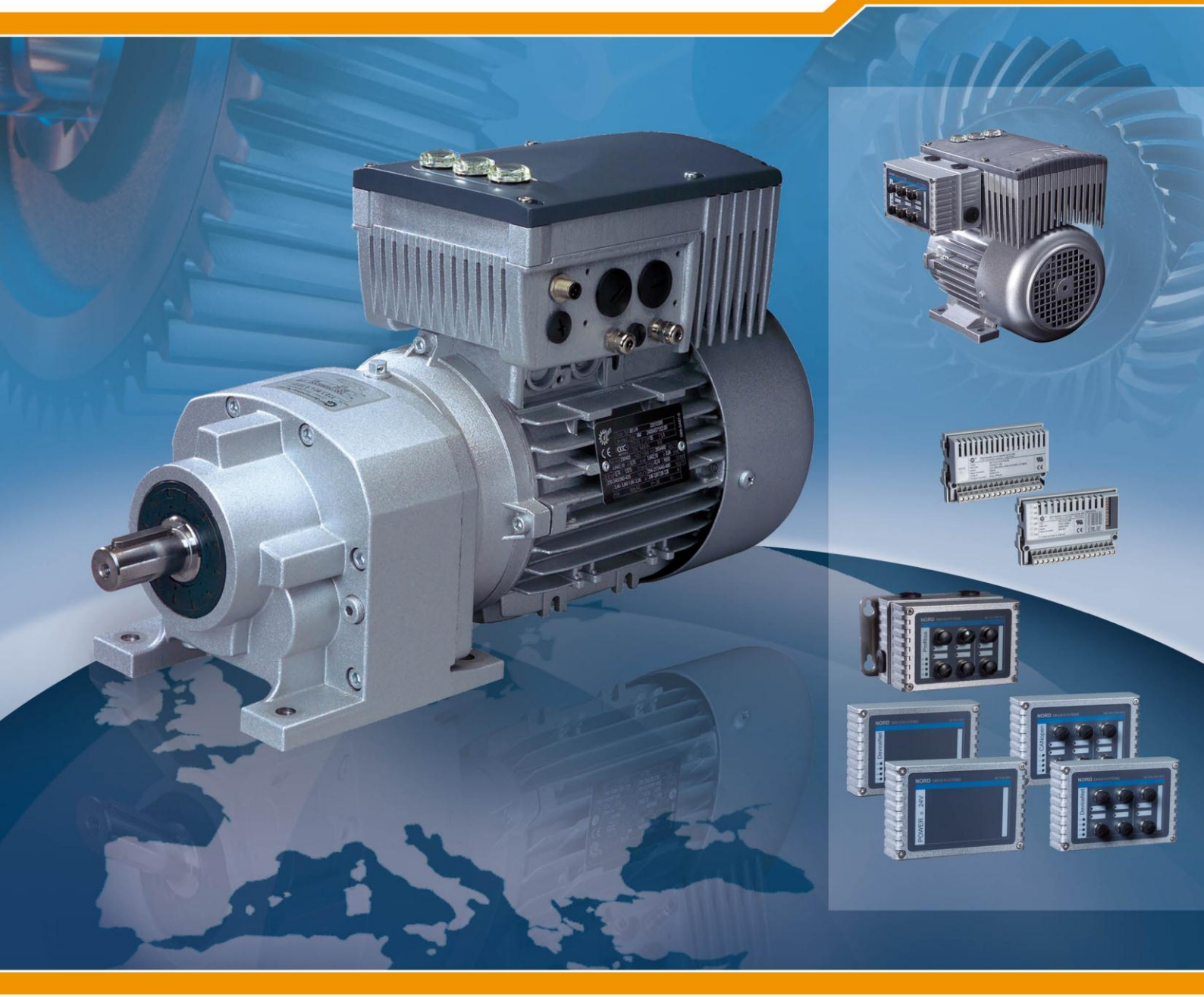
Intelligent Drivesystems, Worldwide Services



GB

BU 0290

PROFINET® bus module
for NORD frequency inverter SK 200E

NORD DRIVESYSTEMS

N O R D Frequency inverters

Safety and operating instructions for drive power converters

(as per: Low Voltage Directive 2006/95/EEC)

1. General

During operation, drive power converters may, depending on their protection class, have live, bare, moving or rotating parts or hot surfaces.

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

Further information can be found in this documentation.

All transportation, installation, initialisation and maintenance work must be carried out by **qualified personnel** (compliant with IEC 364, CENELEC HD 384, DIN VDE 0100, IEC 664 or DIN VDE 0110, and national accident prevention regulations).

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

2. Proper use in Europe

Drive power converters are components intended for installation in electrical systems or machines.

When installed in machines, the drive power converter cannot be commissioned (i.e. commencement of the proper use) until it has been ensured that the machine meets the provisions of the EC Directive 2006/42/EEC (machine directive); EN 60204 must also be complied with.

Commissioning (i.e. implementation of the proper use) is only permitted when the EMC directive (2004/108/EEC) is complied with.

Drive power converters with the CE mark meet the requirements of the Low Voltage Directive 2006/95/EEC. The harmonized standards stated in the Declaration of Conformity are used for the drive power converters.

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

The drive power converters may only be used for the safety functions which are described and for which they have been explicitly approved.

3. Transport, storage

Information regarding transport, storage and correct handling must be complied with.

4. Installation

The installation and cooling of the equipment must be implemented according to the regulations in the corresponding documentation.

The drive power converters must be protected against impermissible loads. Especially during transport and handling, components must not be deformed and/or insulation distances must not be changed. Touching of electronic components and contacts must be avoided.

Drive power converters have electrostatically sensitive components, which can be easily damaged by incorrect handling. Electrical components must not be mechanically damaged or destroyed (this may cause a health hazard!).

5. Electrical connections

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

The electrical installation must be implemented according to the applicable regulations (e.g. cable cross-section, fuses, ground lead connections). Further information is contained in the documentation.

Information about EMC-compliant installation – such as shielding, earthing, location of filters and installation of cables can be found in the drive power converter documentation. These instructions must be complied with even with CE marked drive power converters. Compliance with the limiting values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Where necessary, systems where drive power converters 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.

The parameterisation and configuration of the drive power converter must be selected so that no hazards can occur.

All covers must be kept closed during operation.

7. Maintenance and repairs

After the drive power converter is disconnected from the power supply, live equipment components and power connections should not be touched immediately, because of possible charged capacitors. Observe the relevant information signs located on the drive power converter.

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

Documentation

Designation:	BU 0290 GB
Part No.:	607 29 01
Device series:	PROFINET IO for SK 200E
Device types:	**SK TU4-PNT(-C)** with SK TI4-TU BUS

Version list

Designation of previous issues	Software Version	Remarks
BU 0290 GB, October 2012 Part No. 607 2902 / 4312	V 1.1 R0	First issue

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Intended use of the frequency inverter

Compliance with the operating instructions is **essential for fault-free operation** and the acceptance of any warranty claims. **These operating instructions must be read** before working with the device!

These operating instructions contain **important information about servicing.** They must therefore **be kept close to the** device.

The field bus technology options described here are intended for use in combination with SK 200 E series frequency inverters. Use of SK TU4-EPNT(-C) technology units is also possible with the SK 500E series. The use of these technology options with other devices is not permitted and can lead to their destruction.

The field bus technology options and the associated frequency inverters are devices for fixed installation on motors or in equipment close to the motor to be operated. All details regarding technical data and permissible conditions at the installation site must be complied with.

Commissioning (commencement of the intended use) is not permitted until it has been ensured that the machine complies with the EMC Directive 2004/108/EEC and that the conformity of the end product meets the Machinery Directive 2006/42/EEC (observe EN 60204).

NOTE

This supplementary operating manual is only valid in conjunction with the operating manual supplied for the respective frequency inverter (Manual BU0200).

1 General

Modern field bus systems, microcontrollers and communication networks have had a great influence on automation systems and have resulted in greater flexibility, availability and ultimately, also a reduction in costs.

The widespread use of PC-based control only became possible with the availability of field bus systems. With increasing control unit performance, the classic field bus ultimately became the limiting criterion for the entire system. It was therefore an obvious step to adapt Ethernet technology, which provides high rates of data transmission in IT applications, to the field of automation.

