1 Hz)	Error in an external system bus module → Bus module → Timeout on external BUS (E10.2) → System bus module has module error (E10.3)
			On	System bus in "BUS off" state

6.3 Messages

Fault messages

Coding		Fault message	Cause • Remedy
Group	Number		
E001	1.0	Inverter overtemp.	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. - Reduce or increase ambient temperature - Check fan or cabinet ventilation - Check the device for dirt Further notes: - See P739 for temperature display
E001	1.1	Intern. inverter temp	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. - Reduce or increase ambient temperature - Check fan or cabinet ventilation - Check the device for dirt Further notes: - See P739 for temperature display
E002	2.0	Motor overtemp.PTC	Motor temperature sensor (PTC resistor), the separate PTC resistor input 38/39 or KTY / PT1000 have triggered at the analogue input (P400 = 48). - Reduce motor load - Increase motor speed - Install external motor fan or check the function Further notes: - Check setting P425
E002	2.1	Motor overtemp.I ² t	The inverter has detected an impermissible motor temperature (motor I²t). - Reduce motor load - Increase motor speed - Repeat stator resistance measurement 8.8 "Motor data – characteristic curves (Asynchronous motors) "
E002	2.2	Ext Resistor Temp <i>"External braking resistor overtemperature"</i> Overtemperature via digital input P420/P480 [...] = 13	Thermostat (e.g. braking resistor) has triggered. The Digital input is "low" Check connections and temperature sensor

6 Operating status messages

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

E004 4.0	Module overcurrent	Module error (short-term) • Short circuit or earth fault at the frequency inverter output (motor cable or motor) • Optional braking resistor is defective / must be checked • Optional motor choke is defective / must be checked Further notes: • Other error causes – Incorrectly dimensioned breaking resistor – Motor cable too long • For devices with safe pulse block – Cable resistance too high or voltage at the “safe pulse block” too low • Do not disconnect P537! Note: The error may significantly reduce the service life of the device or even destroy it
E004 4.1	Overcurrent measurem.	Pulse switch-off (P537) has been reached three times within 50 ms. • Reduce motor load • Check system for blockage or overload Further notes: • Error message is only possible if P112 and P536 are switched off • Check motor data settings on the device (P201 ... P209) and check motor dimensioning • Check ramp times (P102/P103)

6 Operating status messages

E005	5.0	Overvoltage Ud	link voltage is too high. → The drive is overloaded during the braking process. → The braking resistor or connections and cables to the braking resistor are defective. → When operating in an IT network, there may be an earth fault. - Check the dimensioning of the braking resistor - Check the IT network for earth faults Do not carry out parameterisation and possible earth fault tests, such as testing of an earth fault monitor, at the same time Further notes: - Extend the deceleration time (P103) - Extend the quick stop time (P426) - Speed fluctuation (for example due to high flywheel masses) → If necessary, set the V/f characteristic curve (P211, P212) - Set disconnection mode (P108) with delay (not permissible for lifting gears!)
E005	5.1	Mains overvoltage	Mains voltage is too high. Check if the device is suitable for electrical connection to the supply network 7 "Technical data".
E006	6.0	Charging error	DC link voltage is too low. Check if the device is suitable for electrical connection to the supply network (see 7 "Technical data").
E006	6.1	Mains low voltage	Mains voltage is too low. Check if the device is suitable for electrical connection to the supply network (see 7 "Technical data")
E007	7.0	Mains Phase Failure	Error at mains connection side. - Check all mains phases for availability (see technical data 7 "Technical data") - Mains is asymmetrical
E007	7.1	Phasefailure dc-link	Mains phase error Check all mains phases for availability (see technical data 7 "Technical data")
E008	8.0	Parameter loss (maximum EEPROM value exceeded)	Error in EEPROM data. - Software version of the stored data set not compatible with the software version of the FI Note: Faulty parameters are automatically reloaded (factory setting). - EMC interferences (see also E020)
E008	8.1	Inverter ID error	Initialisation error - Switch the mains voltage off and on again - EEPROM defective
E008	8.2	Extern. EEPROM error	- Check plug-in EEPROM (-EEP feature) for correct fit - Plug-in EEPROM defective (P550 = 1)

E008	8.3	EEPROM KSE error (Customer unit incorrectly identified (customer unit configuration))	The configuration of the frequency inverter was not correctly identified. Switch the mains voltage off and on again
E008	8.4	EEPROM intern. error (Database version incorrect)	The database version in the EEPROM does not match the database version from the firmware. Parameters are reloaded automatically (factory setting)
E008	8.7	EEPROM copy differs	The parameters redundantly saved in the EEPROM differ from each other.

6 Operating status messages

E010	10.0	Bus time-out	Telegram time-out of bus system (CAN, CANopen, USS), voltage supply for the bus system is missing • Check data cable connections Further notes: • Data transfer defective. Check P513 • Check the program sequence of the bus protocol • Check the bus master • Check the 24 V supply of the internal CAN/CANopen Bus • Node guarding error (internal CANopen) • Bus-Off error (internal CANbus)
E010	10.1	System-error option	Bus interface system error. • Further details can be found in the respective supplementary bus instructions I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	10.2	Bus time-out option	Bus interface telegram time-out by PLC. • Telegram transmission defective • Check the physical bus connections • Check the program sequence of the bus protocol • Check the bus master • PLC is in "STOP" or "ERROR" status
E010	10.3	System-error option	Bus interface system error • Further details can be found in the respective supplementary bus instructions. I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	10.4	Init-error option	Bus module initialisation error. • Restart the frequency inverter (switch the power supply off and on again) • Check the bus module power supply • DIP switch position of a connected I/O extension module defective
E010	10.5 10.6 10.7	System-error option	Bus interface system error. • Further details can be found in the respective supplementary bus instructions I/O extension: • Incorrect measurement of the input voltages or undefined provision of the output voltages due to errors in reference voltage generation • Short circuit at analogue output
E010	10.8	Error option	External bus interface communication error. • Connection error/fault of the external bus interface • Short-term interruption (< 1 s) of the 24 V supply of the internal CAN/CANopen bus

E010	10.9	Missing Option /P120	The module entered in P120 is not present. Check connections and cables on both sides
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6 Operating status messages

E011	11.0	Control terminals	A/D converter error. - Internal control terminal (internal data bus) defective or interference due to radio radiation (EMC) - Check control connections for short circuit - Minimise EMC interferences by separate routing of control and power cables - Earth device and screening well
E012	12.0	External Watchdog	Time monitoring of digital inputs. A digital input has been set to the "Watchdog" function and the expected pulse failed to appear. - Check the digital inputs Further notes: - Check P420 - Check P460
E012	12.1	Limit moto./Customer	The drive switch-off limit has triggered. - Reduce motor load - Check system for blockage or overload Further notes: - Check P534 [-01]
E012	12.2	Limit gen.	The machine drives the motor and puts it into generator operation. The generator switch-off limit has triggered. - Reduce (generator) motor load - Check system for overload Further notes: - Check P534 [-02]
E012	12.3	Torque limit	A parameterised limit value for the torque has been reached. Limit from potentiometer or setpoint source has switched off (P400 = 12)
E012	12.4	Current limit	Limit from potentiometer or setpoint source has switched off (P400 = 14).
E012	12.5	Load monitor	Switch-off due to overshooting or undershooting of permissible load torques (P525 ... P529) for the time set in P528. - Adjust load Further notes: - Change limit values (P525 ... P527) - Increase delay time (P528) - Change monitoring mode (P529)
E012	12.8	Analog in. minimum	Switch-off due to undershooting of the 0 % adjustment value (P402) with setting (P401) "0 - 100 % with error switch-off 1" or "[...] with error switch-off 2".
E012	12.9	Analog in. maximum	Switch-off due to undershooting of the 100 % adjustment value (P403) with setting (P401) "0 - 100 % with error switch-off 1" or "[...] with error switch-off 2".

E013	13.0	Encoder error	Missing signals from encoder (TTL), slip error. • Check connections and cables on both sides • Check the mechanical installation of the encoder (encoder shaft is at a halt when slip error monitoring is active) Further notes: • Check encoder type and parameterisation • Check voltage supply • Check cable routing (EMC)
E013	13.1	Speed slip error	The difference between measured and calculated speed has exceeded a limit value. • Check mechanical installation of (TTL) encoder • Check system for blockage or overload Further notes: • Check limit values in P327 and P328 • Increase acceleration times The inverter is in derating mode. The current required for acceleration is not available (see FAQ).
E013	13.2	Disconnect. control	The slip error switch-off monitoring has triggered. The motor could not follow the setpoint. • Check system for blockage or overload Further notes: • Check motor data (P201 ... P209) • Check Star Delta connection • Check encoder settings (P300) and following in servo mode • Increase setting value for torque current limit (P112) • Increase setting value for current limit (P536) • Check deceleration time (P103) and extend if necessary
E013	13.3	Slipfault encoder	Incorrect direction of rotation of the encoder. • Check connections
E013	13.4	HTL slip error	In the operating state “Ready for switch-on” (FI not enabled), the frequency inverter has detected a speed $\neq 0$ of the encoder. • Check mechanical installation of encoder • Check system for overload • Check function of the holding brake if present
E013	13.5 ... 13.9	Reserved	Error message for POSICON →  BU0210.
E014	14.2 ... 14.8	Reserved	POSICON error message see supplementary manual →  BU0210.
E016	16.0	Motor phase failure	A motor phase is not connected. • Check connections and cables on both sides • Check the motor Further notes: • Check P539

6 Operating status messages

E016	16.1	Magn. current watch	Required exciting current not achieved at moment of switch-on. • Check connections and cables on both sides • Check the motor Further notes: • Check P539 • Check motor data (P201 ... P209)
E016	16.2	Change phase direct.	The motor phase sequence (U – V – W) has been changed during operation (enable). Further notes: • Check P583 • Has parameter set (P100) been switched over?
E018	18.0	Reserved	Error message for “Safe Pulse Block”, see supplementary instructions
E018	18.0	Reserved	Error message for “Safe Pulse Block” →  BU0230.
E019	19.0	Error parameter identification	Automatic identification of the connected motor has failed. • Check connections and cables on both sides • Check the motor Further notes: • Check motor data (P201 ... P209)
E019	19.1	Rotorposition	Incorrect data with regard to the rotor position due to: • Incorrect result for rotor position identification by test signal method (P330) • Impermissible switching of the parameterised control method (P300) with enabled drive Further notes: • Increase static boost (P210)
E019	19.2	Rotorpos.North/South	• Incorrect result for rotor position identification by test signal method • Control method “CFC open-loop-inje” (P300): Error caused by flying start attempt (P520) at speed < 10 Hz

E020	20.1	Watchdog	System error in program execution, triggered by EMC interference • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.2	Stack overflow	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.3	Stack underflow	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.4	Undefined opcode	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.5	Protected instruction	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.6	Illegal word access	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.7	Illegal instruction access	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.8	EEPROM error (Wrong flash checksum)	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E020	20.9	Memory Protection Error	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E021	21.0	NMI error	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well

6 Operating status messages

E021	21.1	PLL error	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E021	21.2	ADU error	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E021	21.3	PMI error	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E021	21.4	Userstack Overflow	System error in program execution, triggered by EMC interference. • Observe wiring guidelines • Use an additional external line filter • Earth the device well
E022	22.0 ... 22.9	Reserved	Error message for PLC →  BU0550 .
E023	23.0 ... 23.7	Reserved	Error message for PLC →  BU0550 .
E024	24.0 ... 24.7	Reserved	Error message for PLC →  BU0550 .

Warning messages

Coding		Warning message	Cause • Remedy
Group	Number		
C001	1.0	Inverter overtemp.	Temperature monitoring of the inverter Temperature range has been exceeded or undershot. • Reduce or increase ambient temperature • Check fan or cabinet ventilation • Check the device for dirt Further notes: • See P739 for temperature display
C002	2.0	Motor overtemp. PTC	Warning from the motor temperature sensor (trigger limit reached) • Reduce motor load • Increase motor speed • Install external motor fan or check the function Further notes: • Check setting P425
C002	2.1	Motor overtemp. I ² t	The inverter has detected an impermissible motor temperature (motor I²t). • Reduce motor load • Increase motor speed • Repeat stator resistance measurement 8.8 "Motor data – characteristic curves (Asynchronous motors)"
C002	2.2	Ext resistor temp.	Temperature sensor (e.g. braking resistor) has been triggered. The digital input is "low". • Check connection and temperature sensor
C003	3.0	Overcurrent I ² t lim.	The current limit (I²t) has been exceeded (e.g more than 1.3 × rated current for 60 s). • Reduce motor load • Check system for blockage or overload • Check rotary encoder settings (resolution, defect, connection) Further notes: • Adjust the current limit by changing the pulse frequency (P504)
C003	3.1	Overcurrent chopper I ² t	The current limit (I²t) of the brake chopper has been exceeded (e.g more than 1.3 × rated current for 60 s). • Avoid overcurrent in braking resistor Further notes: • Check braking resistor values (P555, P556, P557 and P554, if available)
C003	3.5	Torque limit	The limit value of the torque generating current (parameterised, mechanical load limit) has been reached. • Check system for blockage or overload Further notes:

6 Operating status messages

			Check value in P112
C003	3.6	Current limit	The limit value of the frequency inverter output current (parameterised frequency inverter load limit) has been reached. - Check system for blockage or overload Further notes: - Check P536

C004	4.1	Overcurrent measurem.	The pulse disconnection (P537) has been achieved. • Reduce motor load • Check system for blockage or overload Further notes: • Error message is only possible if P112 and P536 are switched off • Check motor data settings on the device (P201 ... P209) and check motor dimensioning • Check ramp times (P102/P103)
C012	12.1	Limit moto./Customer	The motor switch-off limit is reached. • Reduce motor load • Check system for blockage or overload Further notes: • Check settings P534 [-01]
C012	12.2	Limit gen.	The machine drives the motor and puts it into generator operation. Warning: 80% of the generator switch-off limit have been reached. • Reduce (generator) motor load • Check system for overload Further notes: • Check settings P534 [-02]
C012	12.3	Torque limit	Warning: 80% of the limitation of the potentiometer or the setpoint source have been reached. (P400 = 12)
C012	12.5	Load monitor	Overshooting or undershooting of permissible load torques (P525 ... P529) for half of the time set in P528. • Adjust load Further notes: • Change limit values (P525 ... P527) • Increase delay time (P528) • Change monitoring mode (P529)

Messages on switch-on inhibit, "not ready"

Coding		Reason for switch-on inhibit, "not ready"	Cause • Remedy
Group	Number		
I000	0.1	Volt. blocked by IO	The input which is parameterised with the "Voltage disable" function (P420/P480) is not set ("Low"). - Set input ("High") - Check connections and cables on both sides Further notes: - Check parameterisation of digital functions (P420/P480)
I000	0.2	Quick stop by IO	The input which is parameterised with the "Quick stop" function (P420/P480) is not set ("Low"). - Set input ("High") - Check connections and cables on both sides Further notes: - Check parameterisation of digital functions (P420/P480)
I000	0.3	Volt. blocked by Bus	If "Source control word" (P509) is not 0 or 1, Bit 1 is not set in the control word ("Low"). Further notes: Set Bit 1 to "High" in the control word
I000	0.4	Quick stop by Bus	If "Source control word" (P509) is not 0 or 1, Bit 2 is not set in the control word ("Low"). Further notes: Set Bit 2 to "High" in the control word
I000	0.5	Enable at start	An enable signal was applied during the switch-on phase of the frequency inverter (mains or control voltage "ON"). Or the frequency inverter switches from the "Fault" or "Switch-on inhibit" state to the "Ready" state although the enable is still active. - Deactivate enable signal Further notes: - Activate "Automatic starting" (P428) NOTICE! Risk of injury! Drive starts up immediately! - Check enable signals - Digital inputs (P420) - BusIO In (P480) - Control word (P740)
I000	0.8	Right dir. locked	Switch-on inhibit with frequency inverter shut-off activated by: P540 or by "Block enable right" (P420 = 31 or P420 = 73) Notice: The frequency inverter switches to "Ready to switch-on" status.

I000	0.9	Left dir. locked	Switch-on inhibit with frequency inverter shut-off activated by: • P540 or by "Block enable left" (P420 = 32 or P420 = 74) Notice: The frequency inverter switches to "Ready to switch-on" status.
I006 ¹⁾	6.0	Charging error	Charging relay not energised, because: • Mains/link voltage too low • Mains voltage failure • Evacuation mode active (P420/P480)
I011	11.0	Analog Stop	If an analogue input of the frequency inverter or connected IO extension is configured for wire break detection (2 ... 10 V signal or 4 ... 20 mA signal) the frequency inverter changes to the status "ready for switch-on" of the analogue signal undershoots the value 1 V or 2 mA. This also occurs if the relevant analogue input is parameterised to function "0" (no function). • Check connection
I014 ¹	14.4	Reserved	Information message for POSICON →  BU0210.
I018 ¹	18.0	Reserved	Information message for "Safe stop" function →  BU0230.

1 Indication of operating mode (message) on the ParameterBox or virtual operating unit of the software: "**Not ready**".

6.4 FAQ operational problems

Fault	Possible cause	Remedy
Device will not start (all LEDs off)	- No mains voltage or wrong mains voltage - SK 2x5E: No 24 V DC control voltage	- Check connections and supply cables - Check switches / fuses
Device does not react to enabling	- Control elements not connected - Incorrect control word source setting - Right and left enable signals present simultaneously - Enable signal present before device ready for operation (device expecting a 0 → 1 edge)	- Reset enable - Change over P428 if necessary: "0" = device expecting a 0→1 edge for enable / "1" = device reacts to "Level" → <i>Danger: Drive can start up independently!</i> - Check control connections - Check P509
Motor will not start in spite of enable being present	- Motor cables not connected - Brake not ventilating - No setpoint specified - Incorrect setpoint source setting	- Check connections and supply cables - Check control elements - Check P510
Device switches off without error message when load increases (increased mechanical load / speed)	Mains phase missing	- Check connections and supply cables - Check switches / fuses
Motor rotates in the wrong direction	Motor cable: U-V-W incorrectly connected	- Motor cable: Change 2 phases - Alternative: - Check motor phase sequence (P583) - Change Enable right/left functions (P420) - Change control word Bit 11/12 (for bus control)
Motor not reaching required speed	Maximum frequency parameter setting too low	Check P105
Motor speed does not correspond to setpoint	Analogue input function set to "Frequency additions" and another setpoint is present	- Check P400 - Check setting of integrated potentiometer (P1) (SK 2x5E only) P420, check active fixed frequencies - Check bus setpoints - Check P104 / P105 "min. / max. frequency" - Check P113 "jog frequency"

Motor generating a considerable amount of noise (at the current limit) and "OFF" signal is implemented at slow speed with little or no control, possibly with error message 3.0	• Tracks A and B swapped round by encoder (for speed feedback) • Incorrect encoder resolution setting • Encoder power supply missing • Encoder faulty	• Check encoder connections • Check P300, P301 • Monitor via P735 • Check encoder
Intermittent communication error between FI and option modules	• System bus terminating resistor not set • Poor connection contacting • Interference on system bus line • Maximum system bus length exceeded	• First and last subscriber only: Set DIP switches for terminating resistance • Check connections • Connect GND of all FI connected to system bus • Pay attention to routing regulations (separate routing of signal and control cables and mains and motor cables) • Check cable lengths (system bus)

Table 15: FAQ operational problems

7 Technical data

7.1 General frequency inverter data

Function	Specification
Output frequency	0.0 ... 400.0 Hz
Pulse frequency	3.0 ... 16.0 kHz, factory setting = 6 kHz Power derating > 8 kHz with 115 / 230 V device, > 6 kHz with 400 V device
Typical overload capacity	150% for 60 s, 200% for 3.5 s
Efficiency	> 95% depending on the size
Energy efficiency	IE2 (chapter 7.2)
Insulation resistance	> 5 MΩ
Leakage current	> 40 mA possible with standard configuration for operation on the TN/TT network - Reduction to 10 mA – 20 mA in the frequency range below 1 kHz possible when configured for operation on the IT network - The specifications apply to the factory setting of the pulse frequency (see also parameter P504)
Operating/ambient temperature	-25°C ... +40°C, for detailed information (including UL values) on individual device types and operating modes, see (chapter 7.3) ATEX: -20 ... +40 °C (chapter 2.6)
Storage and transport temperature	-25°C ... +60/70°C
Long-term storage	(chapter 9.1)
IP code	IP55, optionally IP66 (chapter 1.9) NEMA1, higher NEMA classifications upon request
Max. installation altitude above sea level	Up to 1000 m No power derating 1000 ... 2000 m: 1% / 100 m power derating, overvoltage category 3 2000 ... 4000 m: 1% / 100 m power derating, overvoltage category 2, external overvoltage protection required at mains input
Ambient conditions	<i>Transport (IEC 60721-3-2):</i> Mechanical: 2M2 <i>Operation (IEC 60721-3-3):</i> Mechanical: 3M7, 3M6 (size 4) Climatic: 3K3 (IP55) 3K4 (IP66)
Environmental protection	<i>Energy-saving function</i> (chapter 8.7), see P219 <i>EMC</i> (chapter 8.3) <i>RoHS</i> (chapter 1.6)
Protective measures against	Overtemperature of the frequency inverter Short-circuit, earth fault, overload, idling Overvoltage and undervoltage
Motor temperature monitoring	I ² t motor, PTC/bimetallic switch
Regulation and control	Sensorless current vector control (ISD), linear V/f characteristic curve, VFC open-loop, CFC open-loop, CFC open-loop-injection, CFC closed-loop
Waiting period between two mains switch-on cycles	60 s for all devices in normal operating cycle
Interfaces	<i>Standard</i> RS-485 (USS) (for parameterisation units only) RS-232 (single slave) System bus <i>Option</i> ASi – on board (chapter 4.5) Various bus modules (chapter 3.2)
Electrical isolation	Control terminals
Connection terminals, electrical connection	<i>Power unit</i> (chapter 2.4.2) <i>Control unit</i> (chapter 2.4.3)

7.2 Technical data for determining the energy efficiency level

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



Information

Calculation basis for the energy efficiency level

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

Simplifications are included in the calculation methods of the standard!

Manufact	FI type	Rel. losses ¹⁾ (rel. motor stator frequency / rel. torque-producing current)								Standby ²⁾	Standby ²⁾ (UKCA)	IE rating
		90/100	90/50	50/100	50/50	50/25	0/100	0/50	0/25			
Getriebebau NORD GmbH & Co. KG	NORDAC FLEX SK 2xxE-	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[%]	[W]	[%]	
	250-323	4,6	3,9	4,2	3,7	3,6	3,8	3,6	3,5	5,1	2,04	IE2
	370-323	3,9	3,2	3,5	3,0	2,9	3,2	2,9	2,8	5,1	1,38	IE2
	550-323	3,5	2,7	3,0	2,5	2,4	2,7	2,4	2,4	5,1	0,93	IE2
	750-323	3,3	2,5	2,8	2,3	2,2	2,5	2,1	2,1	5,1	0,68	IE2
	111-323	3,0	2,0	2,5	1,8	1,6	2,1	1,7	1,5	5,1	0,46	IE2
	151-323	3,0	2,0	2,5	1,8	1,5	2,1	1,7	1,5	6,0	0,40	IE2
	221-323	3,2	2,1	2,7	1,9	1,6	2,4	1,8	1,6	6,0	0,27	IE2
	301-323	2,9	1,9	2,4	1,7	1,4	2,1	1,6	1,4	7,0	0,23	IE2
	401-323	2,9	1,8	2,4	1,6	1,3	2,0	1,5	1,2	7,0	0,18	IE2
	551-323	3,8	2,5	3,3	2,3	1,9	2,9	2,2	1,9	7,0	0,13	IE2
	751-323	3,7	2,1	3,1	1,9	1,5	2,7	1,7	1,4	7,0	0,09	IE2
	112-323	4,0	2,2	3,4	2,1	1,6	3,1	1,9	1,5	7,0	0,06	IE2
	550-340	2,6	2,1	2,5	2,1	2,0	2,3	2,0	2,0	6,1	1,10	IE2
	750-340	2,4	1,8	2,3	1,7	1,5	2,2	1,6	1,4	6,1	0,81	IE2
	111-340	2,1	1,5	2,0	1,4	1,2	1,9	1,4	1,2	6,1	0,55	IE2
	151-340	2,3	1,6	2,2	1,5	1,2	2,0	1,4	1,2	5,7	0,38	IE2
	221-340	2,4	1,5	2,2	1,5	1,2	2,0	1,4	1,1	5,7	0,26	IE2
	301-340	2,3	1,5	2,1	1,5	1,2	2,0	1,4	1,1	6,3	0,21	IE2
	401-340	2,4	1,5	2,2	1,4	1,2	2,0	1,4	1,1	6,3	0,16	IE2
	551-340	2,2	1,2	1,9	1,1	0,8	1,7	1,0	0,8	7,0	0,13	IE2
	751-340	2,1	1,1	1,9	1,1	0,8	1,7	1,0	0,7	7,0	0,09	IE2
	112-340	2,4	1,4	2,2	1,3	1,0	2,0	1,2	1,0	13,1	0,12	IE2
	152-340	2,3	1,3	2,1	1,2	0,9	2,0	1,2	0,9	13,1	0,09	IE2
	182-340	2,6	1,5	2,4	1,4	1,1	2,3	1,3	1,0	13,1	0,07	IE2
	222-340	2,6	1,5	2,5	1,4	1,1	2,3	1,3	1,0	16,1	0,07	IE2

Getriebebau NORD GmbH & Co. KG	NORDAC FLEX SK 2xxE-	[kVA]	[kW]	[A]	[°C]	[Hz]	[V]
	250-323	0,5	0,25	1,31	40	50	200 V – 240 V
	370-323	0,7	0,37	1,83	40	50	200 V – 240 V
	550-323	1,0	0,55	2,56	40	50	200 V – 240 V
	750-323	1,3	0,75	3,39	40	50	200 V – 240 V
	111-323	1,7	1,10	4,49	40	50	200 V – 240 V
	151-323	2,3	1,50	6,02	40	50	200 V – 240 V
	221-323	3,3	2,20	8,67	40	50	200 V – 240 V
	301-323	4,4	3,00	11,66	40	50	200 V – 240 V
	401-323	5,9	4,00	15,34	40	50	200 V – 240 V
	551-323	7,9	5,50	20,83	40	50	200 V – 240 V
	751-323	10,0	7,50	26,11	40	50	200 V – 240 V
	112-323	14,4	11,00	37,82	40	50	200 V – 240 V
	550-340	1,2	0,55	1,70	40	50	380 V – 480 V
	750-340	1,6	0,75	2,30	40	50	380 V – 480 V
	111-340	2,1	1,10	3,10	40	50	380 V – 480 V
	151-340	2,8	1,50	4,00	40	50	380 V – 480 V
	221-340	3,8	2,20	5,50	40	50	380 V – 480 V
	301-340	5,2	3,00	7,50	40	50	380 V – 480 V
	401-340	6,6	4,00	9,50	40	50	380 V – 480 V
	551-340	8,7	5,50	12,50	40	50	380 V – 480 V
	751-340	11,1	7,50	16,00	40	50	380 V – 480 V
	112-340	15,9	11,00	23,00	40	50	380 V – 480 V
	152-340	22,2	15,00	32,00	40	50	380 V – 480 V
	182-340	27,7	18,50	40,00	40	50	380 V – 480 V
	222-340	31,9	22,00	46,00	40	50	380 V – 480 V

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

2) Standby losses in % of the rated output power

7.3 Electrical data

The following table lists the electrical data for frequency inverters. The details based on measurement series for the operating modes are for orientation purposes and may deviate in practice. The measurement series were made at the rated speed with 4-pole NORD standard motors

The following factors have a particular influence on the determined limiting values:

Wall mounted

- Installation location
- Influence from adjacent devices
- Additional air currents

and also with

Motor Mounted

- Type of motor used,
- Size of motor used
- Speed with internally ventilated motors
- Use of external fans.



Information

Single phase operation

For single phase operation (115 / 230 V) the mains impedance must be at least 100 μ H for each conductor. If this is not the case, a mains choke must be installed.

Failure to comply with this may cause damage to the device due to impermissible currents in the components.



Information

Information about current and power

The powers stated for the operating modes are only a rough categorisation

The current values are more reliable details for the selection of the correct frequency inverter/motor combination!

The following tables contain the data which is relevant for UL(see chapter 1.6.1 "UL and CSA approval").