1.1 The bus system

As a physical transfer medium, PROFINET® transfers many years of experience with PROFIBUS-DP-V1 to Fast Ethernet. In addition to the conventional open Ethernet communication TCP/IP it enables real time communication of process data. PROFINET defines three communication classes, which provide different levels of efficiency and functionality:

- TCP/IP or UDP/IP communication without real time capability
- Real time communication for process data (>1ms) →RT
- Isochronous real time communication for synchronised process data → IRT

Features of the SK TU4-PNT(-C)

- PROFINET IO real time communication (RT=Real Time and IRT=Isochronous Real Time)
- Automatic address assignment via the IO controller using DCP (discovery configuration protocol)
- Switched Ethernet
- Autonegotiation (negotiation of transfer parameters)
- Autocrossover (Transmission and reception cables crossed over in the switch)
- Conforms with Class B, C
- PROFINET IO bus cable connection via RJ45 plug - connector
- Connection of I/Os and system bus via screw terminals and optionally via M12 round connectors
- Display of specific PROFINET IO status with 2 LEDs
- Specific DEVICE or FI status display with 2 LEDs
- Eight integrated 24V inputs and two 24V outputs
- Available as a version in a separate housing (optionally IP55 / IP66)
- An interface (RS232/RS485) via an integrated RJ12 socket is available for parameter access by means of the manual control unit SK PAR-3H or via NORDCON software.

Performance

- Electrically isolated bus interface $500V_{eff}$
- 100Mbit/s data communication
- Full duplex transmission
- Transmission of a maximum of five setpoints or actual values to the frequency inverter
- Cyclic parameterisation (PPO 1 + 2) or acyclic parameterisation (Records)
- PROFINET Bus Gateway solution → up to 4 frequency inverters can be connected to a PROFINET bus module
- Almost unlimited participants in the PROFINET system possible (limited by the controller)

1.2 Delivery

Check the equipment **immediately** after delivery/unpacking for transport damage such as deformation or loose parts.

If there is any damage, contact the carrier immediately and carry out a thorough assessment.

Important! This also applies even if the packaging is undamaged.

1.3 Scope of supply

Standard version: **SK TU4-PNT(-C)** IP55 **(optionally IP66)**
Operating instructions as PDF file on CD ROM
including NORD CON, (Windows PC-based parameterisation software)

Available accessories: **SK TI4-TU-BUS(-C)** (bus connection unit, required for SK TU4…)
SK TIE4-WMK-TU, wall-mounting kit TU4
M12 round plug connector (Section 8.2 "Cable glands and shielding connections")
Matching **RJ12 to SUB-D9** adapter cable to connection to a PC
ParameterBox: **SK PAR-3H**, plain text LCD display

1.4 Certifications

1.4.1 European EMC Directive

If the NORD frequency inverter or its options are installed according to the recommendations in this instruction manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3. (see also Section 8.1.3 , "Cable layout and shielding (EMC measures)")

1.4.2 RoHS compliance

The bus options described here are designed to be RoHS compliant according to Directive 2002/95/EEC

1.5 Type code / Optional BUS modules

BUS = Bus module or I/O extension

SK TU4-PNT (-C-M12-WMK-TU)

- Wall mounting kit: for external technology units, TU4
- M12 system connectors: only TU4, alternative to terminals (not for PROFINET)
- IP protection class: *Standard* = IP55, C = „coated“ IP66
- Option type: CAO = CANopen, PBR = Profibus, PNT = PROFINET
  DEV = DeviceNet, IOE = I/O-extension
- Option series: TU4 = external Technology Unit
  CU4 = internal customer unit (not for PROFINET)

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

Optional external
technology unit, SK TU4-…(Examples)

1.6 Version with protection class IP55 / IP66

NORD SK 200E frequency inverters and the **external additional modules** are available in all sizes and powers in the protection classes IP55 (standard) or IP66 (optional).

The protection class IP66 must always be stated when ordering!

There are no restrictions or differences to the scope of functions in either protection class. In order to differentiate the protection classes, modules with protection class IP66 are given an extra "-**C**" (**c**oated →coated PCBs) in their type designation.

e.g. SK TU4-PNT-**C**

IP55 version:

The IP55 version of the external technology units is the **standard** version. Both versions (inverter-mounted – as a supplement to the frequency inverter or wall mounted on the wall bracket) are available.

IP66 version:

In contrast to the IP55 version the IP66 version is a modified **option**. With this design, both versions (inverter-mounted or wall-mounted) are also available. The modules available for the IP66 version (adapter units, technology units and customer units) have the same functionalities as the corresponding modules for the IP55 version.

NOTE

The modules for the IP66 design are identified by an additional "-**C**" and are modified according to the following **special measures**!

Special measures:

Impregnated PCBs, coated housing

Diaphragm valve for pressure compensation on temperature changes.

Low pressure test

→ A free M12 screw connection is required for low pressure testing. After successful testing, a diaphragm valve is inserted here. This screw connections is therefore no longer available for a cable gland.

NOTE

For all versions, care must be taken that the cable and the cable gland are carefully matched. This is essential to ensure that the required protection class is maintained.

2 Assembly and installation

2.1 Installation and assembly

Only external technology units (**Technology Units**) are available for PROFINET IO. These are tailored to the NORD SK 200E frequency inverter series.

These are used to connect SK 200E series speed regulated drive units to overriding automation systems via the PROFINET IO field bus.

SK 200E with external technology unit SK TU4-…
and BUS connection module SK TI4-TU-BUS

SK TIE4-WMK-TU with BUS connection module SK TI4-TU-BUS
and external technology unit SK TU4-PNT

The **technology units (Technology Unit, SK TU4-...)** are externally attached to the SK 200E connection unit and are therefore easy to access. Mounting of the SK TU4-... separate from the frequency inverter is possible by means of the wall mounting kit **SK TIE4-WMK-TU**. The electrical connection to the SK 200E is made via the internal system bus. Optionally, 4 or 5 pin M12 round connectors are available (for installation on the BUS connection unit **SK TI4-TU-BUS**), which can be used for connection of the digital I/Os and the system bus cables.

NOTE

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

Mounting of the external technology unit **remote** from the frequency inverter is possible with the additional wall-mounting kit (SK TIE4-WMK-TU). However, a maximum cable length of **30m** should not be exceeded.

The external technology units (SK TU4-...) cannot be operated without the BUS connection unit (SK TI4-TU-BUS)!

NOTE

Only one technology unit (SK CU4-... or SK TU4-...) can be connected to a system bus.

2.1.1 Overview of PROFINET IO modules

Bus Module	Description	Data
PROFINET IO module*) **SK TU4-PNT(-C)** Part No. 275281115 (IP55) Part No. 275281165 (IP66)	 This option enables control of the SK 200E via PROFINET IO. This option is installed externally to the frequency inverter. According to the installation location, at least one "BUS connection unit"* is required.	Supported profile: CoE Baud rate: up to 100 MBaud Connection: 36 pin spring terminal bar of the “BUS connection unit”* 8x Digital inputs: Low: 0-5V, High: 11-30V 2x Digital outputs: 0/24V System bus
Connection unit for TU4 **SK TI4-TU-BUS** Part No. 275280000 (IP55) Part No. 275280500 (IP66)	 The connection unit is always required in order to use an external technology unit (SK TU4-...). This implements the connection of the technology unit to the SK 200E or the wall-mounting kit.	Connection: 36 pin spring terminal bar 36x 2.5mm^2 AWG 26-14 spring terminals
TU4 Wall-mounting kit **SK TIE4-WMK-TU** Part. No. 275274002	 With the wall mounting kit, a technology unit can be used/installed separately from the SK 200E.	
*) in order to use the TU4 modules, a suitable SK TI4-TU-BUS connection unit must always be available!		

Table 1 Overview of PROFINET IO modules

2.1.2 Installing the SK TU4-PNT-... technology unit

WARNING

Installation must be carried out by qualified personnel only, paying particular attention to safety and warning instructions.

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

Mounting of the technology unit **remote** from the frequency inverter is possible with the **additional wall mounting kit** SK TIE4-WMK-TU.

Together with the BUS connection unit SK TI4-TU-BUS(-C) the technology unit SK TU4-PNT-…(-C) forms a stand-alone functional unit. This can be attached to the SK 200E frequency inverter or installed separately by means of the optional SK TIE4-WMK-TU wall-mounting kit.