7.3.1 Electrical data 1~ 115 V

Device type		SK 2x5E...	-250-112-	-370-112-	-550-112-	-750-112-		
		Size	1	1	2	2		
Nominal motor power (4-pole standard motor)		230 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW		
		240 V	1/3 hp	1/2 hp	3/4 hp	1 hp		
Mains voltage		115 V	1 AC, 100 ... 120 V, ± 10%, 47 ... 63 Hz					
Input current		rms ¹⁾	8.9 A	11.0 A	13.1 A	20.1 A		
		FLA ²⁾	8.9 A	10.8 A	13.1 A	20.1 A		
Output voltage		230 V	3 AC, 0 ... 2 times mains voltage					
Output current ³⁾		rms ¹⁾	1.7 A	2.2 A	3.0 A	4.0 A		
		FLA motor mounting ²⁾	1.7 A	1.7 A	3.0 A	3.0 A		
		FLA wall mounting ²⁾	1.7 A	2.1 A	3.0 A	4.0 A		
Min. braking resistance		Accessories	75 Ω	75 Ω	75 Ω	75 Ω		
Motor mounting (ventilated)								
Max. continuous power / max. constant current								
		S1-50 °C	0.25 kW / 1.6 A	0.25 kW / 1.6 A	0.37 kW / 2.6 A	0.37 kW / 2.6 A		
		S1-40 °C	0.25 kW / 1.7 A	0.25 kW / 1.8 A	0.55 kW / 3.0 A	0.55 kW / 3.0 A		
		S1-30 °C	0.25 kW / 1.7 A	0.37 kW / 2.0 A	0.55 kW / 3.0 A	0.55 kW / 3.4 A		
Max. permissible ambient temperature with nominal output current								
S1			47 °C	23 °C	40 °C	11 °C		
S3 70% ED 10 min			50 °C	35 °C	50 °C	25 °C		
S6 70% ED 10 min (100% / 20% M _N)			50 °C	30 °C	45 °C	20 °C		
Wall mounting (ventilated / unventilated)								
Max. continuous power / max. constant current								
		S1-50 °C	0.25 kW / 1.6 A	0.25 kW / 1.6 A	0.55 kW / 3.0 A	0.55 kW / 3.0 A		
		S1-40 °C	0.25 kW / 1.7 A	0.37 kW / 2.0 A	0.55 kW / 3.0 A	0.55 kW / 3.3 A		
		S1-30 °C	0.25 kW / 1.7 A	0.37 kW / 2.1 A	0.55 kW / 3.0 A	0.55 kW / 3.6 A		
Max. permissible ambient temperature with nominal output current								
S1			48 °C	36 °C	50 °C	16 °C		
S3 70% ED 10 min			50 °C	40 °C	50 °C	30 °C		
S6 70% ED 10 min (100% / 20% M _N)			50 °C	40 °C	50 °C	25 °C		
			Fuses (AC) general (recommended)					
Slow-blowing			16 A	16 A	16 A	25 A		
		Isc ⁴⁾ [A]	Fuses (AC), UL-approved					
		10 000						
		65 000						
		100 000						
Class								
Fuse ⁵⁾	RK5	(x)	x	30 A	30 A	30 A	30 A	
	CC, J, R, T, G, L	(x)	x	30 A	30 A	30 A	30 A	
	Bussmann FRS-	(x)	x	R-30	R-30	R-30	R-30	
CB ⁶⁾	(≥ 115 V)	x		25 A	25 A	25 A	25 A	

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (100 V – 120 V) according to UL/CSA

3) FLA (S1-40 °C), FLA motor mounting: refers to a motor with fan

4) Maximum permissible mains short-circuit current

5) The use of an SK TU4-MSW(-...) module limits the permissible mains short-circuit current to 10 kA

6) "Inverse time trip type" according to UL 489

7.3.2 Electrical data 1~ 230 V

Device type		SK 2xxE...	-250-123-	-370-123-	-550-123-	-750-123-	-111-123-
		Size	1	1	1	2 ^{a)}	2 ^{a)}
Nominal motor power (4-pole standard motor)		230 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	1.10 kW
		240 V	1/3 hp	1/2 hp	3/4 hp	1 hp	1 1/2 hp
Mains voltage		230 V	1 AC, 200 ... 240 V, ± 10%, 47 ... 63 Hz				
Input current		rms ¹⁾	3.9 A	5.8 A	7.3 A	10.2 A	14.7 A
		FLA ²⁾	3.9 A	5.8 A	7.3 A	10.1 A	14.6 A
Output voltage		230 V	3 AC 0 ... Mains voltage				
Output current ^{3), 4)}		rms ¹⁾	1.7 A	2.2 A	3.0 A	4.0 A	5.5 A
		FLA motor mounting ²⁾	1.7 A	2.2 A	2.6 A	3.9 A	5.4 A
		FLA wall mounting ²⁾	1.7 A	2.2 A	2.9 A	3.9 A	4.4 A ^{b)}
Min. braking resistance		Accessories	75 Ω	75 Ω	75 Ω	75 Ω	75 Ω
Motor mounting (ventilated) ⁴⁾							
Max. continuous power / max. constant current							
		S1-50 °C	0.25 kW / 1.6 A	0.25 kW / 1.8 A	0.37 kW / 2.5 A	0.55 kW / 3.4 A	0.75 kW / 4.3 A
		S1-40 °C	0.25 kW / 1.7 A	0.37 kW / 2.0 A	0.55 kW / 2.8 A	0.55 kW / 3.7 A	0.75 kW / 4.8 A
		S1-30 °C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 2.9 A	0.75 kW / 4.0 A	1.10 kW / 5.4 A
Max. permissible ambient temperature with nominal output current							
S1			49 °C	33 °C	36 °C	35 °C	29 °C
S3 70% ED 10 min			50 °C	45 °C	45 °C	45 °C	40 °C
S6 70% ED 10 min (100% / 20% M _N)			50 °C	40 °C	40 °C	40 °C	35 °C
Wall mounting (ventilated / unventilated) ⁴⁾							
Max. continuous power / max. constant current							
		S1-50 °C	0.25 kW / 1.5 A	0.37 kW / 2.2 A	0.37 kW / 2.7 A	0.75 kW / 4.0 A	0.75 kW / 4.3 A
		S1-40 °C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 2.9 A	0.75 kW / 4.0 A	0.75 kW / 4.8 A
		S1-30 °C	0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 2.9 A	0.75 kW / 4.0 A	1.10 kW / 5.3 A
Max. permissible ambient temperature with nominal output current							
S1			44 °C	50 °C	42 °C	50 °C	27 °C
S3 70% ED 10 min			50 °C	50 °C	45 °C	50 °C	40 °C
S6 70% ED 10 min (100% / 20% M _N)			45 °C	50 °C	45 °C	50 °C	35 °C
			Fuses (AC) general (recommended)				
Slow-blowing			10 A	10 A	16 A	16 A	16 A
		Isc ⁵⁾ [A]	Fuses (AC), UL-approved				
		Class	10 000	65 000	100 000		
Fuse ⁶⁾	RK5	(x)	x			10 A	30 A
	CC, J, R, T, G, L	(x)	x			10 A	30 A
	Bussmann FRS-	(x)	x			R-10	R-30
CB ⁷⁾	(≥ 230 V)	x				10 A	25 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (200 V – 240 V) according to UL/CSA

3) FLA (S1-40 °C), FLA motor mounting: refers to a motor with fan

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Maximum permissible mains short-circuit current

6) The use of an SK TU4-MSW(-...) module limits the permissible mains short-circuit current to 10 kA

7) "Inverse time trip type" according to UL 489

a) Size 2: SK 2x5E only

b) 5.4 A when using a suitable fan

7.3.3 Electrical data 3~ 230 V

Device type		SK 2xxE...	-250-323-	-370-323-	-550-323-	-750-323-	-111-323-	
		Size	1	1	1	1	1	
Nominal motor power (4-pole standard motor)	230 V	0.25 kW	0.37 kW	0.55 kW	0.75 kW	1.10 kW		
	240 V	1/3 hp	1/2 hp	3/4 hp	1 hp	1 1/2 hp		
Mains voltage		230 V	3 AC, 200 ... 240 V, ± 10%, 47 ... 63 Hz					
Input current	rms ¹⁾	1.4 A	1.9 A	2.6 A	3.5 A	5.1 A		
	FLA ²⁾	1.4 A	1.9 A	2.6 A	3.5 A	5.1 A		
Output voltage		230 V	3 AC 0 ... Mains voltage					
Output current ^{3), 4)}	rms ¹⁾	1.7 A	2.2 A	3.0 A	4.0 A	5.5 A		
	FLA motor mounting ²⁾	1.7 A	2.2 A	2.9 A	3.9 A	5.4 A		
	FLA wall mounting ²⁾	1.7 A	2.2 A	2.9 A	3.9 A (S1-40 °C)	4.0 A ^{a)} (S1-40 °C)		
Min. braking resistance		Accessories	100 Ω	100 Ω	100 Ω	100 Ω	100 Ω	
Motor mounting (ventilated) or wall mounting with SK TIE4-WMK-L-1 (ventilated) ⁴⁾								
Max. continuous power / max. constant current								
S1-50 °C			0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 3.0 A	0.75 kW / 4.0 A	1.1 kW / 5.5 A	
Max. permissible ambient temperature with nominal output current								
S1			50 °C	50 °C	50 °C	50 °C	50 °C	
S3 70% ED 10 min			50 °C	50 °C	50 °C	50 °C	50 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	50 °C	50 °C	50 °C	
Wall mounting (unventilated) ⁴⁾								
Max. continuous power / max. constant current								
S1-50 °C			0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 2.8 A	0.55 kW / 2.8 A	0.55 kW / 3.4 A	
S1-40 °C			0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 3.0 A	0.55 kW / 3.5 A	0.75 kW / 4.2 A	
S1-30 °C			0.25 kW / 1.7 A	0.37 kW / 2.2 A	0.55 kW / 3.0 A	0.75 kW / 4.0 A	0.75 kW / 4.8 A	
Max. permissible ambient temperature with nominal output current								
S1			50 °C	50 °C	48 °C	32 °C	20 °C	
S3 70% ED 10 min			50 °C	50 °C	50 °C	40 °C	30 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	50 °C	35 °C	25 °C	
			Fuses (AC) general (recommended)					
Slow-blowing			10 A	10 A	10 A	10 A	16 A	
Class		Isc ⁵⁾ [A]	Fuses (AC), UL-approved					
		10 000	65 000	100 000				
Fuse ⁶⁾	RK5	(x)	x	5 A	5 A	10 A	10 A	10 A
	CC, J, R, T, G, L	(x)	x	5 A	5 A	10 A	10 A	10 A
	Bussmann FRS-	(x)	x	R-5	R-5	R-10	R-10	R-10
CB ⁷⁾	(≥ 230 V)	x		5 A	5 A	10 A	10 A	10 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **F**ull **L**oad **C**urrent, maximum current for the entire, above-mentioned mains voltage range (200 V – 240 V) according to UL/CSA

3) FLA (S1-45 °C), FLA motor mounting: refers to a motor with fan

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Maximum permissible mains short-circuit current

6) The use of an SK TU4-MSW(-...) module limits the permissible mains short-circuit current to 10 kA

7) "Inverse time trip type" according to UL 489

a) 5.4 A when using a suitable fan

Device type		SK 2xxE...	-151-323-	-221-323-	-301-323-	-401-323-	
		Size	2	2	3	3	
Nominal motor power (4-pole standard motor)		230 V	1.5 kW	2.2 kW	3.0 kW	4.0 kW	
		240 V	2 hp	3 hp	4 hp	5 hp	
Mains voltage		230 V	3 AC, 200 ... 240 V, $\pm 10\%$, 47 ... 63 Hz				
Input current		rms ¹⁾	6.6 A	9.1 A	11.8 A	15.1 A	
		FLA ²⁾	6.6 A	9.1 A	11.7 A	14.9 A	
Output voltage		230 V	3 AC 0 ... Mains voltage				
Output current ^{3), 4)}		rms ¹⁾	7.0 A	9.5 A	12.5 A	16.0 A	
		FLA motor mounting ²⁾	6.9 A	8.8 A	12.3 A	15.7 A	
		FLA wall mounting ²⁾	5.5 A ^{a)} (S1-40 °C)	5.5 A ^{b)} (S1-40 °C)	8.0 A ^{c)} (S1-40 °C)	8.0 A ^{d)} (S1-40 °C)	
Min. braking resistance		Accessories	62 Ω	62 Ω	33 Ω	33 Ω	
Motor mounting (ventilated) or wall mounting with SK TIE4-WMK-L-1 (or -2) (ventilated) ⁴⁾							
Max. continuous power / max. constant current							
		S1-50 °C	1.5 kW / 7.0 A	1.5 kW / 9.2 A	3.0 kW / 12.5 A	3.0 kW / 14.5 A	
		S1-40 °C	1.5 kW / 7.0 A	2.2 kW / 9.5 A	3.0 kW / 12.5 A	4.0 kW / 16.0 A	
Max. permissible ambient temperature with nominal output current							
S1			50 °C	49 °C	50 °C	46 °C	
S3 70% ED 10 min			50 °C	50 °C	50 °C	47 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	50 °C	47 °C	
Wall mounting (unventilated) ⁴⁾							
Max. continuous power / max. constant current							
		S1-50 °C	0.55 kW / 3.8 A	0.75 kW / 4.7 A	1.1 kW / 6.8 A	1.1 kW / 6.8 A	
		S1-40 °C	0.75 kW / 4.8 A	1.10 kW / 5.8 A	1.5 kW / 8.7 A	1.5 kW / 8.7 A	
		S1-30 °C	1.10 kW / 5.7 A	1.50 kW / 6.7 A	2.2 kW / 10.4 A	2.2 kW / 10.4 A	
Max. permissible ambient temperature with nominal output current							
S1			15 °C	6 °C	18 °C	-4 °C	
S3 70% ED 10 min			25 °C	20 °C	30 °C	0 °C	
S6 70% ED 10 min (100% / 20% M _N)			20 °C	10 °C	25 °C	0 °C	
Fuses (AC) general (recommended)							
Slow-blowing			16 A	20 A	20 A	25 A	
		Isc ⁵⁾ [A]	Fuses (AC), UL-approved				
		10 000	65 000	100 000			
Class							
Fuse ⁶⁾	RK5	(x)	x	10 A	30 A	30 A	30 A
	CC, J, R, T, G, L	(x)	x	10 A	30 A	30 A	30 A
	Bussmann FRS-	(x)	x	R-10	R-30	R-30	R-30
CB ⁷⁾	(≥ 230 V)	x		10 A	25 A	25 A	25 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (200 V – 240 V) according to UL/CSA

3) FLA (S1-45 °C), FLA motor mounting: refers to a motor with fan

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Maximum permissible mains short-circuit current

6) The use of an SK TU4-MSW(-...) module limits the permissible mains short-circuit current to 10 kA

7) "Inverse time trip type" according to UL 489

a) 6.9 A when using a suitable fan

b) 8.8 A when using a suitable fan

c) 12.3 A when using a suitable fan

d) 15.7 A when using a suitable fan

Device type		SK 2xxE...	-551-323-	-751-323-	-112-323-		
		Size	4	4	4		
Nominal motor power (4-pole standard motor)	230 V		5.5 kW	7.5 kW	11.0 kW		
	240 V		7 ½ hp	10 hp	15 hp		
Mains voltage	230 V	3 AC, 200 ... 240 V, ± 10%, 47 ... 63 Hz					
Input current	rms ¹⁾		23.5 A	29.5 A	40.5 A		
	FLA ²⁾		22.5 A	28.5 A	39.5 A		
Output voltage	230 V	3 AC 0 ... Mains voltage					
Output current ^{3), 4)}	rms ¹⁾		23.0 A	29.0 A	40.0 A		
	FLA motor mounting ²⁾		22.0 A	28.0 A	39.0 A		
	FLA wall mounting ²⁾		22.0 A	28.0 A	39.0 A		
Min. braking resistance	Accessories		30 Ω	20 Ω	15 Ω		
Motor mounting (blower cooling ⁵⁾, integrated into the device) ⁴⁾							
Max. continuous power / max. constant current							
		S1-40 °C	5.5 kW / 23.0 A	7.5 kW / 29.0 A	11.0 kW / 40.0 A		
Max. permissible ambient temperature with nominal output current							
S1			40 °C	40 °C	40 °C		
S3 70% ED 10 min			50 °C	50 °C	44 °C		
S6 70% ED 10 min (100% / 20% M _N)			47 °C	50 °C	44 °C		
Wall mounting (blower cooling ⁵⁾, integrated into the device) ⁴⁾							
Max. continuous power / max. constant current							
		S1-40 °C	5.5 kW / 23.0 A	7.5 kW / 29.0 A	11.0 kW / 40.0 A		
Max. permissible ambient temperature with nominal output current							
S1			45 °C	45 °C	45 °C		
S3 70% ED 10 min			50 °C	50 °C	47 °C		
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	47 °C		
			Fuses (AC) general (recommended)				
Slow-blowing			35 A	50 A	50 A		
		Isc ⁶⁾ [A]	Fuses (AC), UL-approved				
		10 000					
		65 000					
		100 000					
Class							
Fuse	CC, J, R, T, G, L (300 V)		x	60 A	60 A	60 A	
CB ⁷⁾	(300 V)	x		60 A	60 A	60 A	

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (200 V – 240 V) according to UL/CSA

3) FLA (S1-40 °C)

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Blower cooling, temperature-controlled: ON = 55 °C, OFF = 50 °C,
Run-on time when undershooting the 50 °C limit and removing the enable: 2 minutes

6) Maximum permissible mains short-circuit current

7) "Inverse time trip type" according to UL 489

7.3.4 Electrical data 3~ 400 V

Device type		SK 2xxE...	-550-340-	-750-340-	-111-340-	-151-340-	-221-340-	
		Size	1	1	1	1	1	
Nominal motor power (4-pole standard motor)		400 V	0.55 kW	0.75 kW	1.1 kW	1.5 kW	2.2 kW	
		480 V	¾ hp	1 hp	1½ hp	2 hp	3 hp	
Mains voltage		400 V	3 AC 380 ... 500 V, - 20% / + 10%, 47 ... 63 Hz					
Input current		rms ¹⁾	1.6 A	2.2 A	2.9 A	3.7 A	5.2 A	
		FLA ²⁾	1.4 A	2.0 A	2.7 A	3.4 A	4.7 A	
Output voltage		400 V	3 AC 0 ... Mains voltage					
Output current ^{3), 4)}		rms ¹⁾	1.7 A	2.3 A	3.1 A	4.0 A	5.5 A	
		FLA motor mounting ²⁾	1.5 A	2.1 A	2.8 A	3.6 A	4.9 A	
		FLA wall mounting ²⁾	1.5 A	2.1 A	2.8 A	3.6 A (S1-40 °C)	4.0 A ^{a)} (S1-40 °C)	
Min. braking resistance		Accessories	200 Ω	200 Ω	200 Ω	200 Ω	200 Ω	
Motor mounting (ventilated) or wall mounting with SK TIE4-WMK-L-1 (ventilated) ⁴⁾								
Max. continuous power / max. constant current								
S1-50 °C			0.55 kW / 1.7 A	0.75 kW / 2.3 A	1.1 kW / 3.1 A	1.5 kW / 4.0 A	2.2 kW / 5.5 A	
Max. permissible ambient temperature with nominal output current								
S1			50 °C	50 °C	50 °C	50 °C	50 °C	
S3 70% ED 10 min			50 °C	50 °C	50 °C	50 °C	50 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	50 °C	50 °C	50 °C	
Wall mounting (unventilated) ⁴⁾								
Max. continuous power / max. constant current								
S1-50 °C			0.55 kW / 1.7 A	0.75 kW / 2.3 A	0.75 kW / 2.8 A	0.75 kW / 2.8 A	0.75 kW / 2.8 A	
S1-40 °C			0.55 kW / 1.7 A	0.75 kW / 2.3 A	1.1 kW / 3.1 A	1.1 kW / 3.3 A	1.1 kW / 3.3 A	
S1-30 °C			0.55 kW / 1.7 A	0.75 kW / 2.3 A	1.1 kW / 3.1 A	1.5 kW / 3.9 A	1.5 kW / 3.9 A	
Max. permissible ambient temperature with nominal output current								
S1			50 °C	50 °C	45 °C	29 °C	1 °C	
S3 70% ED 10 min			50 °C	50 °C	50 °C	40 °C	15 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	50 °C	35 °C	5 °C	
			Fuses (AC) general (recommended)					
Slow-blowing			10 A	10 A	10 A	10 A	10 A	
Class		Isc ⁵⁾ [A]	Fuses (AC), UL-approved					
		10 000	65 000	100 000				
Fuse ⁶⁾	RK5	(x)	x	5 A	5 A	10 A	10 A	10 A
	CC, J, R, T, G, L	(x)	x	5 A	5 A	10 A	10 A	10 A
	Bussmann FRS-	(x)	x	R-5	R-5	R-10	R-10	R-10
CB ⁷⁾	(≥ 230 / 400 V)	x		5 A	5 A	10 A	10 A	10 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (380 V – 500 V) according to UL/CSA

3) FLA (S1-45 °C), FLA motor mounting: refers to a motor with fan

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Maximum permissible mains short-circuit current

6) The use of an SK TU4-MSW(...) module limits the permissible mains short-circuit current to 10 kA

7) "Inverse time trip type" according to UL 489

a) 4.9 A when using a suitable fan

Device type		SK 2xxE...	-301-340-	-401-340-	-551-340-	-751-340-	
		Size	2	2	3	3	
Nominal motor power (4-pole standard motor)	400 V		3.0 kW	4.0 kW	5.5 kW	7.5 kW	
	480 V		4 hp	5 hp	7 ½ hp	10 hp	
Mains voltage		400 V	3 AC 380 ... 500 V, - 20% / + 10%, 47 ... 63 Hz				
Input current	rms ¹⁾		7.0 A	8.9 A	11.7 A	15.0 A	
	FLA ²⁾		6.3 A	8.0 A	10.3 A	13.1 A	
Output voltage		400 V	3 AC 0 ... Mains voltage				
Output current ^{3), 4)}	rms ¹⁾		7.5 A	9.5 A	12.5 A	16.0 A	
	FLA motor mounting ²⁾		6.7 A	8.5 A	11.0 A	14.0 A	
	FLA wall mounting ²⁾		5.5 ^{a)} A (S1-40 °C)	5.5 ^{b)} A (S1-40 °C)	8.0 ^{c)} A (S1-40 °C)	8.0 ^{d)} A (S1-40 °C)	
Min. braking resistance	Accessories		110 Ω	110 Ω	68 Ω	68 Ω	
Motor mounting (ventilated) or wall mounting with SK TIE4-WMK-L-1 (or -2) (ventilated) ⁴⁾							
Max. continuous power / max. constant current:							
		S1-50 °C	2.2 kW / 5.5 A	3.0 kW / 8.0 A	4.0 kW / 11.8 A	5.5 kW / 13.8 A	
		S1-40 °C	3.0 kW / 7.5 A	4.0 kW / 9.5 A	5.5 kW / 12.5 A	7.5 kW / 16.0 A	
Max. permissible ambient temperature with nominal output current							
S1			43 °C	41 °C	48 °C	43 °C	
S3 70% ED 10 min			45 °C	45 °C	50 °C	45 °C	
S6 70% ED 10 min (100% / 20% M _N)			45 °C	41 °C	50 °C	45 °C	
Wall mounting (unventilated) ⁴⁾							
Max. continuous power / max. constant current:							
		S1-50 °C	1.1 kW / 3.1 A	1.5 kW / 4.0 A	1.5 kW / 5.3 A	2.2 kW / 6.3 A	
		S1-40 °C	1.5 kW / 4.0 A	1.5 kW / 4.9 A	2.2 kW / 6.9 A	3.0 kW / 7.9 A	
		S1-30 °C	1.5 kW / 4.8 A	2.2 kW / 5.7 A	3.0 kW / 8.4 A	4.0 kW / 9.4 A	
Max. permissible ambient temperature with nominal output current							
S1			-3 °C	-20 °C	1 °C	-18 °C	
S3 70% ED 10 min			0 °C	-5 °C	15 °C	-5 °C	
S6 70% ED 10 min (100% / 20% M _N)			0 °C	-15 °C	5 °C	-10 °C	
Fuses (AC) general (recommended)							
Slow-blowing			16 A	16 A	20 A	25 A	
		Isc ⁵⁾ [A]	Fuses (AC), UL-approved				
		10 000	65 000	100 000			
Class							
Fuse ⁶⁾	RK5	(x)	x	10 A	30 A	30 A	30 A
	CC, J, R, T, G, L	(x)	x	10 A	30 A	30 A	30 A
	Bussmann FRS-	(x)	x	R-10	R-30	R-30	R-30
CB ⁷⁾	(≥ 230 / 400 V)	x		10 A	25 A	25 A	25 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (380 V – 500 V) according to UL/CSA

3) FLA (S1-45 °C), FLA motor mounting: refers to a motor with fan

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Maximum permissible mains short-circuit current

6) The use of an SK TU4-MSW(-...) module limits the permissible mains short-circuit current to 10 kA

7) "Inverse time trip type" according to UL 489

a) 6.7 A when using a suitable fan

b) 8.5 A when using a suitable fan

c) 11.0 A when using a suitable fan

d) 14.0 A when using a suitable fan

Device type		SK 2xxE...	-112-340-	-152-340-	-182-340-	-222-340-	
		Size	4	4	4	4	
Nominal motor power (4-pole standard motor)	400 V		11.0 kW	15.0 kW	18.5 kW	22.0 kW	
	480 V		15 hp	20 hp	25 hp	30 hp	
Mains voltage	400 V		3 AC 380 ... 500 V, - 20% / + 10%, 47 ... 63 Hz				
Input current	rms ¹⁾		23.6 A	32.0 A	40.5 A	46.5 A	
	FLA ²⁾		20.5 A	28.0 A	35.5 A	42.5 A	
Output voltage	400 V		3 AC 0 ... Mains voltage				
Output current ^{3), 4)}	rms ¹⁾		23.0 A	32.0 A	40.0 A	46.0 A	
	FLA motor mounting ²⁾		20.0 A	28.0 A	35.0 A	42.0 A	
	FLA wall mounting ²⁾		20.0 A	28.0 A	35.0 A	42.0 A	
Min. braking resistance	Accessories		47 Ω	33 Ω	27 Ω	24 Ω	
Motor mounting (blower cooling ⁵⁾, integrated into the device) ⁴⁾							
Max. continuous power / max. constant current							
S1-40 °C			11.0 kW / 23.0 A	15.0 kW / 32.0 A	18.5 kW / 40.0 A	22.0 kW / 46.0 A	
Max. permissible ambient temperature with nominal output current							
S1			40 °C	40 °C	40 °C	40 °C	
S3 70% ED 10 min			50 °C	49 °C	41 °C	41 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	49 °C	41 °C	41 °C	
Wall mounting (blower cooling ⁵⁾, integrated into the device) ⁴⁾							
Max. continuous power / max. constant current							
S1-40 °C			11.0 kW / 23.0 A	15.0 kW / 32.0 A	18.5 kW / 40.0 A	22.0 kW / 46.0 A	
Max. permissible ambient temperature with nominal output current							
S1			45 °C	45 °C	41 °C	40 °C	
S3 70% ED 10 min			50 °C	50 °C	43 °C	42 °C	
S6 70% ED 10 min (100% / 20% M _N)			50 °C	50 °C	43 °C	41 °C	
				Fuses (AC) general (recommended)			
Slow-blowing			35 A	50 A	50 A	63 A	
		Isc ⁶⁾ [A]	Fuses (AC), UL-approved				
		10 000					
		65 000					
		100 000					
Class							
CB ⁷⁾ Fuse	CC, J, R, T, G, L (600 V)		x	60 A	60 A	60 A	60 A
	(600 V)	x		60 A	60 A	60 A	60 A

1) Note the derating curve (Fig. Section 8.4.4 "Reduced output current due to low voltage")

2) FLA – **Full Load Current**, maximum current for the entire, above-mentioned mains voltage range (380 V – 500 V) according to UL/CSA

3) FLA (S1-40 °C)

4) SK 21xE and SK 23xE devices: When using safe functions (functional safety: STO and SS1), restrictions regarding the permissible temperature range according to [BU 0230](#) must be observed.

5) Blower cooling, temperature-controlled: ON = 55 °C, OFF = 50 °C,
Run-on time when undershooting the 50 °C limit and removing the enable: 2 minutes