2.1.2.1 Dimensions of the SK TI4-WMK-TU wall-mounting kit

The optional wall-mounting kit has the following dimensions.

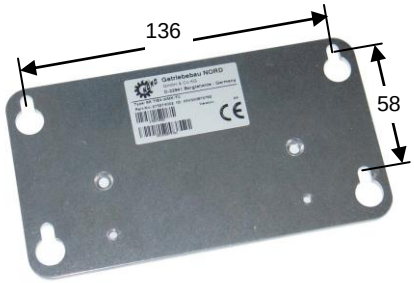


Fig. 1 Wall-mounting kit SK TIE4-WMK-TU, dimensions

2.1.2.2 BUS connection unit SK TI4-TU-BUS(-C)

Various cable glands closed by caps are located on the sides of the BUS connection unit.

The following holes are available as cable inlets:

- 2 x 1 M20 x 1.5 (on sides)
- 4 M16 x 1.5 (underside)
- 2 M25 x 1.5 (rear side, without caps)

External BUS connection unit SK TI4-TU-BUS

The transparent screw-on cover (M20 x 1.5) on the upper right serves as access to the diagnostic interface (RJ12 socket, interface RS232/RS485). The upper left screw-on cover is not used.

2.1.2.3 Mounting the SK TI4-TU-BUS on the SK 200E

The screw fittings and seals required for installation are enclosed with the modules or are fitted to the intended locations.

Mounting of the technology unit on the SK 200E must be carried out as follows:

1. Switch off the mains.
2. Remove the two M25 caps on the required side of the frequency inverter (right / left).
3. Remove the printed circuit board (with terminal bar) from the BUS connection unit.
4. Install the SK TI4-TU-BUS with the enclosed seal on the SK 200E using the 4 enclosed bolts.
5. Screw in both of the enclosed M25 to M12 reductions from the inside of the connection unit of the frequency inverter. (Purpose: to avoid damage to the internal wiring in the area of the junction of the SK TI4-TU-...(connector unit for optional external modules) to the SK TI4-… (frequency inverter connector unit))
6. Replace the printed circuit board (See point 3) and carry out the electrical connections.
7. Fit and screw on the SK TU4 module.

Mounting an external technology unit on the SK 200E (example)

Technology unit SK TU4-PNT

BUS Connection Unit SK TI4-TU-BUS

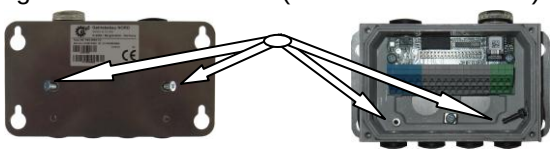
Wall-mounting kit SK TI4-WMK-TU

2.1.2.4 Wall-mounting the SK TI4-TU-BUS

The screw fittings (except for anchoring screws) and seals required for installation are enclosed with the modules or are fitted to the intended locations.

The connecting cable between the technology unit and the SK 200E should not be longer than 30m.

1. Mount the SK TI4-TU-BUS connecting unit with adhered seal on the wall-mounting kit. To do this: Insert the 2 x cheese-head screws (enclosed with wall-mounting kit) into the (countersunk) holes from the outside and with the 2 x bolts (enclosed with the wall-mounting kit) securely screw both components together from the inside (BUS connection unit).



Wall-mounting kit SK TI4-WMK-TU with field bus technology unit

2. Make a suitable cable connection between the technology unit and the frequency inverter. Take care that there is appropriate screw fitting and sealing of the modules. The cable sets enclosed with the BUS connection unit are not used.
3. Fit and screw on the SK TU4 module.

2.2 Electrical connection

WARNING

THE DEVICES MUST BE EARTHED.

Safe operation of the devices requires that is installed and commissioned by qualified personnel in compliance with the instructions provided in this Manual.

In particular, the general and regional installation and safety regulations for work on high voltage systems (e.g. VDE) must be complied with as must the regulations concerning correct use of tools and the use of personal protection equipment.

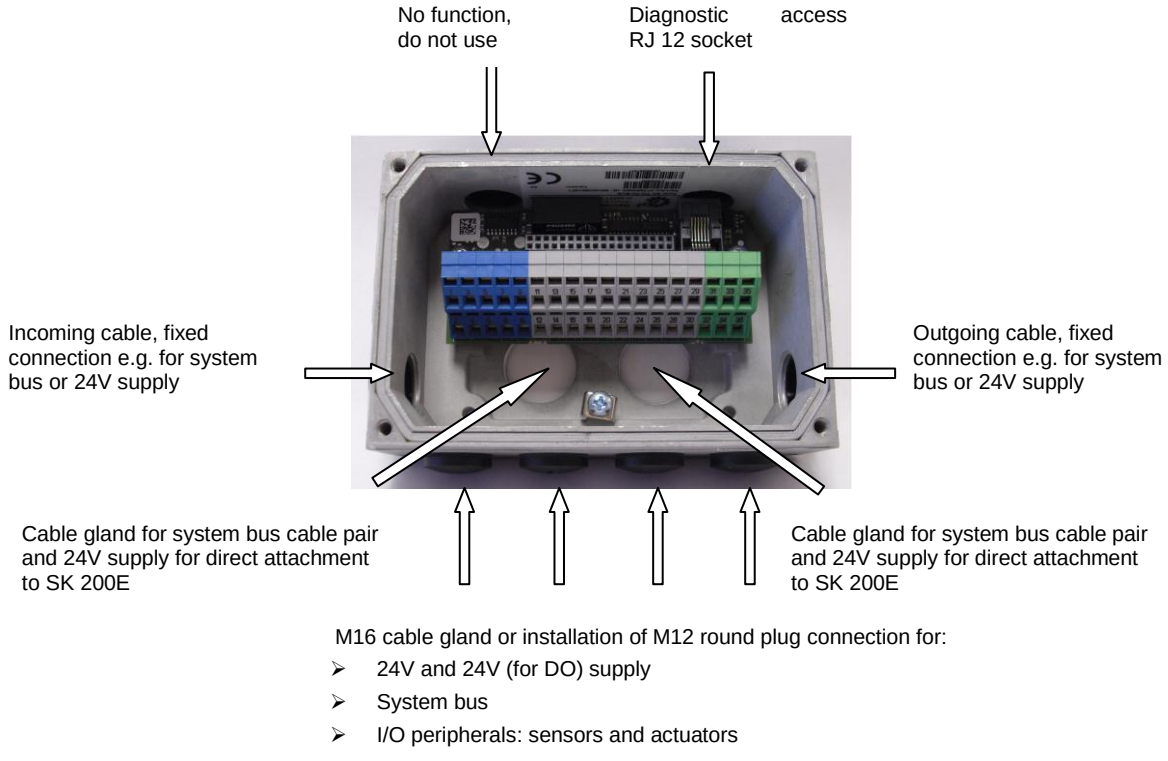
Dangerous voltages can be present at the motor connection terminals of the frequency inverter even when the inverter is switched off. Always use insulated screwdrivers on these terminal fields.

Ensure that the input voltage source is not live before setting up or changing connections to the unit.

Make sure that the inverter and motor are specified for the correct supply voltage.

2.2.1 Cable gland

Both the SK 200E connection unit and the bus module provide extensive facilities for the connection of all the required cables. The cables may enter the housing via cable glands and be connected to the terminal bar. However, appropriate round plug connections (e.g.: M12 round plug connectors in M16 cable glands) may be fitted in order to provide a plug-in solution.



M16 cable gland or installation of M12 round plug connection for:

- 24V and 24V (for DO) supply
- System bus
- I/O peripherals: sensors and actuators

Fig. 2 Cable gland on the BUS module / connection unit

2.2.2 Control connections

2.2.2.1 Field bus (PROFINET IO)

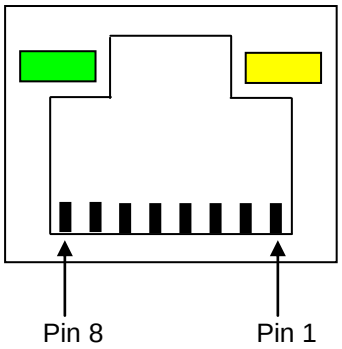
Specification	
PROFINET IO	Max. baud rate 100 MBaud
	Electrical isolation 500V_{eff}
Bus connection	2 × RJ45
Bus termination	Performed automatically by the SK TU4-… technology unit
Cable	Ethernet CAT-5 or better
Max. cable length	100m between two Ethernet bus modules
Supply voltage	24V ± 20%, current consumption ≈ 100mA Reverse polarity protected
Status display	4 LEDs
Device address	via the PROFINET IO controller or parameterisation
PE	Connection via plug pins under the 24V supply
Shield	The shields of the two RJ sockets are connected together and connected to PE with a high resistance and capacitance.

Table 2 Electrical specifications of the SK TU4-PNT

The field bus cable must only be connected to the two RJ45 sockets mounted on the front.

Signal	Name	RJ45 Pin
TX+	Transmission Data +	1
TX-	Transmission Data -	2
RX+	Receive Data +	3
RX-	Receive Data -	6

Table 3 RJ45 socket connections



2.2.2.2 Peripherals (system bus and IOs)

The PROFINET IO modules must be provided with a 24V DC (±20%, 100mA) control voltage. Wire end sleeves must be used for flexible cables.

Designation	Data
Rigid cable cross-section	0.14 … 2.5mm²
Flexible cable cross-section	0.14 … 1.5mm²
AWG standard	AWG 26-14
Tightening torque (for screw terminals)	0.5 … 0.6Nm

Within the terminal box (unshielded cable section) the data cables (system bus) must be installed as short as possible and of equal length. Associated data cables (e.g.: Sys+ and Sys-) must be twisted.

NOTE

The cable shielding must be connected to the *functional earthing* [1](usually the electrically conducting mounting plate) in order to prevent EMC interference in the device.

In order to achieve this, for PROFINET connections it is mandatory that the metallic metric EMC screws are used for the connection of the PROFINET shielding lead to the frequency inverter or the housing of the technology unit. This ensures a wide area connection of the *functional earthing*.

The double spring terminal bar is divided into 2 potential levels (system bus and digital outputs).

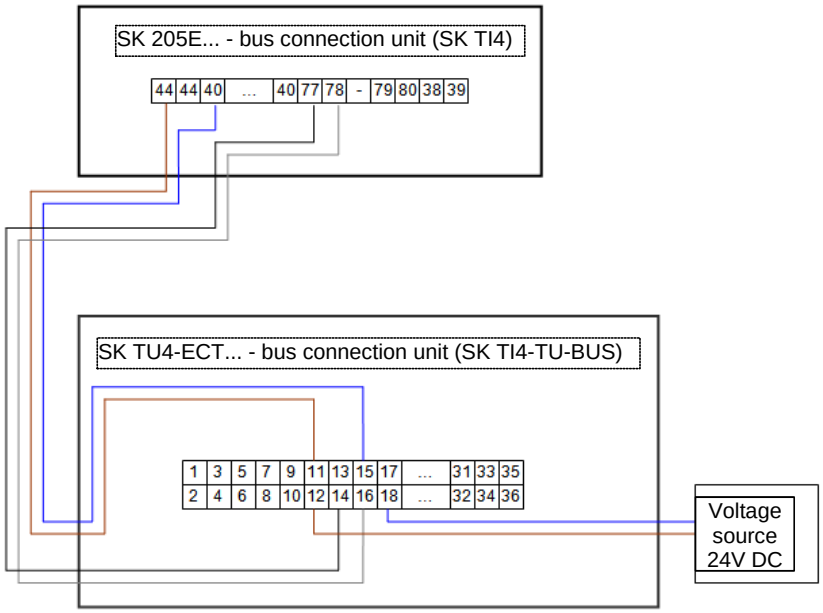
A separate power source should be used for the supply of the DOs. However, by bridging 24V 2 and 0V 2 to one of the terminals of the system bus level (24V and 0V) it is possible to implement the supply of the DOs. However, in this case it should be noted that there is an increased risk of introducing interference into the bus cables.

Connection of up to 8 sensors and 2 actuators is made via the terminal bar.

Potential level: system bus					Potential level: system bus										Potential level: DOs		
Digital inputs					**System bus level and digital inputs**										**Digital outputs**		
24V	DIN 5	DIN 6	0V	24V (as for 1)	24V (as for 1)	24V (as for 1)	0V	0V	DIN 1	0V	24V (as for 1)	DIN 2	0V	24V (as for 1)	24V 2	DO 1	0V 2
1	**3**	**5**	**7**	**9**	**11**	**13**	**15**	**17**	**19**	**21**	**23**	**25**	**27**	**29**	**31**	**33**	**35**
2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**	**28**	**30**	**32**	**34**	**36**
24V (as for 1)	DIN 7	DIN 8	0V	24V (as for 1)	24V (as for 1)	Sys +	Sys -	0V	DIN 3	0V	24V (as for 1)	DIN 4	0V	24V (as for 1)	24V 2	DO 2	0V 2

Illustration of the terminal bar of the bus connection unit SK TI4-TU-BUS with allocation of functions

Connection example: SK TU4-PNT to SK 200E



NOTE

Looping of the 24V supply or GND is possible, however the maximum current load of **3A** must not be exceeded with the module.

Only adjacent terminals (e.g.: 11/12) may be used for looping.

Terminals 1/2 are preferentially for use with sensors and with maximum loads of **500mA**.

[1] In systems, electrical equipment is usually connected to a ***functional earth***. This serves as a means to dissipate leakage and interference currents in order to ensure EMC characteristics and must therefore be implemented according to high frequency technology aspects.

Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
1 24V 2 9 10	24V supply (Module and system bus level)	24VDC ±20% ≈ 100 mA reverse polarity protected Max. permissible current load: **500mA**	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN8) via DC/DC converter to Terminal 11.	-
3 DIN5	Digital input 5 (I/O PROFINET DIN5)	Low 0V ... 5V High 15V ... 30V R_i = 10kΩ Input capacitance 10nF Scan rate 1 ms Inputs as per EN 61131-2 Type 1	Each digital input has a reaction time of 3 ms.	P174
4 DIN7	Digital input 7 (I/O PROFINET DIN7)			P174
5 DIN6	Digital input 6 (I/O PROFINET DIN6)			P174
6 DIN8	Digital input 8 (I/O PROFINET DIN8)			P174
7 0V 8	GND Reference potential for digital signals	As for terminal 15	GND for system bus and digital inputs (DIN1 to DIN8) via connection of DC/DC converter to Terminal 15	-
11 24V 12 13	24V supply (Module and system bus level)	As for terminal 1 However, max. permissible current load: **3A**	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN8)	-
15 0V 17 18	GND Reference potential for digital signals			-
14 Sys+	System bus data cable +		System bus interface	-
16 Sys-	System bus data cable -			-
19 DIN1	Digital input 1 (I/O PROFINET DIN1)	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms Inputs as per EN 61131-2 Type 1	Each digital input has a reaction time of 3 ms.	P174
20 DIN3	Digital input 3 (I/O PROFINET DIN3)			P174
21 0V 22	GND Reference potential for digital signals	As for terminal 15	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN8)	-
23 24V 24	24V supply (Module and system bus level)	As for terminal 1 However, max. permissible current load: **3A**		-

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
25 DIN2	Digital input 2 (I/O PROFINET DIN2)	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms Inputs as per EN 61131-2 Type 1	Each digital input has a reaction time of 3 ms.	P174
26 DIN4	Digital input 4 (I/O PROFINET DIN4)			P174
27 0V 28	GND Reference potential for digital signals	As for terminal 15	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN8)	-
29 24V 30	24V supply (Module and system bus level)	As for terminal 1 However, max. permissible current load: **3A**		-
Potential isolation				
31 24V2	24V supply of digital outputs	24VDC -/+20% Up to 1A, according to load reverse polarity protected	Supply voltage connection for digital outputs (DO1 and DO2) If necessary, bridge to 24V terminal	-
32 0V2	GND 2 Reference potential for digital outputs		Ground for digital outputs (DO1 and DO2) If necessary, bridge to 0V terminal	-
33 DO1	Digital output 1 (I/O PROFINET DO1)	Low = 0V High: 24V Rated current: 500mA each	The digital outputs should be used with a separate 24V supply	P150 P175
34 DO2	Digital output 2 (I/O PROFINET DO2)			P150 P175
35 0V2 36	GND 2 Reference potential for digital outputs		Ground for digital outputs (DO1 and DO2) If necessary, bridge to 0V terminal	-

Table 4 Connection assignment of BUS connection unit for PROFINET IO

3 Displays and diagnosis

Various diagnosis possibilities are available, depending on the device. Operating conditions or errors are visualised by means of LEDs. PC-based communication or the connection of a parameterisation unit is possible via an RS232 interface (RJ12 diagnostic socket).