6) Maximum permissible mains short-circuit current

7) "Inverse time trip type" according to UL 489

8 Additional information

8.1 Setpoint processing

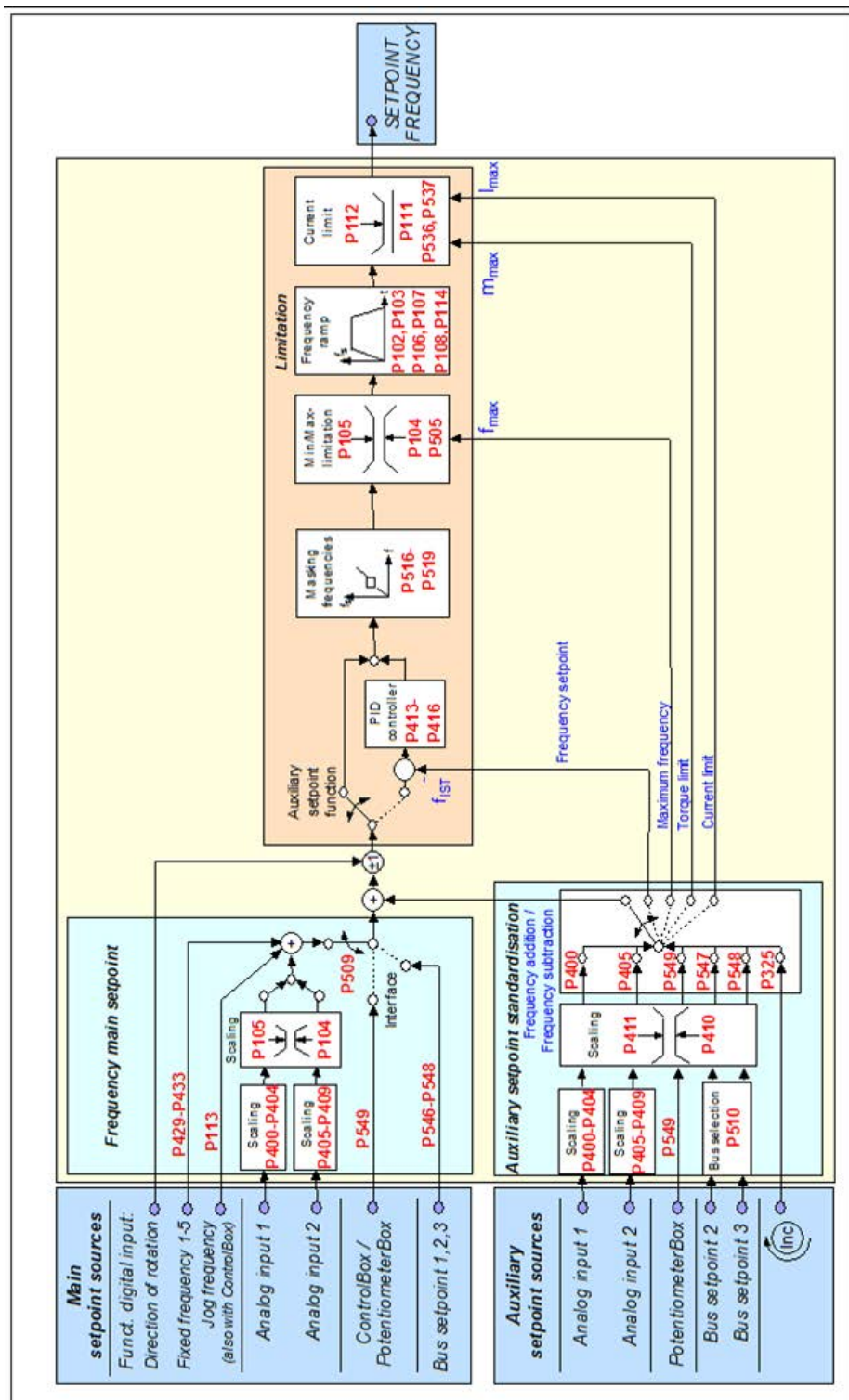
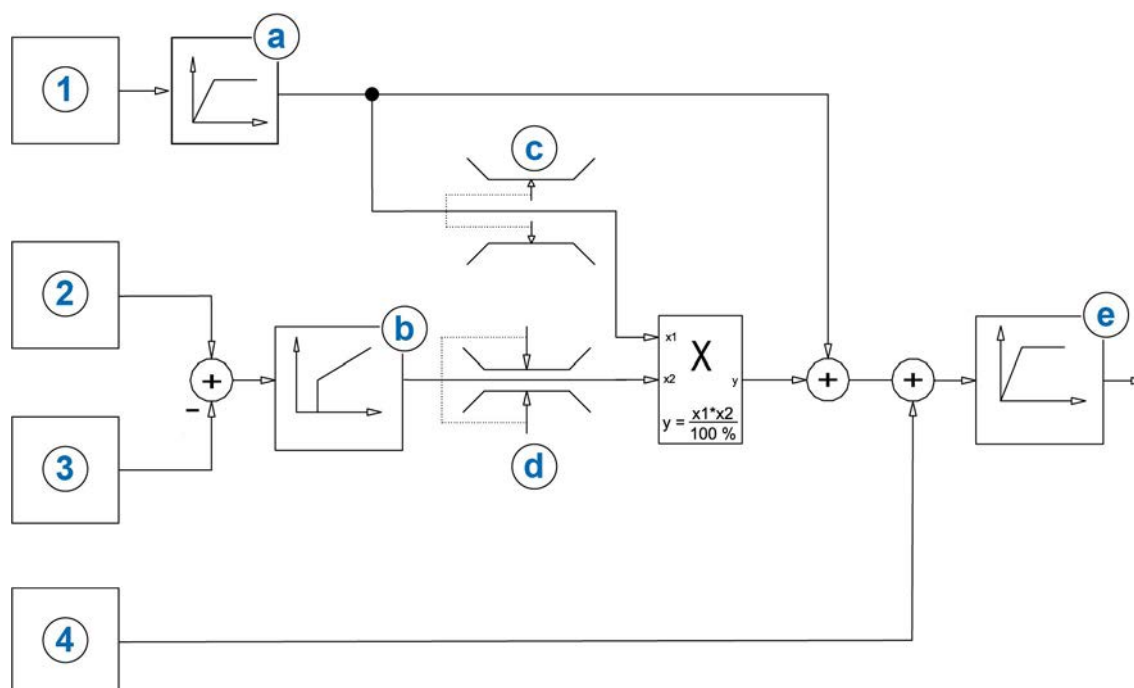


Figure 29 Setpoint processing

8.2 Process controller

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

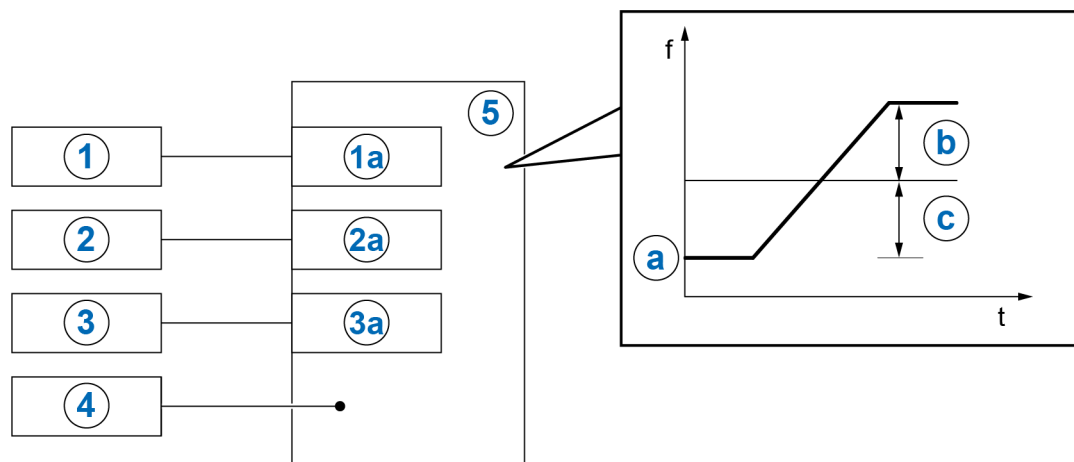
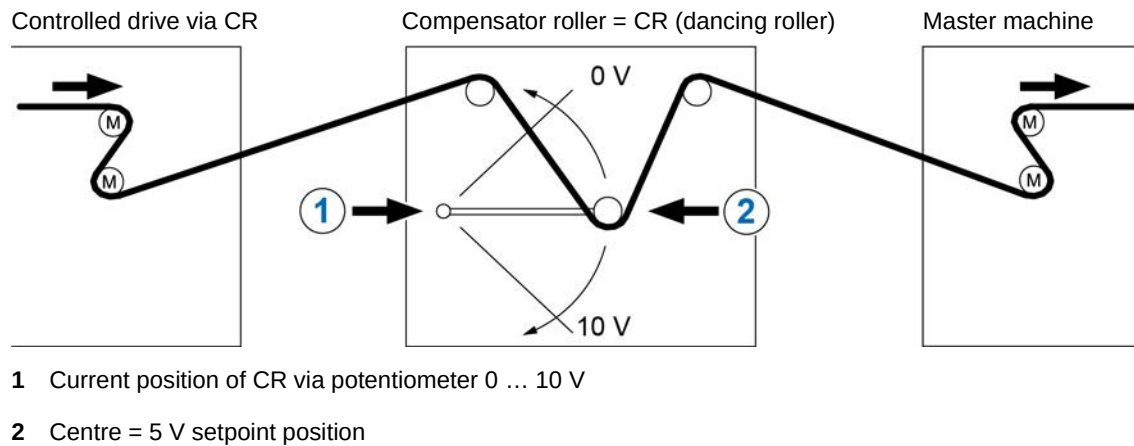


1	Master setpoint	P400 ¹
2	Process controller setpoint	P412
3	Actual value	P400 ¹
4	---	---
a	PI controller ramp time	P416
b	P factor	P413
	I factor	P414
c	Min. limitation	P466
d	Max. limitation	P415
e	Acceleration time	P102

¹ Also possible via bus (P546) or PLC (P553).

Figure 30: Flow chart: Process controller

8.2.1 Sample application: Process controller



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

Figure 31: Sample application: Dancing roller

8.2.2 Process controller parameter settings

(Example: SK 2x0E setpoint frequency: 50 Hz, control limits: +/- 25%)

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

Example: $\geq 50\text{Hz} + \frac{50\text{Hz} \times 25\%}{100\%} = \mathbf{62.5\text{Hz}}$

P400 [-01] (Funct. Analogue input1) : **"2"** (frequency addition)

P411 (setpoint frequency) [Hz] : Set frequency with 10 V at analogue input 1

Example: **50 Hz**

P412 (Process controller setpoint) : CR middle position / Default setting **5V** (adjust if necessary)

P413 (P controller) [%] : Factory setting **10%** (adjust if necessary)

P414 (I-controller) [%/ms] : recommended **100%/s**

P415 (limitation +/-) [%] : Controller limitation (see above)

Note: Parameter P415 is used as a control limit after the PI controller.

Example: **25%** of setpoint

P416 (Ramp time PI setpoint) [s] : Factory setting **2s** (if necessary, adjust to match controller behaviour)

P420 [-01] (Funct. digital input 1) : **"1"** Enable right

P400 [-02] (Funct. Analogue input 2) : **"6"** PI process controller actual value

8.3 Electromagnetic compatibility (EMC)

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

8.3.1 General Provisions

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

1. *EU Declaration of Conformity*

This is a declaration from the manufacturer, stating that the requirements in the applicable European standards for the electrical environment of the equipment have been met. Only those standards which are published in the Official Journal of the European Community may be cited in the manufacturer's declaration.

2. *Technical documentation*

Technical documentation can be produced which describes the EMC characteristics of the device. This documentation must be authorised by one of the "Responsible bodies" named by the responsible European government. This makes it possible to use standards which are still in preparation.

3. *EU Type test certificate*

This method only applies to radio transmitter equipment.

The devices only have an intrinsic function when they are connected to other equipment (e.g. to a motor). The base units cannot therefore carry the CE mark that would confirm compliance with the EMC directive. Precise details are therefore given below about the EMC behaviour of this product, based on the proviso that it is installed according to the guidelines and instructions described in this documentation.

The manufacturer can certify that his equipment meets the requirements of the EMC directive in the relevant environment with regard to their EMC behaviour in power drives. The relevant limit values correspond to the basic standards EN 61000-6-2 and EN 61000-6-4 for interference immunity and interference emissions.

8.3.2 EMC evaluation

Two standards must be observed when evaluating electromagnetic compatibility.

1. EN 55011 (environmental standard)

In this standard, the limit values are defined in dependence on the basic environment in which the product is operated. A distinction is made between two environments, where the **first environment** describes the non-industrial **living and business area** without its own high-voltage or medium-voltage distribution transformers. The **second environment** defines **industrial areas**, which are not connected to the public low-voltage network, but have their own high-voltage or medium-voltage distribution transformers. The limit values are subdivided into **classes A1, A2 and B**.

2. EN 61800-3 (product standard)

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

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

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

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

1) Device used neither as a plug-in device nor in moving equipment

2) "The drive system can cause high-frequency interference in a living environment that may make interference suppression measures necessary."

3) "The drive system is not intended for use in a public low-voltage network that feeds residential areas."

Table 16: EMC comparison between EN 61800-3 and EN 55011

8.3.3 EMC of device

NOTICE

EMC interference to the environment

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

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

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

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

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

- System design
- System impedance
- Load cycles

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

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

The limit value classes are only achieved if

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

The shielding of the motor cable must be attached at both sides in the motor terminal box and the inverter housing in the event of wall mounting.

Device type Max. motor cable, shielded	Jumper position 2.4.2.1 "Mains supply (L1, L2(/N), L3, PE)"	Conducted emissions 150 kHz - 30 MHz	
		Class C2	Class C1
Device motor-mounted	Jumper set (CY=ON)	+	-
Device wall-mounted	Jumper set (CY=ON)	5 m	-

EMC overview of the standards that, according to EN 61800-3 are used as test and measurement methods:		
<i>Interference emission</i>		
Conducted emissions (Interference voltage)	EN 55011	C2
		-
Radiated emission (Disturbance field strength)	EN 55011	C2
		-
<i>Interference immunity</i> EN 61000-6-1, EN 61000-6-2		
ESD, electrostatic discharge	EN 61000-4-2	6 kV (CD), 8 kV (AD)
EMF, high-frequency electromagnetic fields	EN 61000-4-3	10 V/m; 80 ... 1000 MHz 3 V/m; 1400 ... 2700 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 / -earth)	EN 61000-4-5	1 kV/2 kV
Conducted disturbance caused by high-frequency fields	EN 61000-4-6	10 V, 0.15 ... 80 MHz
Voltage fluctuations and dips	EN 61000-2-4	+10%, -15%
Voltage unbalances and frequency changes	EN 61000-2-4	3%; 2%

Table 17: Overview according to product standard EN 61800-3

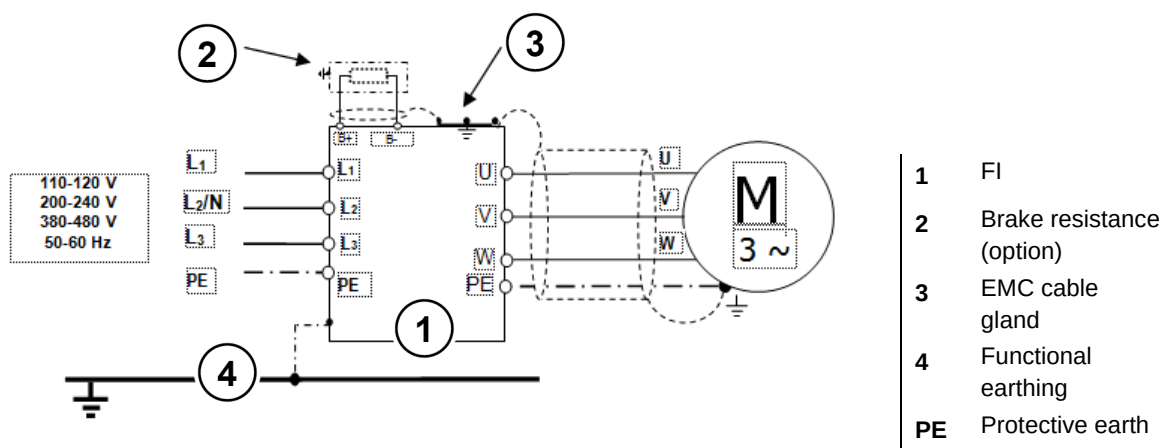


Figure 32: Wiring recommendation

8.4 Reduced output power

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

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

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

8.4.1 Increased heat dissipation due to pulse frequency

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

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

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

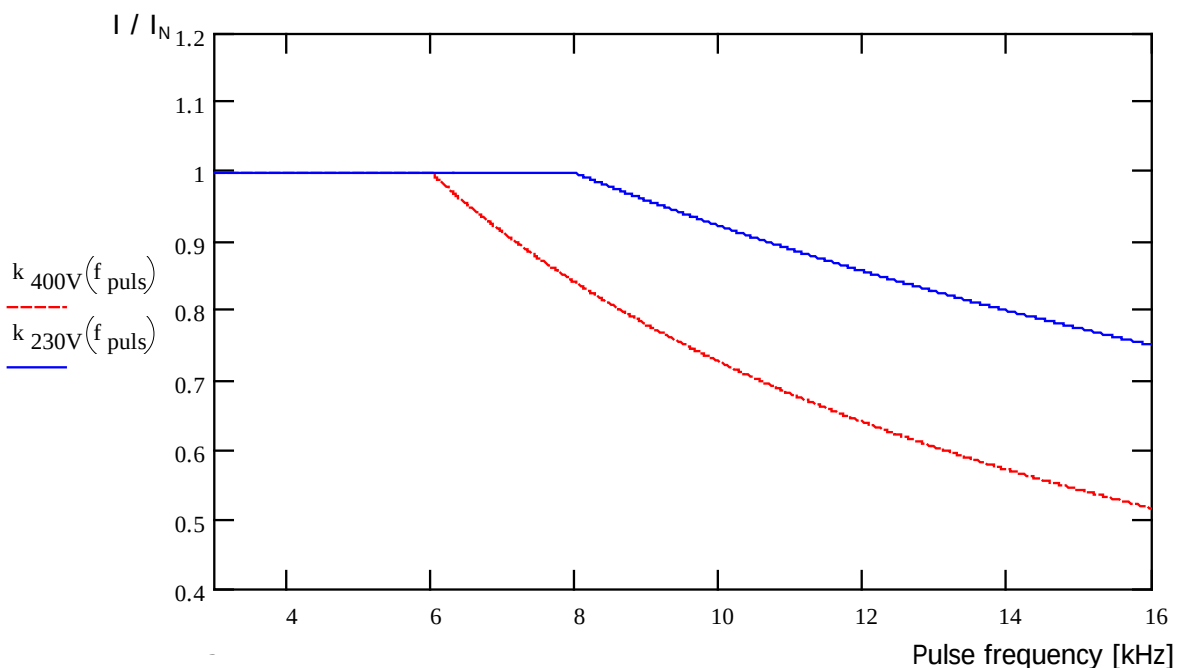


Figure 33: Heat losses due to pulse frequency

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.