PROFINET **Module** SK TU4-PNT with
SK TI4-TU-BUS and SK TIE4-WMK-TU
Status **LEDs** and screw connection for **RJ12** diagnostic interface

Frequency inverterSK 205E
viewing window (transparent screw-on cover) for diagnostic interface **RJ12,** status **LEDs, potentiometer**

3.1 LED displays

Both the SK 200E frequency inverter and the PROFINET modules provide LED status and diagnostic displays to indicate the various statuses.

A differentiation into 2 categories is made

- **Module** or module-specific displays (S and E or DS and DE)
- **PROFINET**-specific displays
  (- physical status: L/A in and L/A out
  - Process status: RUN and BF)

3.1.1 Device-specific display versions

3.1.1.1 frequency inverter SK200E

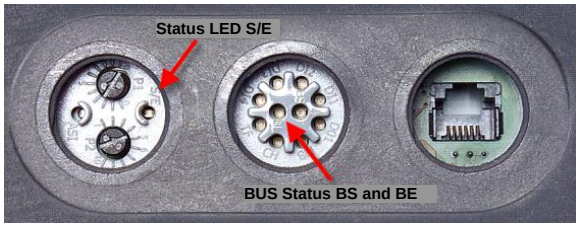
LED **S/E**

The double **LED S/E** indicates the operating status of the frequency inverter by change of colour and different flashing frequencies. A device error is indicated by cyclic red flashing of the LED. The frequency of the flashing signals corresponds to the error number (Manual BU 0200).

LEDs **RUN** and **BF**

The dual **LEDs RUN** (**BUS State)** and **BF (BUS Fault)** indicate the status of the system bus communication module. Various bus communication errors are indicated by means of different flashing frequencies.

A detailed description of the LED displays of the frequency inverter can be found in the main manual (BU0200).



3.1.1.2 Technology unit SK TU4-PNT

LEDs **LINK** and **ACT**

The single colour **LINK** LEDs indicate the physical connection to the Ethernet bus.

The single colour **ACT (Activity)** LEDs indicate bus activity (data transfer).

LEDs **RUN** and **BF**

The single colour LEDs **RUN (PROFINET RUN)** and **BF (PROFINET BUS FAULT)** indicate the PROFINET communication status.

LEDs **DS** and **DE**

The dual colour LEDs **DS (Device State)** and **DE (Device Error)** indicate the status of the module and the status of the system bus.

A detailed description of the LED displays for this module can be found in Section 3.1.2 "Signal status LEDs".

3.1.2 Signal status LEDs

This manual only describes the LED signal statuses of the PROFINET IO modules. Information for the frequency inverter LEDs (SK 200E) can be found in the relevant manual (BU0200).

The statuses indicated by the LED can be read out with the aid of a parameterisation tool from Getriebebau Nord (NORDCON software ParameterBox) and also of course via the information parameter (P173) “Module Status” (See Section 6.2.3 "BUS module information parameters, general (P17x)").

3.1.2.1 Module-specific displays

The status of the technology unit or the system bus is indicated by the LEDs **DS** and **DE**.

DS (**D**evice **S**tate) **Green LED**	**DE** (**D**evice **E**rror) **Red LED**	**Meaning** long flashing = 0.5 s on / 1 s off short flashing = 0.25 s on / 1 s off
OFF	**OFF**	Technology unit not ready, no control voltage
ON	**OFF**	Technology unit ready, no error, at least one frequency inverter is communicating via the system bus
ON	**Short flashing**	Technology unit ready, however → one or more of the connected frequency inverters has a fault status (see frequency inverter manual)
Long flashing	**OFF**	Technology unit ready and at least one further subscriber is connected to the system bus, but → No frequency inverter on the system bus (or connection interrupted) → Address error for one or more system bus participants
Long flashing	**Short flashing** Flash interval **1** x - 1s pause	System bus is in status "Bus Warning" → Communication on system bus interrupted or → no other participant present on the system bus
Long flashing	**Short flashing** Flash interval **2** x - 1s pause	→ System bus is in status "Bus off" or → the system bus 24V power supply was interrupted during operation
Long flashing	**Short flashing** Flash interval **3** x - 1s pause	→No system bus 24V power supply (system bus is in status "Bus off")
Long flashing	**Short flashing** Flash interval **4** x - 1s pause	→ PROFINET error of the technology unit Details: LED flashing code: **RUN** and **BF** (Section 3.1.2.2 "PROFINET displays"
OFF	**Short flashing** Flash interval **1…7** x - 1s pause	System error, internal program sequence interrupted → EMC interference (observe wiring guidelines!) → Module faulty

Table 5 LED display, DS and GB

3.1.2.2 PROFINET displays

The communication status of the PROFINET IO module is indicated by the LEDs **RUN** and **BF**.

RUN = PROFINET IO bus status
BF = PROFINET IO bus fault

PROFINET IO status display

RUN Green LED	Meaning Flashing = 2.5 Hz (0.4 s cycle → 0.2 s on / 0.2 s off)
OFF	Module not in operation Device switched off or initialisation
Flashing	Waiting for AR (no connection to the PROFINET-IO controller) → no parameter communication → no process data communication
ON	AR established (a connection to the PROFINET IO controller has been set up) → Parameter communication active → Process data communication active

Table 6 RUN LED display

PROFINET IO error display

BF Red LED	Meaning Flashing = 2.5 Hz (0.4 s cycle → 0.2 s on / 0.2 s off) Double flash = 2 x brief flashes
OFF	No error
Flashing	Incorrect configuration →General PROFINET configuration error, can be caused by a false GSDML file.
ON	Ethernet error → SK TU4-PNT is not (physically) connected to an Ethernet participant
Double Flash	Watchdog - Timeout → PROFINET or FI timeout (P151)

Table 7 BF LED display

The physical status of the field bus system (PROFINET IO) is indicated by the LINK /ACTIVITY LEDs, which are located directly next to the RJ45 socket on the front panel.

Display of PROFINET Link and Active connections

Link Green LED	Activity Yellow LED	Meaning
Off	Off	Port (RJ45 socket) is not connected to the PROFINET network
On	Off	Port (RJ45 socket is connected to the PROFINET network, but there is no exchange of data
On	On / Flashing	Data exchange via PROFINET active

Table 8 LED display, Link and Activity

3.2 RJ12 Diagnostic socket

All participants which are coupled via a common system bus (field bus module / frequency inverter (up to 4 devices)) can be read out and edited/parameterised via an RJ12 diagnostic socket. This can be either the diagnostic socket of the frequency inverter or that of the BUS connection units. This provides users with a convenient facility to perform diagnosis and parameterisation from a central point, without having to access the particular frequency inverter at its location.

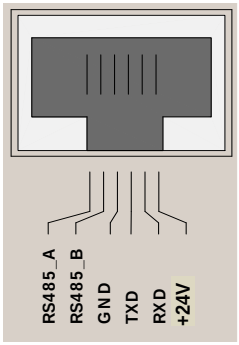
Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
Diagnostic access / RJ12, RS485/RS232				
1 RS485 A	Data cable RS485	Baud rate 9600…38400Baud Termination resistor R=120 Ω to be set by customer at the final participant.	 RJ12: Pin No. 1 … 6 1: RS485_A 2: RS485_B 3: GND 4: RS232_TxD 5: RS232_RxD 6: +24V	P502 ...P513
2 RS485 B				
3 GND	Reference potential for BUS signals	0V digital		
4 232 TXD	Data cable RS232	Baud rate 9600…38400Baud		
5 232 RXD				
6 +24V	24V voltage supply from FI	24V ± 20%		

Table 9 RJ12 socket connections

The bus speed of the diagnostic interface is 38400 baud. Communication is carried out according to the USS protocol.

NOTE

Simultaneous use of several diagnostic sockets with several diagnostic tools may lead to errors during communication. Therefore, only one diagnostic socket within a system bus network should be used.

ParameterBox SK PAR-3H

The ParameterBox **SK PAR-3H** is available as a diagnostic tool.

The necessary connecting cables are included in the scope of delivery of the ParameterBox. For a detailed description of use, please refer to Manual BU0040.

Alternatively, diagnosis can be performed via a Windows PC with the aid of **NORD CON** software (available free of charge from www.nord.com). The necessary connection cable (**RJ12 - SUB D9**) is available from Getriebebau Nord GmbH as part number *278910240*. If necessary, an interface converter from SUB D9 to USB2.0 is commercially available.

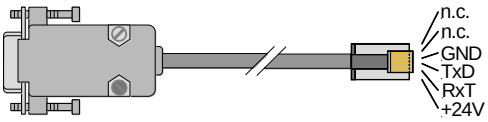
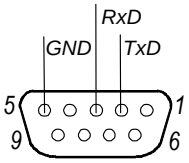
Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
Accessory cable (optional) for PC connection				
Adapter cable RJ12 to SUB-D9	... for direct connection to a PC with NORD CON software	Length 3m Assignment RS 232 (RxD, TxD, GND) Part. No. 278910240	 Assignment of SUB-D9 connector: Pin2: RS232_TxD Pin3: RS232_RxD Pin5: GND 	

Table 10 Connection of RJ12 adapter cable to SUB-D9

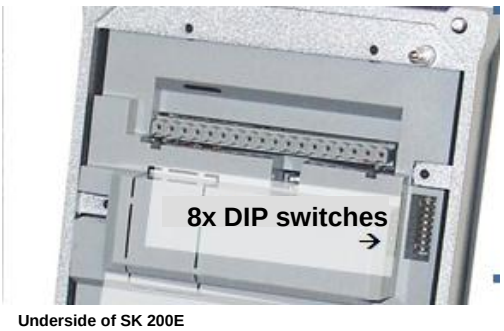
No special settings are required to set up communication with the individual diagnostic tools.

The allocation of addresses is defined via the system bus addressing. The display of the diagnostic tool is according to the following table, whereby the frequency inverter which is directly connected to the diagnostic tool is automatically assigned the address **"0"**.

Device	External technology unit	Frequency inverter with address 32 (system bus)	Frequency inverter with address 34 (system bus)	Frequency inverter with address 36 (system bus)	Frequency inverter with address 38 (system bus)
USS address	30	1	2	3	4

Note

Setting of the system bus address is carried out via two DIP switches (DIP 1 and 2) on the underside of the SK 200E- frequency inverter. For further details, please refer to the frequency inverter manual (BU 0220). The address of the BUS module is defined as "30".



Underside of SK 200E

Fig. 3: DIP switches (system bus), frequency inverter

4 Commissioning

After **installation** of the components, and **connection** of the control and signal cables to the control terminal bar of the module the module must be integrated into the field bus. Then the PROFINET IO module must be implemented in the automation concept. In this section, the design of hardware in the SIMATIC Manager is shown as an example. Finally, some parameters for the PROFINET connection in the frequency inverter must be adapted.

4.1 Cabling

4.1.1 Topology

The SK TU4-PNT (PROFINET IO) modules can be connected to each other in star, tree, linear or ring topologies.

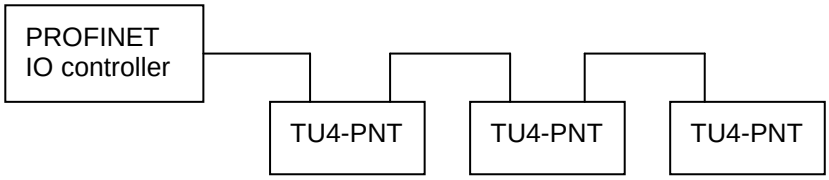


Fig. 4: Example of PROFINET IO linear topology

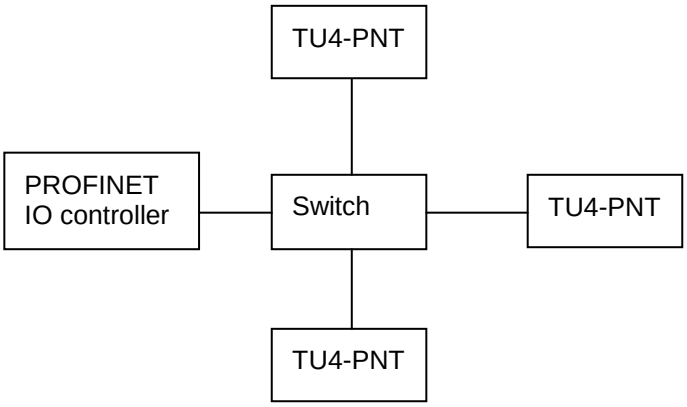


Fig. 5: Example of PROFINET IO star topology with switch

4.1.2 EMC

If EMC measures are not in place, high-frequency interference which is mainly caused by switching processes or lightning often causes electronic components in the bus participants to be faulty and error-free operation can no longer be ensured.

Correct laying of the bus cable dampens the electrical influences which may occur in an industrial environment. The following points must be observed:

- Implement long connections between bus participants by the shortest possible distances.
- Only use plugs with a metal housing.
- For the production of bus cables lay the shielding on as wide an area of the plug as possible.
- With the parallel installation of bus cables, a minimum distance of 20 cm should be maintained from other cables carrying a voltage greater than 60V. In particular, this must be observed for cables to motors or chopper resistors. This applies to lines laid both inside and outside of control cabinets.
- The minimum distances for parallel installation may be reduced by shielding cables carrying voltage or by means of earthed metal dividers in the cable ducts.
- Connect each SK TU4 Ethernet module to the PE (PE terminal inside the module)

4.2 Parameter settings of the frequency inverter

4.2.1 Parameter settings of the SK 200E frequency inverter

The following settings must be made on the SK 200E:

- **FI address (preferably set via DIP switches (DIP1 and 2)), if several FIs are connected to an SK TU4-PNT (Gateway mode)**
- Set the control and setpoints (preferably via DIP switches (DIP3)), or via parameter:
  - Control via "system bus" → P509 = 3
  - Setpoints via "system bus" → P510 = 3 or 0 if P509 = 3
- Setting of setpoints via P546 [-01] … [-03]
- Setting of actual values via P543 [-01] … [-03]

A precise description of the parameters can be found in Section 6.1 of this supplementary manual or in the SK 200E operating manual.

The parameters can be set with NORD parameterisation tools or via the PROFINET IO controller.

4.2.2 Parameter settings of the SK 500E frequency inverter

The following settings must be made on the SK 500E:

- Control via "CANopen" → P509 = 6
- Setpoints via "CANopen" → P510 = 6 or 0 if P509 = 6
- Setting of setpoints via P546, P547 and P548 (SK 54xE and above: P546 [-01] … P546 [-05])
- Setting of actual values via P543, P544 and P545 (SK 54xE and above: P543 [-01] … P543 [-05])
- Setting of system bus monitoring via P513 = 0.6s
- Setting of the baud rate via P514 = 5 (corresponds to 250kB)
- Setting of the system bus addresses via P515 [-01] = 32, 34, 36 or 38

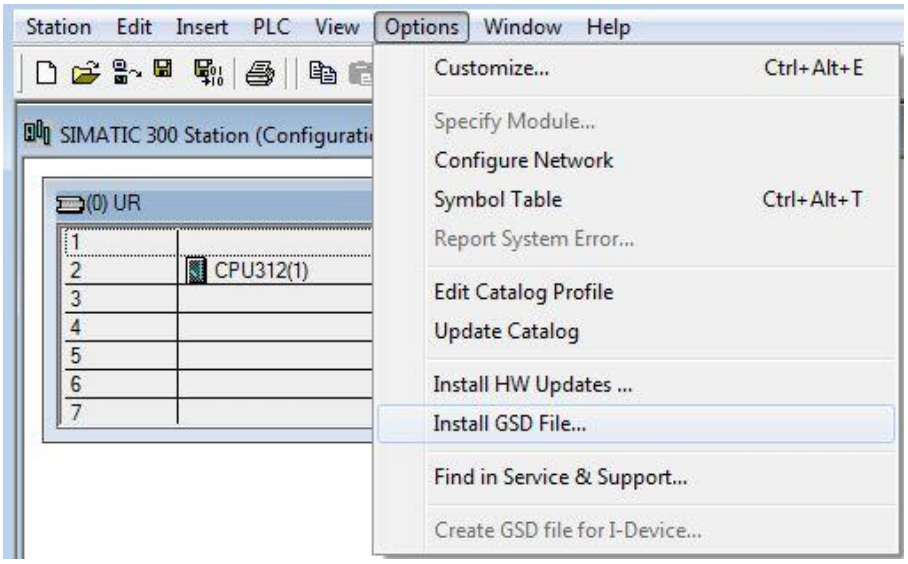
For a detailed description of the parameters, please refer to the SK 500E operating manual.