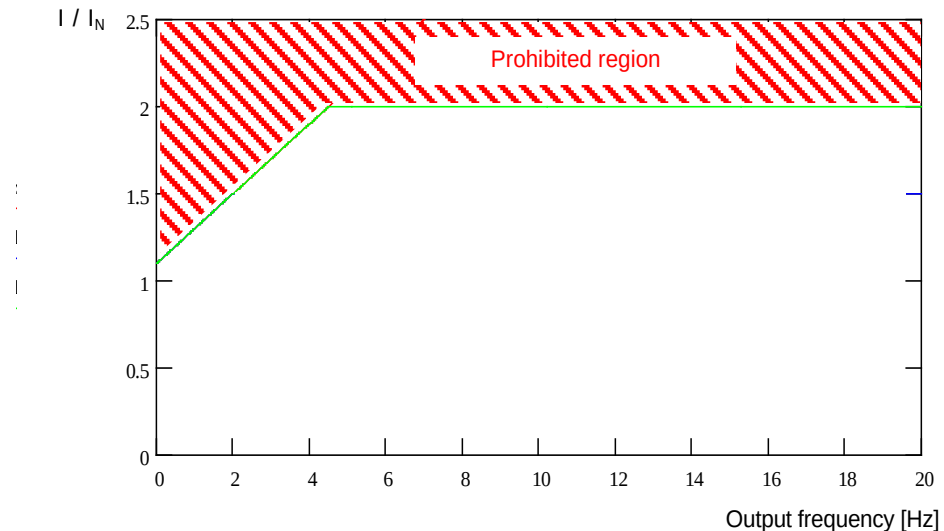
230V devices: Reduced overload capacity (approx.) due to pulse frequency (P504) and time						
Pulse frequency [kHz]	Time [s]					
	> 600	60	30	20	10	3.5
3...8	110%	150%	170%	180%	180%	200%
10	103%	140%	155%	165%	165%	180%
12	96%	130%	145%	155%	155%	160%
14	90%	120%	135%	145%	145%	150%
16	82%	110%	125%	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 18: 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 19: 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.

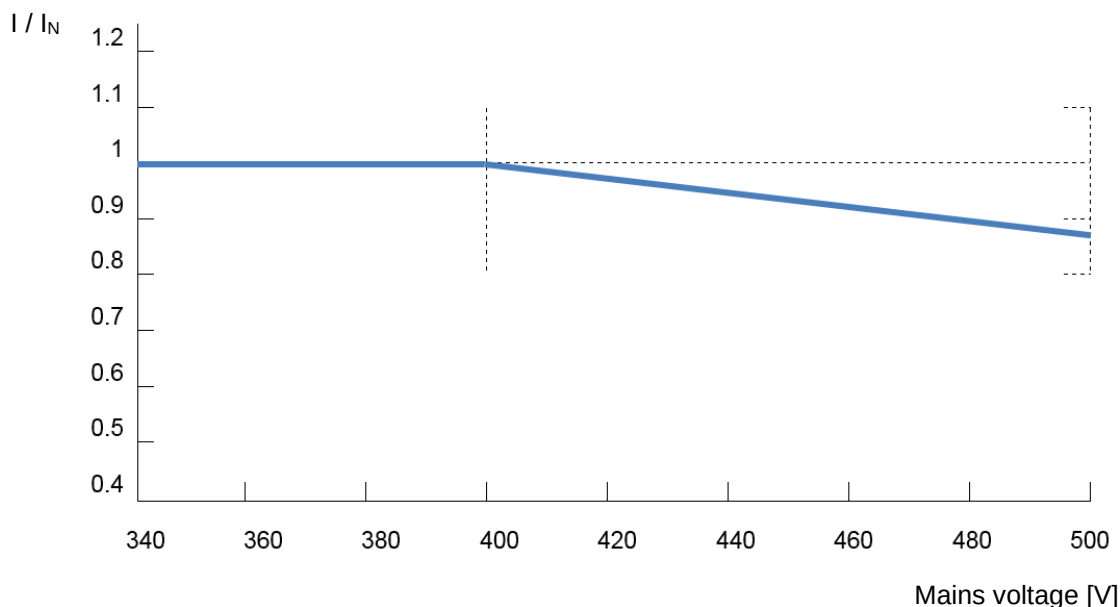


Figure 34: Reduced output current due to low voltage

8.4.5 Reduced output current due to heat sink temperature

The heat sink temperature is included in the output current reduction so that a higher load capacity can be permitted at low heat sink temperatures, especially for higher pulse frequencies. The reduction is increased accordingly for high heat sink temperatures. The ambient temperature and ventilation conditions for the device can thus be utilised more optimally.

8.4.6 Reduced output current due to speed

The size 1 – 3 devices are designed such that the waste heat that occurs can only be given off via the housing in sufficient quantities if the **frequency inverter with motor installation** is also cooled by an air flow. If this air flow is generated by a self-ventilated motor (impeller mounted on the motor shaft), the strength of the air flow then depends on the motor speed. This means that as the motor speed reduces, so does the air flow. Depending on the frequency inverter and the speed that is present, appropriate restrictions in the possible output power (S1 operation) must be taken into consideration.

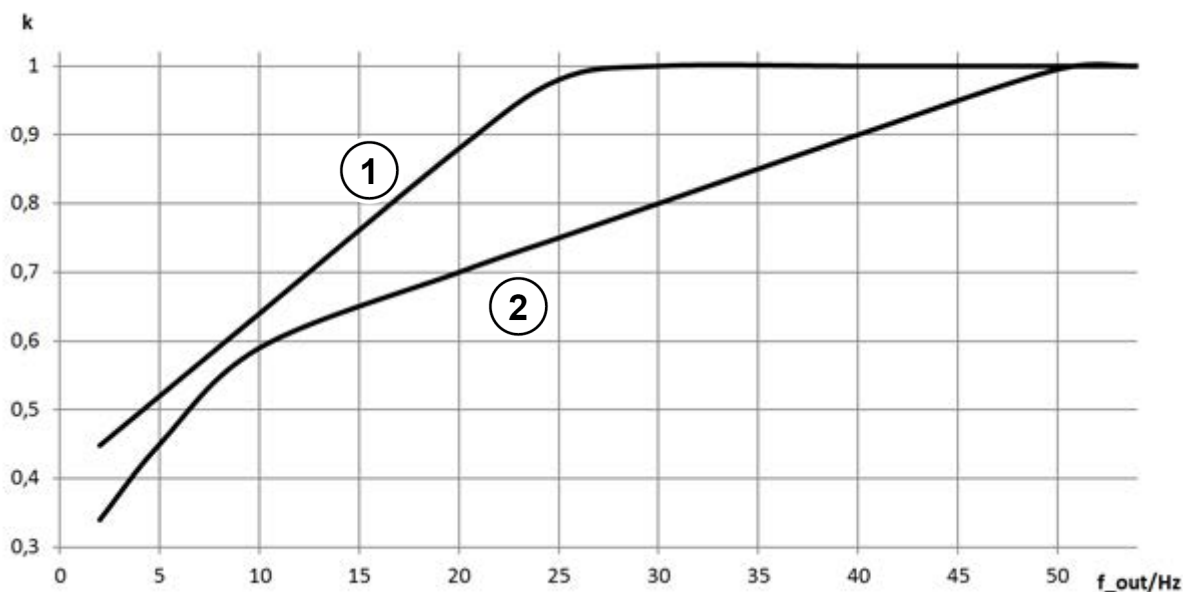
This restriction can be determined on the basis of the following graph. However, it must be taken into consideration that the result that is determined can only be a rough estimate, since various influential factors such as specific frequency inverter / motor combinations cannot also be taken into consideration. More information can be found in the catalogue [G4014](#).

The "k" factor of the following graph must be multiplied by the nominal data of the frequency inverter concerned, and therefore results in the possible continuous current or the possible continuous output in S1 operation.

Example:

SK 200E-401-340A, $I_{nom} = 8.9 \text{ A}$, $f_{out}: 20 \text{ Hz} \rightarrow k=0.7$

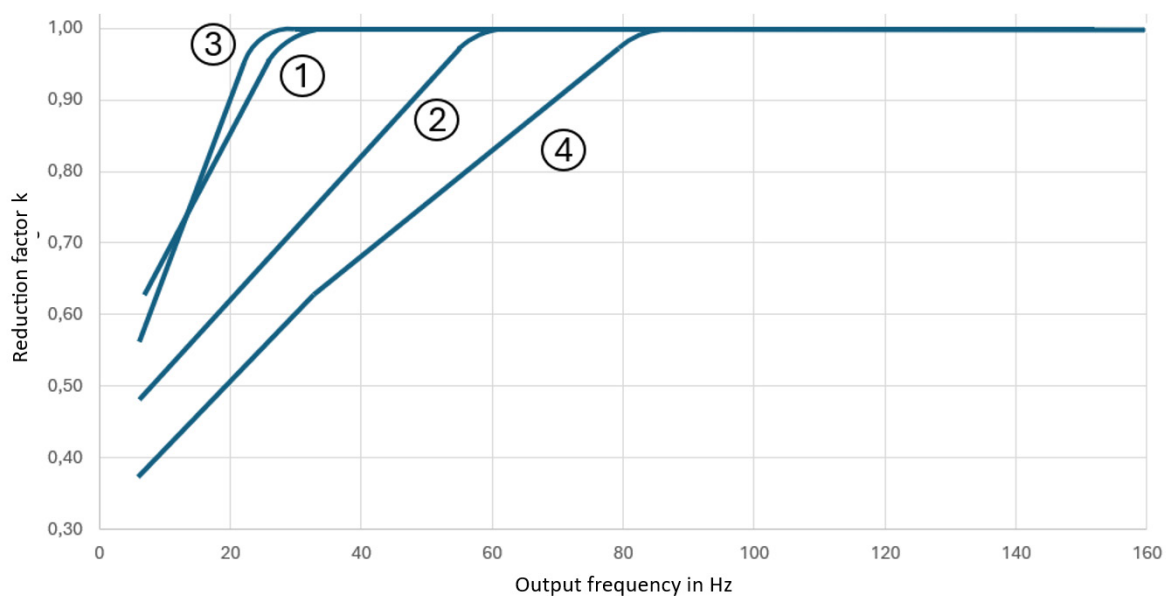
$I = I_{nom} \times k \rightarrow I = 8.9 \text{ A} \times 0.7 = 6.2 \text{ A}$ in S1 operation



- 1 = All device sizes 1 to 3 except the devices from (2)
- 2 = SK 2xxE-111-323-A, SK 2xxE-221-323-A, SK 2xxE-401-323-A,
SK 2xxE-221-340-A, SK 2xxE-401-340-A, SK 2xxE-751-340-A

Figure 35: Derating factor "k" for motor installation (self-ventilated)

Addition for the use of IE5 motors.



- 1 71F3/8 SK200E, size 1
- 2 71F4/8 SK200E, size 1
- 3 90F2/8 SK200E, size 1
- 4 90F4/8 SK200E, size 2

Figure 36: Derating factor “k” for IE5 motors

8.5 Operation on the RCD

When the line filter is activated (standard configuration), the device is **not** suitable for operation on an RCD (30 mA). To enable operation on an RCD, the line filter configuration must be adjusted on the device.

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

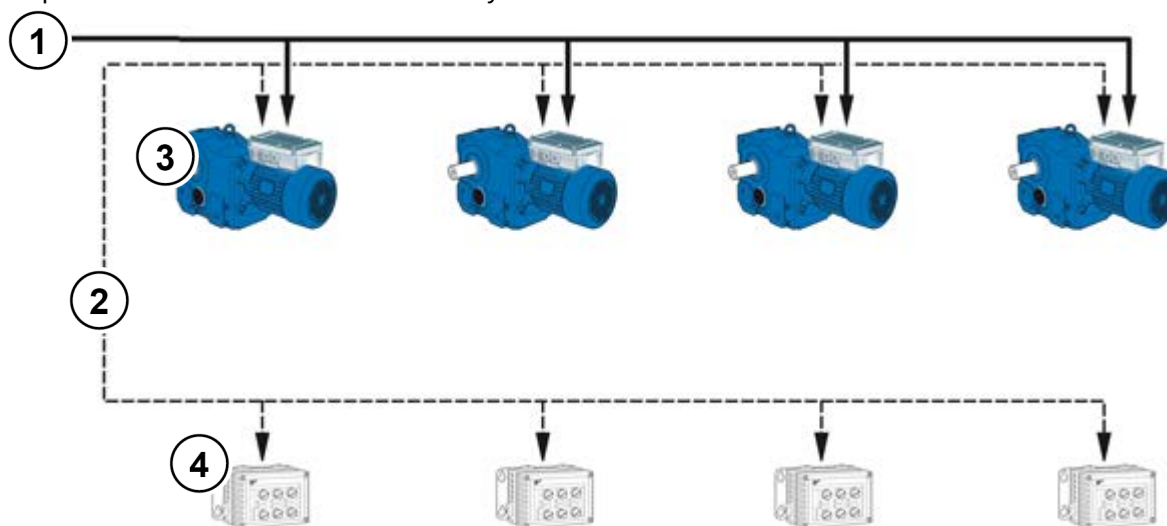
Please also note the information on the leakage currents in the technical data (see chapter 7.1 "General frequency inverter data") and Chapter 2.4.2.1 "Mains supply (L1, L2(/N), L3, PE)".

() See also document [T1800_000000003](#)

8.6 System bus

The device and many of the associated components communicate with each other via the system bus. This bus system is a CAN bus with CANopen protocol. Up to four frequency inverters and their components (field bus module, absolute encoder, I/O modules etc.) can be connected to the system bus. Integration of the components into the system bus does not require any specific knowledge of the bus on the part of the user.