The parameters can be set with NORD parameterisation tools or via the PROFINET IO controller.

4.3 Configuration in the Bus system (example SIMATIC Manager)

In order to carry out planning with the **SK TU4-PNT**, first of all the GSDML file "GSDML-V2.2-NORD DRIVESYSTEMS-TUXPNT-201xxxxx.xm" must be installed in the SIMATIC Manager. Select the relevant file in the Hardware Configurator.

The current gsdml files are available on the NORD homepage under NORD - Dokumentation - Software - NORDAC Options.



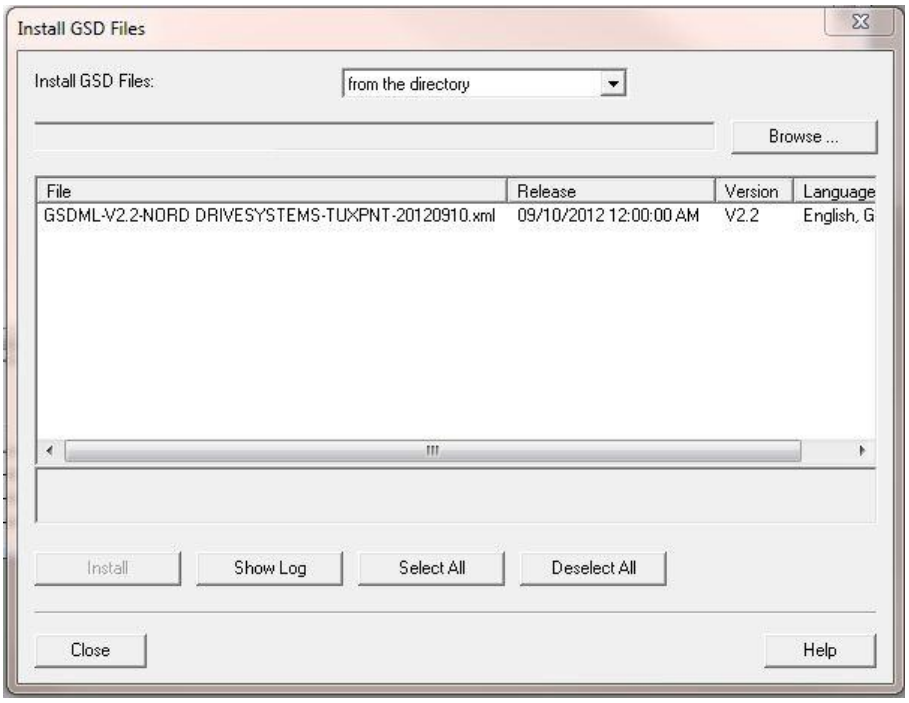


Fig. 6 Installation of the GSDML file in the SIMATIC Manager

After this, the SK TU4-PNT from NORD DRIVESYSTEMS can then be found in the hardware catalogue of the SIMATIC Hardware Manager and can then be entered into the PROFINET system.

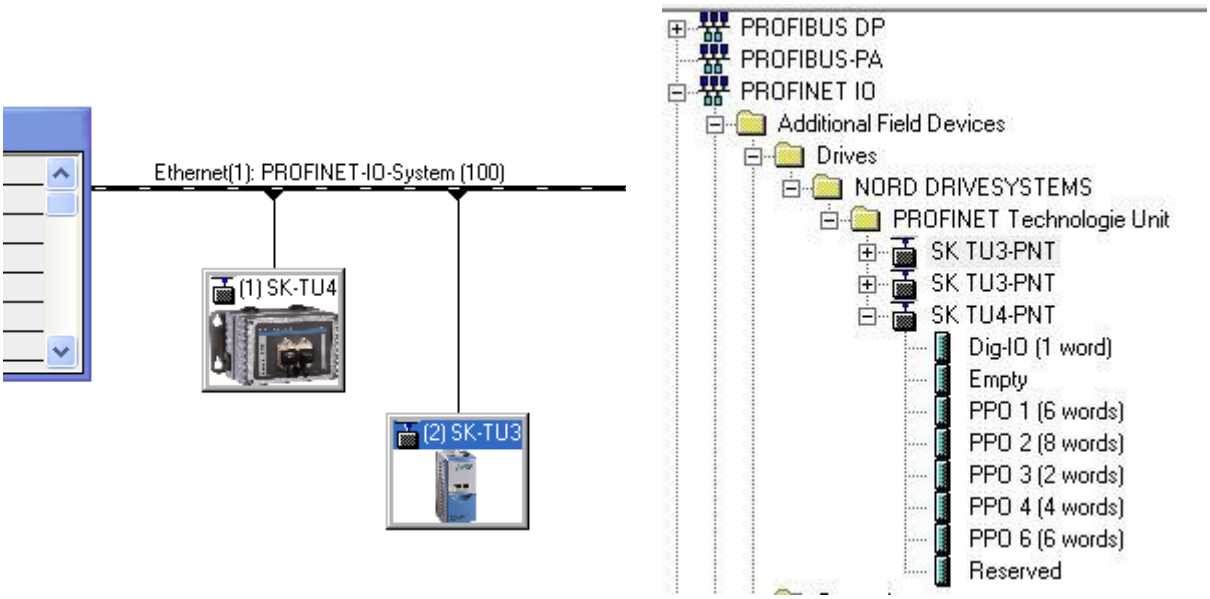


Fig. 7 Hardware Catalogue: Module selection and specification of data format

The data format of the cyclical IO data is specified via the hardware catalogue. Up to 12 Bytes (=PPO6) are transferred to the frequency inverter in a single cycle.

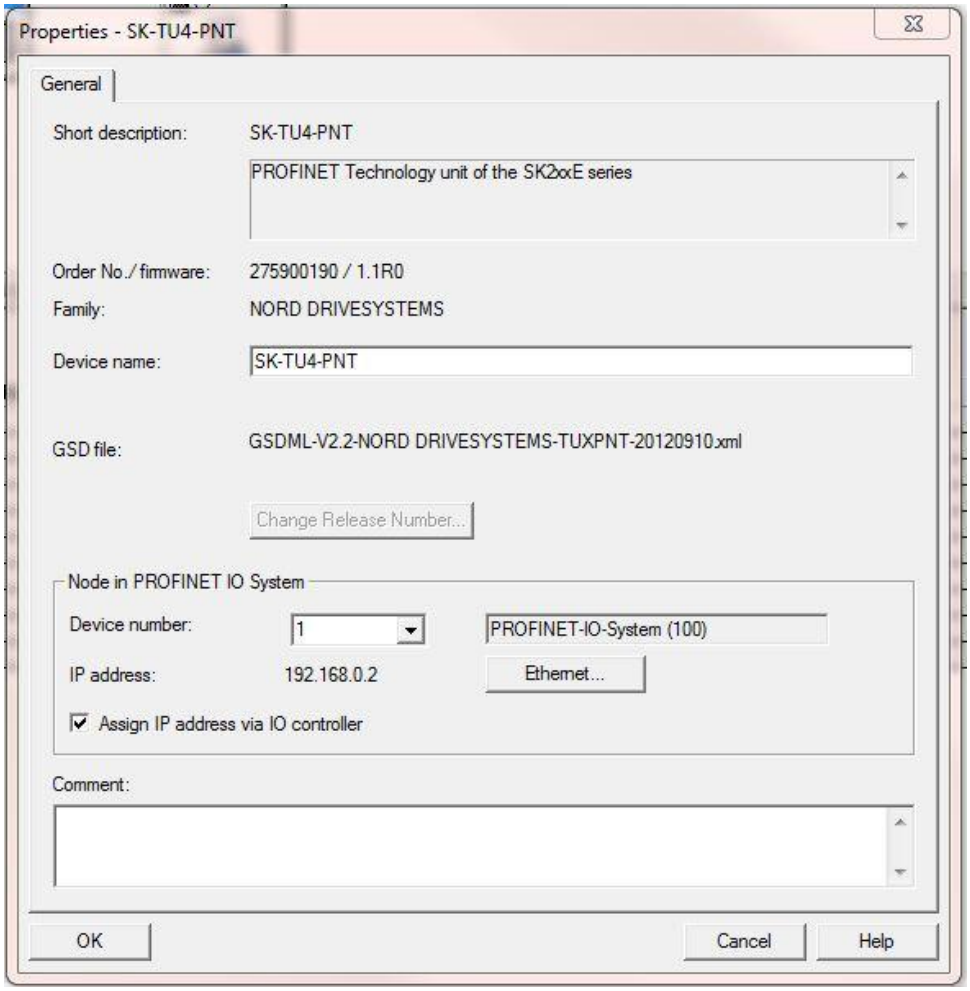


Fig. 8 Module properties

Properties such as the device number, device name and IP address are entered in the Properties dialogue of the SIMATIC Manager.