Only the proper physical configuration of the bus system and if necessary the correct addressing of the participants need to be taken into account by the user.



No.	Type
1	Mains connection
2	System bus cable (CAN_H, CAN_L, GND)
3	Frequency inverters
4	Options - Bus modules - IO Extensions - CANopen rotary encoder

Terminal	Meaning
77	System bus+ (CAN_H)
78	System bus- (CAN_L)
40	GND (Reference potential)
Terminal numbers may differ (depending on the device)	

Information

Communication interference

To minimise the risk of communication interference, the **GND –potentials** (Terminal 40) of all GNDs which are linked via the system bus GND **must be connected together**. The shield of the bus cable must also be connected to PE at both ends.

Information

Communication on the system bus

Communication on the system bus does not take place until an expansion module is connected to it or if the master in a master/slave system is parameterised to **P503=3** and the slave to **P503=2**. This is particularly important if several frequency inverters connected to the system bus in parallel are to be read out using the NORDCON parameterisation software.

Physical structure

Standard	CAN
Physical design	2x2, twisted pair, shielded, stranded wires, wire cross-section $\geq 0.25 \text{ mm}^2$ (AWG23), surge impedance approx. 120Ω
Bus length	max. 20 m total expansion (network), max. 20 m between 2 subscribers,
Structure	preferably linear
Spur cables	possible, (max. 6 m)
Termination resistors	120Ω , 250 mW at both ends of a system bus (with FI or SK xU4-... via DIP switches)
Baud rate	250 kBaud - preset

The CAN_H and CAN_L signals must be connected using a twisted pair of wires. The GND potentials are connected using the second pair of wires.



Addressing

If several frequency inverters are connected to a system bus, these devices must be assigned with unique addresses. This should preferably take place via the DIP switch S1 at the device (see chapter 4.3.2.2 "DIP switches (S1)").

For field bus modules, no assignment of addresses is necessary. The module identifies all the frequency inverters automatically. Access to the individual inverters takes place via the field bus master (PLC). Details of how this is carried out are explained in the relevant bus instructions or data sheets for the individual modules.

I/O extensions must be assigned to the relevant frequency inverter. This is carried out by means of a DIP switch on the I/O module. A special case for the I/O extensions is the "Broadcast" mode. In this mode, the data of the I/O extension (analogue values, inputs etc.) are sent to all inverters simultaneously. Via the parameterisation in each individual frequency inverter, a decision is made as to which of the received values are to be used. More information about the settings can be found in the Data sheets for the relevant modules.



Information

Addressing

Care must be taken that each address is only assigned once. In a CAN-based network double assignment of addresses may lead to misinterpretation of the data and therefore undefined activities in the system.

Integration of devices from other manufacturers

In principle, the integration of other devices into this bus system is possible. These must support the CANopen protocol and a 250 kBaud baud rate. The address range (Node ID) 1 to 4 is reserved for additional CANopen masters. All other participants must be assigned addresses between 50 and 79.

Example of frequency inverter addressing

Frequency inverter	Addressing via DIP switch S1		Resulting Node ID Frequency inverters	Node ID AG
	DIP2	DIP1		
FI 1	OFF	OFF	32	33
FI 2	OFF	ON	34	35
FI 3	ON	OFF	36	37
FI 4	ON	ON	38	39



Information

CANopen absolute encoders

In applications with CANopen absolute encoders, the encoders must be assigned to the relevant FI via the node ID. If there is one encoder and four frequency inverters in the system bus, for example, and the encoder is to work together with FI3, the encoder must be set to a node ID of 37, see table above **Node ID AG**

8.7 Energy efficiency optimisation when operating ASMs

⚠ WARNING

Unexpected movement due to overload

Overloading the drive carries the risk of the motor “breaking down” (sudden loss of torque). An overload may be caused by inadequate dimensioning of the drive or by the occurrence of sudden load peaks, for example. Sudden load peaks may be of mechanical origin (e.g. blockage) or caused by extremely steep acceleration ramps (**P102**, **P103**, **P426**).

Depending on the type of application, a “breakdown” of the motor may cause unexpected movement (e.g. dropping of loads with lifting equipment).

To avoid this risk, the following must be observed:

- For lifting gear applications or applications with frequent large load changes, parameter **P219** must remain in the factory setting (100%).
- Do not undersize the drive, provide adequate overload reserves.
- If necessary, provide protection against falling (e.g. for lifting equipment) or comparable 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 $\cos \varphi$ 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))

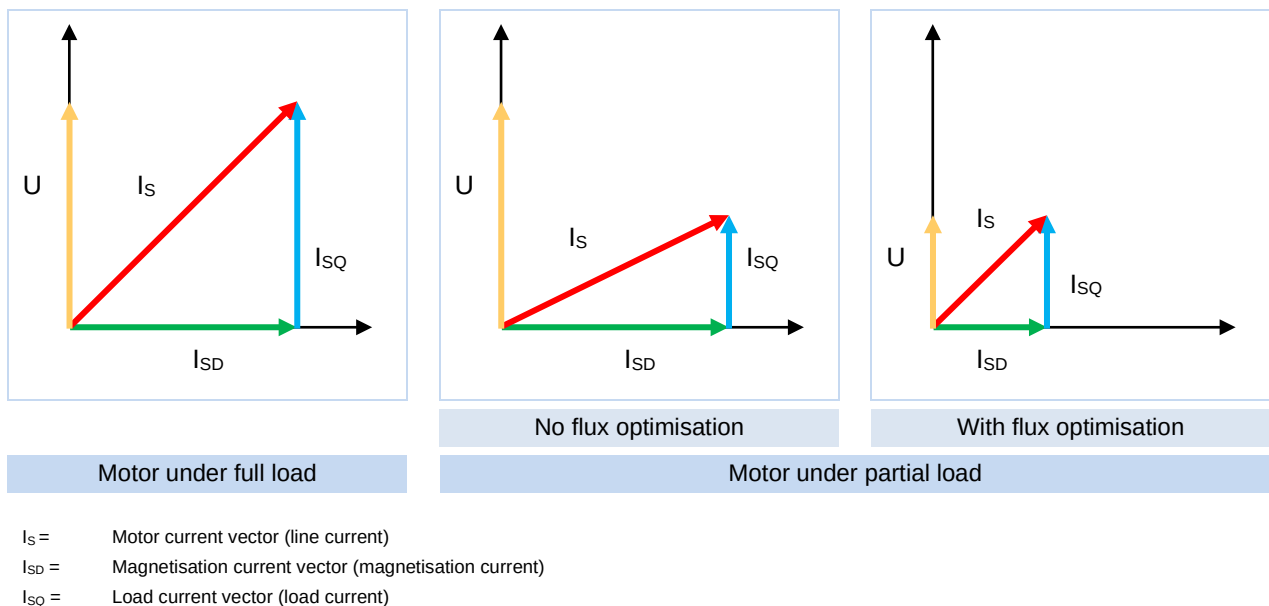


Figure 37: Energy efficiency due to automatic flux optimisation

8.8 Motor data – characteristic curves (Asynchronous motors)

The possible characteristic curves with which the motors can be operated are explained in the following. For operation with the 50 Hz or 87 Hz characteristic curve, the name plate data of the motor is relevant (📖 Section 4.1 "Factory settings"). For operation with a 100 Hz characteristic curve, the use of specially calculated motor data is required (📖 Section 8.8.3 "100 Hz characteristic curve (only 400 V devices)").

8.8.1 50 Hz characteristic curve

(→ Adjustment range 1:10)

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

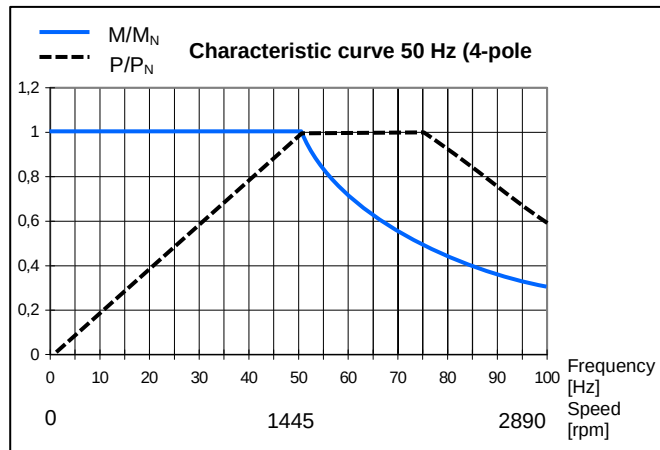


Figure 38: Characteristic curve 50 Hz



Information

Compare motor data with specifications on the name plate.

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

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

115 V / 230 V – frequency inverter

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

The following data refers to a 230 V/400 V winding of the motor. It applies to IE1 and IE2 motors. Please note that these specifications may vary slightly, as the motors are subject to certain manufacturing tolerances. It is recommended to have the resistance of the connected motor calibrated by the frequency inverter (**P208 / P220**).

Motor (IE1) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [min ⁻¹]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

71S/4	250-x23- ²⁾	1,73	50	1365	1,3	230	0,25	0,79	Δ	39,9
71L/4	370-x23- ²⁾	2,56	50	1380	1,89	230	0,37	0,71	Δ	22,85
80S/4	550-x23- ²⁾	3,82	50	1385	2,62	230	0,55	0,75	Δ	15,79
80L/4	750-x23- ²⁾	5,21	50	1395	3,52	230	0,75	0,75	Δ	10,49
90S/4	111-x23-	7,53	50	1410	4,78	230	1,1	0,76	Δ	6,41
90L/4	151-323-	10,3	50	1390	6,11	230	1,5	0,78	Δ	3,99
100L/4	221-323-	14,6	50	1415	8,65	230	2,2	0,78	Δ	2,78
100LA/4	301-323-	20,2	50	1415	11,76	230	3,0	0,78	Δ	1,71
112M/4	401-323-	26,4	50	1430	14,2	230	4,0	0,83	Δ	1,11
132S/4	551-323-	36,5	50	1450	20,0	230	5,5	0,8	Δ	0,72
132M/4	751-323-	49,6	50	1450	26,8	230	7,5	0,79	Δ	0,46
132MA/4	112-323-	60,6	50	1455	32,6	230	9,2	0,829	Δ	0,39

1) At the rating point

2) The same data applies when using the 115 V variant of the SK 2xxE.

Motor (IE2) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [rpm]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

80SH/4	550-x23- ²⁾	3,73	50	1415	2,39	230	0,55	0,7	Δ	9,34
80LH/4	750-x23- ²⁾	5,06	50	1410	3,12	230	0,75	0,75	Δ	6,30
90SH/4	111-x23-	7,32	50	1430	4,26	230	1,1	0,8	Δ	4,96
90LH/4	151-323-	10,1	50	1420	5,85	230	1,5	0,79	Δ	3,27
100LH/4	221-323-	14,5	50	1445	8,25	230	2,2	0,79	Δ	1,73
100AH/4	301-323-	20,3	50	1420	11,1	230	3,0	0,77	Δ	1,48
112MH/4	401-323-	26,6	50	1440	14,1	230	4,0	0,83	Δ	1,00
132SH/4	551-323-	36,6	50	1455	18,8	230	5,5	0,83	Δ	0,60
132MH/4	751-323-	49,1	50	1455	26,2	230	7,5	0,8	Δ	0,42
160MH/4	112-323-	71,7	50	1465	35,5	230	11,0	0,85	Δ	0,26

1) At the rating point

2) The same data applies when using the 115 V variant of the SK 2xxE.

400 V frequency inverter

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

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

Motor (IE1) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [min ⁻¹]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

80S/4	550-340-	3,82	50	1385	1,51	400	0,55	0,75	Y	15,79
80L/4	750-340-	5,21	50	1395	2,03	400	0,75	0,75	Y	10,49
90S/4	111-340-	7,53	50	1410	2,76	400	1,1	0,76	Y	6,41
90L/4	151-340-	10,3	50	1390	3,53	400	1,5	0,78	Y	3,99
100L/4	221-340-	14,6	50	1415	5,0	400	2,2	0,78	Y	2,78
100LA/4	301-340-	20,2	50	1415	6,8	400	3,0	0,78	Δ	5,12
112M/4	401-340-	26,4	50	1430	8,24	400	4,0	0,83	Δ	3,47
132S/4	551-340-	36,5	50	1450	11,6	400	5,5	0,8	Δ	2,14
132M/4	751-340-	49,6	50	1450	15,5	400	7,5	0,79	Δ	1,42
160M/4	112-340-	72,2	50	1455	20,9	400	11,0	0,85	Δ	1,08
160L/4	152-340-	98,1	50	1460	28,2	400	15,0	0,85	Δ	0,66
180MX/4	182-340-	122	50	1460	35,4	400	18,5	0,83	Δ	0,46
180LX/4	222-340-	145	50	1460	42,6	400	22,0	0,82	Δ	0,35

1) At the rating point

Motor (IE2) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [rpm]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

80SH/4	550-340-	3,82	50	1415	1,38	400	0,55	0,7	Y	9,34
80LH/4	750-340-	5,21	50	1410	1,8	400	0,75	0,75	Y	6,30
90SH/4	111-340-	7,53	50	1430	2,46	400	1,1	0,8	Y	4,96
90LH/4	151-340-	10,3	50	1420	3,38	400	1,5	0,79	Y	3,27
100LH/4	221-340-	14,6	50	1445	4,76	400	2,2	0,79	Y	1,73
100AH/4	301-340-	20,2	50	1420	6,4	400	3,0	0,77	Δ	4,39
112MH/4	401-340-	26,4	50	1440	8,12	400	4,0	0,83	Δ	2,96
132SH/4	551-340-	36,5	50	1455	10,82	400	5,5	0,83	Δ	1,84
132MH/4	751-340-	49,6	50	1455	15,08	400	7,5	0,8	Δ	1,29
160MH/4	112-340-	72,2	50	1465	20,5	400	11,0	0,85	Δ	0,78
160LH/4	152-340-	98,1	50	1465	27,5	400	15,0	0,87	Δ	0,53
180MH/4	182-340-	122	50	1475	34,9	400	18,5	0,84	Δ	0,36
180LH/4	222-340-	145	50	1475	40,8	400	22,0	0,86	Δ	0,31

1) At the rating point

8.8.2 87 Hz characteristic curve (only 400V devices)

(→ Variation 01:17)

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

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

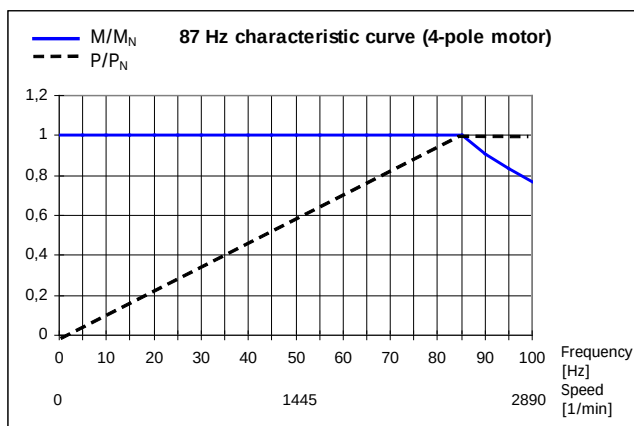


Figure 39: 87 Hz characteristic curve

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



Information

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

Motor (IE1) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [min-1]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
71S/4	550-340-	1,73	50	1365	1,3	230	0,25	0,79	Δ	39,9
71L/4	750-340-	2,56	50	1380	1,89	230	0,37	0,71	Δ	22,85
80S/4	111-340-	3,82	50	1385	2,62	230	0,55	0,75	Δ	15,79
80L/4	151-340-	5,21	50	1395	3,52	230	0,75	0,75	Δ	10,49
90S/4	221-340-	7,53	50	1410	4,78	230	1,1	0,76	Δ	6,41
90L/4	301-340-	10,3	50	1390	6,11	230	1,5	0,78	Δ	3,99
100L/4	401-340-	14,6	50	1415	8,65	230	2,2	0,78	Δ	2,78
100LA/4	551-340-	20,2	50	1415	11,76	230	3,0	0,78	Δ	1,71
112M/4	751-340-	26,4	50	1430	14,2	230	4,0	0,83	Δ	1,11
132S/4	112-340-	36,5	50	1450	20,0	230	5,5	0,8	Δ	0,72
132M/4	152-340-	49,6	50	1450	26,8	230	7,5	0,79	Δ	0,46
132MA/4	182-340-	60,6	50	1455	32,6	230	9,2	0,829	Δ	0,39
160MA/4	222-340-	72,2	50	1455	37	230	11	0,85	Δ	0,36

1) At the rating point

Motor (IE2) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [rpm]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

80SH/4	111-340-	3,73	50	1415	2,39	230	0,55	0,7	Δ	9,34
80LH/4	151-340-	5,06	50	1410	3,12	230	0,75	0,75	Δ	6,30
90SH/4	221-340-	7,32	50	1430	4,26	230	1,1	0,8	Δ	4,96
90LH/4	301-340-	10,1	50	1420	5,85	230	1,5	0,79	Δ	3,27
100LH/4	401-340-	14,5	50	1445	8,25	230	2,2	0,79	Δ	1,73
100AH/4	551-340-	20,3	50	1420	11,1	230	3,0	0,77	Δ	1,48
112MH/4	751-340-	26,6	50	1440	14,1	230	4,0	0,83	Δ	1,00
132SH/4	112-340-	36,6	50	1455	18,8	230	5,5	0,83	Δ	0,60
132MH/4	152-340-	49,1	50	1455	26,2	230	7,5	0,8	Δ	0,42
160MH/4	182-340-	71,7	50	1465	35,5	230	11,0	0,85	Δ	0,26
160LH/4	222-340-	97,8	50	1465	46,0	230	15,0	0,87	Δ	0,17

1) At the rating point

Motor (IE3) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [min ⁻¹]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]

Notice: A comma counts as a full stop and signifies a decimal place.

63 SP/4	550-340-	0,84	50	1370	0,68	230	0,12	0,66	Δ	66,7
63 LP/4	550-340-	1,24	50	1385	1,02	230	0,18	0,62	Δ	39,7
71 SP/4	550-340-	1,69	50	1415	1,21	230	0,25	0,71	Δ	24,0
71 LP/4	750-340-	2,51	50	1405	1,58	230	0,37	0,76	Δ	17,7
80 SP/4	111-340-	3,70	50	1420	2,23	230	0,55	0,75	Δ	10,4
80 LP/4	151-340-	5,06	50	1415	3,10	230	0,75	0,72	Δ	6,50
90 SP/4	221-340-	7,35	50	1430	4,12	230	1,1	0,78	Δ	4,16
90 LP/4	301-340-	10,1	50	1415	5,59	230	1,5	0,79	Δ	3,15
100 LP/4 ²⁾	401-340-	14,4	50	1460	8,13	230	2,2	0,76	Δ	1,77
100 AP/4 ²⁾	551-340-	19,8	50	1450	10,9	230	3,0	0,8	Δ	1,29
112 MP/4	751-340-	26,5	50	1440	13,6	230	4,0	0,83	Δ	0,91
132 SP/4	112-340- ³⁾	35,8	50	1465	18,9	230	5,5	0,8	Δ	0,503
132 MP/4	152-340- ³⁾	49,0	50	1460	27,3	230	7,5	0,77	Δ	0,381
160 SP/4	182-340- ³⁾	59,8	50	1470	29,0	230	9,2	0,88	Δ	0,295
160 MP/4	182-340- ³⁾	71,7	50	1465	35,5	230	11,0	0,85	Δ	0,262

1) At the rating point

2) APAB series

3) SK 2x0E only

8.8.3 100 Hz characteristic curve (only 400 V devices)

(→ adjustment range 1:20)

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

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

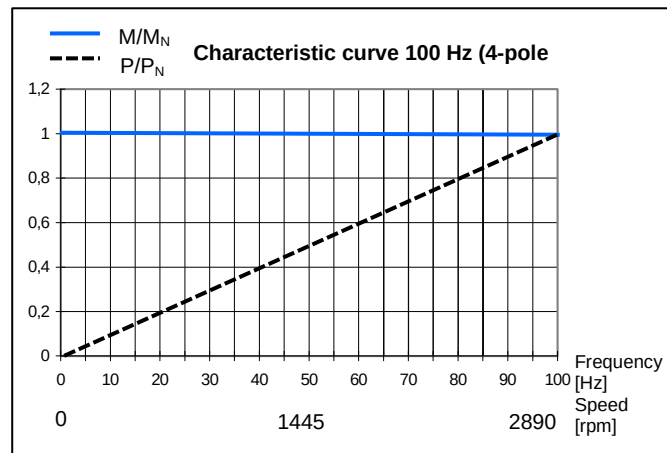


Figure 40: Characteristic curve 100 Hz

Information

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

Motor (IE1) SK ...	Frequency inverter SK 2xxE-...	$M_N^{1)}$ [Nm]	Motor data for parameterisation							
			F_N [Hz]	n_N [min ⁻¹]	I_N [A]	U_N [V]	P_N [kW]	$\cos \varphi$	Δ	R_{St} [Ω]
63S/4	250-340-	0,90	100	2880	0,95	400	0,25	0,63	Δ	47,37
63L/4	370-340-	1,23	100	2895	1,07	400	0,37	0,71	Δ	39,90
71L/4	550-340-	1,81	100	2900	1,59	400	0,55	0,72	Δ	22,85
80S/4	750-340-	2,46	100	2910	2,0	400	0,75	0,72	Δ	15,79
80L/4	111-340-	3,61	100	2910	2,8	400	1,1	0,74	Δ	10,49
90S/4	151-340-	4,90	100	2925	3,75	400	1,5	0,76	Δ	6,41
90L/4	221-340-	7,19	100	2920	4,96	400	2,2	0,82	Δ	3,99
100L/4	301-340-	9,78	100	2930	6,95	400	3,0	0,78	Δ	2,78
100LA/4	401-340-	12,95	100	2950	7,46	400	4,0	0,76	Δ	1,71
112M/4	551-340-	17,83	100	2945	11,3	400	5,5	0,82	Δ	1,11
132S/4	751-340-	24,24	100	2955	16,0	400	7,5	0,82	Δ	0,72
132MA/4	112-340-	35,49	100	2960	23,0	400	11,0	0,80	Δ	0,39

Notice: A comma counts as a full stop and signifies a decimal place.

1) At the rating point

Motor (IE2) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [rpm]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
80SH/4	750-340-	2,44	100	2930	1,9	400	0,75	0,7	Δ	9,34
80LH/4	111-340-	3,60	100	2920	2,56	400	1,1	0,73	Δ	6,3
90SH/4	151-340-	4,89	100	2930	3,53	400	1,5	0,79	Δ	4,96
90LH/4	221-340-	7,18	100	2925	4,98	400	2,2	0,79	Δ	3,27
100LH/4	301-340-	9,69	100	2955	6,47	400	3,0	0,78	Δ	1,73
100AH/4	401-340-	13,0	100	2940	8,24	400	4,0	0,79	Δ	1,48
112MH/4	551-340-	17,8	100	2950	11,13	400	5,5	0,82	Δ	1,0
132SH/4	751-340-	24,2	100	2960	15,3	400	7,5	0,83	Δ	0,6
132MH/4	112-340-	29,6	100	2965	19,5	400	9,2	0,79	Δ	0,42
160MH/4	152-340-	48,3	100	2967	29,0	400	15,0	0,87	Δ	0,256
160LH/4	182-340-	59,4	100	2975	35,7	400	18,5	0,86	Δ	0,168
180MH/4	222-340-	70,5	100	2980	43,2	400	22	0,85	Δ	0,115

1) At the rating point

Motor (IE3) SK ...	Frequency inverter SK 2xxE-...	M _N ¹⁾ [Nm]	Motor data for parameterisation							
			F _N [Hz]	n _N [min-1]	I _N [A]	U _N [V]	P _N [kW]	cos φ	Y/Δ	R _{St} [Ω]
Notice: A comma counts as a full stop and signifies a decimal place.										
63 SP/4	550-340-	0,59	100	2885	0,58	400	0,18	0,61	Δ	66,7
63 LP/4	550-340-	0,82	100	2910	0,83	400	0,25	0,56	Δ	39,7
71 SP/4	550-340-	1,20	100	2920	1,01	400	0,37	0,69	Δ	24,0
71 LP/4	550-340-	1,79	100	2925	1,34	400	0,55	0,72	Δ	17,7
80 SP/4	750-340-	2,44	100	2935	1,77	400	0,75	0,73	Δ	10,4
80 LP/4	111-340-	3,58	100	2930	2,13	400	1,1	0,84	Δ	6,50
90 SP/4	151-340-	4,86	100	2945	3,1	400	1,5	0,79	Δ	4,16
90 LP/4	221-340-	7,17	100	2930	4,33	400	2,2	0,83	Δ	3,15
100 LP/4 ²⁾	301-340-	9,65	100	2970	5,79	400	3,0	0,82	Δ	1,77
100 AP/4 ²⁾	401-340-	12,9	100	2960	7,52	400	4	0,85	Δ	1,29
112 MP/4	551-340-	17,8	100	2950	10,3	400	5,5	0,85	Δ	0,91
132 SP/4	751-340-	24,1	100	2970	14,3	400	7,5	0,83	Δ	0,503
132 MP/4	112-340- ³⁾	29,6	100	2970	18	400	9,2	0,82	Δ	0,381
160 SP/4	112-340- ³⁾	35,3	100	2975	21	400	11	0,85	Δ	0,295
160 MP/4	152-340- ³⁾	48,2	100	2970	27,5	400	15	0,86	Δ	0,262
160 LP/4	182-340- ³⁾	59,4	100	2975	34,4	400	18,5	0,85	Δ	0,169
180 MP/4	222-340- ³⁾	70,4	100	2985	40,6	400	22	0,85	Δ	0,101

1) At the rating point

2) APAB series

3) SK 2x0E only

8.9 Motor data – characteristic curves (synchronous motors)

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

For the assignments of the motors to a frequency inverter, refer to  [B5000](#).

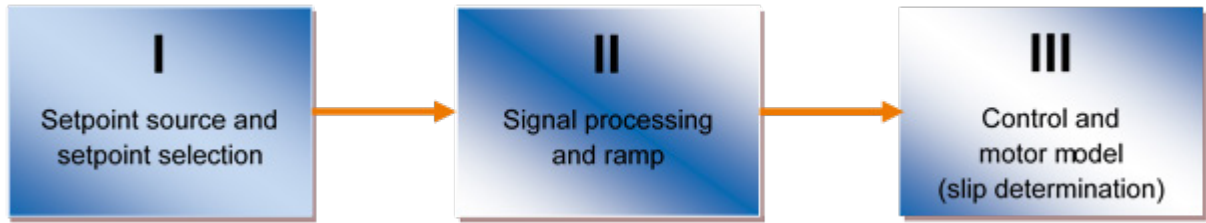
8.10 Scaling of set-/actual values

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

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

8.11 Definition of set and actual value processing (frequencies)

The frequencies used in P502 / P543 are processed in various ways according to the following table.



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

Table 20: Set and actual value processing in the frequency inverter

8.12 Motor temperature monitoring

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

The following options are available.

1. Measurement of the motor temperature with a temperature sensor

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

a. Threshold value monitoring by PTC resistor

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

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

The temperature sensor is connected to an analogue input of the frequency inverter that has been parameterised accordingly. In this case, too, the drive is switched off when a defined temperature is reached.

In addition, the measurement values recorded are also used to optimise the motor control.

Details: See Chapter 4.4 "Temperature sensors"

2. Sensorless motor temperature monitoring

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

From firmware version V 3.0 R0 and higher, the approximate motor start temperature is determined by measuring the stator resistance. The time of the measurement can be configured and is defined via parameter P336 "Mode Rotorpos ident".

For older firmware versions, the approximate motor start temperature was assumed through a defined value, which affected the accuracy of the temperature monitoring.

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

9 Maintenance and servicing information

9.1 Maintenance information

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

Dusty environments

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

Long-term storage



Information

Climatic conditions for long-term storage

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

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

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



Information

Control voltage with SK 2x5E

With devices of type SK 2x5E, a 24 V control voltage supply must be provided in order to make the regeneration process possible.



Information

Accessories

The regulations for **long-term storage** apply to the accessories, such as 24 V power supply modules (SK xU4-24V-..., SK TU4-POT-...), and the electronic brake inverter (SK CU4-MBR) likewise.

9.2 Service notes

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

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

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

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

- Remove all non-original parts from the device.

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

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

Information

Factory settings of parameters

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

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

9.3 Disposal

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

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

9.3.1 Disposal according to German law

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



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

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

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

- Contact: info@nord.com

9.3.2 Disposal outside of Germany

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

9.4 Abbreviations

AIN	Analogue input	FI (switch)	Leakage current circuit breaker
AS-i (AS1)	AS Interface	FI	Frequency inverter
ASi (LED)	Status LED – AS interface	I/O	In / Out (Input / Output)
ASM	Asynchronous machine, asynchronous motor	ISD	Field current (Current vector control)
AOUT	Analogue output	LED	Light-emitting diode
AUX	Auxiliary (voltage)	LPS	List of planned slaves (AS-I)
BR	Braking resistor	P1 ...	Potentiometer 1 ...
DI (DIN)	Digital input	PMSM	Permanent magnet synchronous machine / -motor
DigIn		PLC / SPS	Programmable Logical Controller
DS (LED)	Status LED – device status	PELV	Safety low voltage
CFC	Current Flux Control (current-controlled, field-oriented control)	S	Supervisor Parameter, P003
DO (DOUT)	Digital output	S1...	DIP switch 1 ...
DigOut		SW	Software version, P707
I / O	Input /Output	TI	Technical information / Data sheet (Data sheet for NORD accessories)
EEPROM	Non-volatile memory	VFC	Current Flux Control (current-controlled, field-oriented control)
EMKF	Electromotive force (induction voltage)		
EMC	Electromagnetic compatibility		

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