5 Communication

5.1 Process data

Control words and setpoints are transferred from the bus master / controller to the SK TU4-…bus module as process data and in return, the status word and actual values are sent to the bus master / controller from the FI. Transfer is carried out cyclically. The bus master / controller can access these process values directly, as they are stored in the IO area.

The length and structure of the process data is specified via the PPO types during the planning of the PROFINET network.

The allocation of the values transferred in the setpoint/actual value area of the FI is made via the parameters P543 to P548 or P543 [-01]…[-05] and P546 [-01] …[-05]..

5.1.1 Process data structure

The structure of the process data is defined by the PPO type.

5.1.1.1 Pure process data communication

Direction of transmission	Transmitted data (4 Byte)	
	1st word	2nd word
... to SK TU4	Control word	Setpoint 1
... from the SK TU4	Status word	Actual value 1

Table 11: PPO 3

Direction of transmission	Transmitted data (8 Byte)			
	1st word	2nd word	3rd word	4th word
... to SK TU4	Control word	Setpoint 1	Setpoint 2	Setpoint 3
... from the SK TU4	Status word	Actual value 1	Actual value 2	Actual value 3

Table 12: PPO 4

Direction of transmission	Transmitted data (12 Byte)					
	1st word	2nd word	3rd word	4th word	5th word	6th word
... to SK TU4	Control word	Setpoint 1	Setpoint 2	Setpoint 3	Setpoint 4	Setpoint 5
... from the SK TU4	Status word	Actual value 1	Actual value 2	Actual value 3	Actual value 4	Actual value 5

Table 13: PPO 6

5.1.1.2 Process and parameter data communication

The exchange of process and parameter data is possible by selecting the PPO types 1 or 2.

Direction of transmission	Transmitted data (12 Byte)					
	1st word	2nd word	3rd word	4th word	5th word	6th word
... to SK TU4	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO	Control word	Setpoint 1
... from the SK TU4	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO	Status word	Actual value 1

Table 14: PPO 1

Direction of transmission	Transmitted data (16 Byte)			
	1st word	2nd word	3rd word	4th word
... to SK TU4	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO
... from the SK TU4	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO

Direction of transmission	Transmitted data (16 Byte)			
	5th word	6th word	7th word	8th word
... to SK TU4	Control word	Setpoint 1	Setpoint 2	Setpoint 3
... from the SK TU4	Status word	Actual value 1	Actual value 2	Actual value 3

Table 15: PPO 2

5.1.2 Control word

The control word (STW) is the first word transferred to the frequency inverter in the process data area in an order telegram. For example, a control word "Ready for switch-on" corresponds to $047E_{(hex)}$. In general the command "Standby" should be the first command which is transferred to the inverter.

Bit	Value	Meaning	Remarks	
0	0	Not ready for operation	Reverse with the brake ramp, with disconnection from supply at f=0Hz **(OFF1)**	
	1	**Ready for operation**	Frequency inverter ready for operation	
1	0	**Disable voltage**	Cut off voltage; the inverter output voltage is switched off; the FI enters a state where switching on is disabled. **(OFF2)**	
	1	Do not disable voltage	Operating condition OFF 2 is cancelled	
2	0	**Emergency Stop** active	Quick stop with programmed quick stop time; with disconnection from supply at f=0Hz; the FI switches to starting disabled condition **(OFF3)**.	
	1	Emergency Stop not active	Operating condition OFF 3 is cancelled	
3	0	Disable operation	Disable voltage; the inverter output voltage is switched off; the FI enters a state where switching on is enabled.	
	1	**Enable operation**	The output voltage is enabled; ramp to the existing setpoint	
4	0	Pulse not enabled	Ramp generator is set to zero; no disconnection from supply at f=0Hz; FI remains in the operation enabled state.	
	1	**Enable pulses**	Ramp generator enabled	
5	0	Ramp not enabled	The setpoint currently provided by the ramp generator is "frozen" (frequency is maintained).	
	1	**Enable ramp**	Setpoint on ramp generator enabled.	
6	0	Setpoint not enabled	Selected setpoint value is set to zero on the ramp generator.	
	1	**Enable setpoint**	Selected ramp generator setpoint is activated.	
7	0	No acknowledgement	With the switch from 0 to 1, errors which are no longer active are acknowledged.	
	1	**Acknowledge error (0→1)**	Note: If a digital input has been programmed for the "ack.fault" function, this bit must not permanently be set to 1 via the bus (otherwise, flank evaluation would be prevented).	
8	0			
	1	**Start function 480, 11**	Bus bit 8 from the control word is set. Only for SK 2xxE and SK 5xxE. For further details of the function please refer to parameter (P480).	
9	0			
	1	**Start function 480, 12**	Bus bit 9 from the control word is set. Only for SK 2xxE and SK 5xxE. For further details of the function please refer to parameter (P480).	
10	0	Control data invalid	The transmitted process data is invalid.	
	1	**Control data valid**	Valid process data is transferred from the master. **Note:** In order for the transmitted setpoint to be valid, this bit must also be set (setting: interface), even if only setpoint values are transmitted via the bus.	
11	0			
	1	**Rotation right is on**	Rotational direction right (priority) ON*	
12	0			
	1	**Rotation left is on**	Rotational direction left ON*	
13	0/1	*Reserved*	Reserved	
14	0/1	**Parameter set Bit 0 ON**	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	**Parameter set Bit 1 ON**		

*If Bit 12=0, then "Direction of rotation right ON" applies

Table 16 Meaning of individual control word bits

5.1.3 Status word

In the inverter response telegram, in the area of the process data the status word (ZSW) is transferred as the first word. The meaning of the individual bits deviate for some types of devices.

Bit	Value	Meaning	Remarks	
0	0	Not ready to start		
	1	**Ready to start**	Initialisation completed, charging relay ON, output voltage disabled	
1	0	Not ready for operation	Causes: ON command has not been activated, fault is signaled, OFF2 or OFF3 activated, starting disabled state activated	
	1	**Ready for operation**	ON command activated, no faults present. The inverter can be started with the command ENABLE OPERATION	
2	0	Operation not enabled		
	1	**Operation enabled**	The output voltage is enabled; ramp to the existing setpoint	
3	0	No error		
	1	**Fault**	Drive fault resulting in stoppage; this state is changed to starting disabled after the fault has been successfully acknowledged	
4	0	Voltage not enabled	OFF2 command applied	
	1	**Voltage enabled**		
5	0	**Emergency stop**	OFF3 command applied	
	1	No emergency stop		
6	0	Starting not disabled		
	1	**Starting disabled**	Switches first to OFF1, then to ready-to-start status	
7	0	No warning		
	1	**Warning active**	Drive operation continues, no acknowledgement necessary	
8	0	Setpoint not reached	Actual value does not match the setpoint (with *posicon:* failure to reach setpoint position)	
	1	**Setpoint reached**	Actual value matches required setpoint (setpoint has been reached) (with *posicon:* setpoint has been reached)	
9	0	Bus control not active	Guidance on local device has been activated	
	1	**Bus controller active**	The master has been requested to assume guidance.	
10	0			
	1	**Start function 481.9**	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481.	
11	0			
	1	**Rotation right is on**	Inverter output voltage is turning right	
12	0			
	1	**Rotation left is on**	Inverter output voltage is turning left	
13	0			
	1	**Start function 481.10**	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481.	
14	0/1	**Parameter set Bit 0 ON**	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	**Parameter set Bit 1 ON**		

Table 17 Meaning of individual status word bits

5.1.4 FI Status Machine

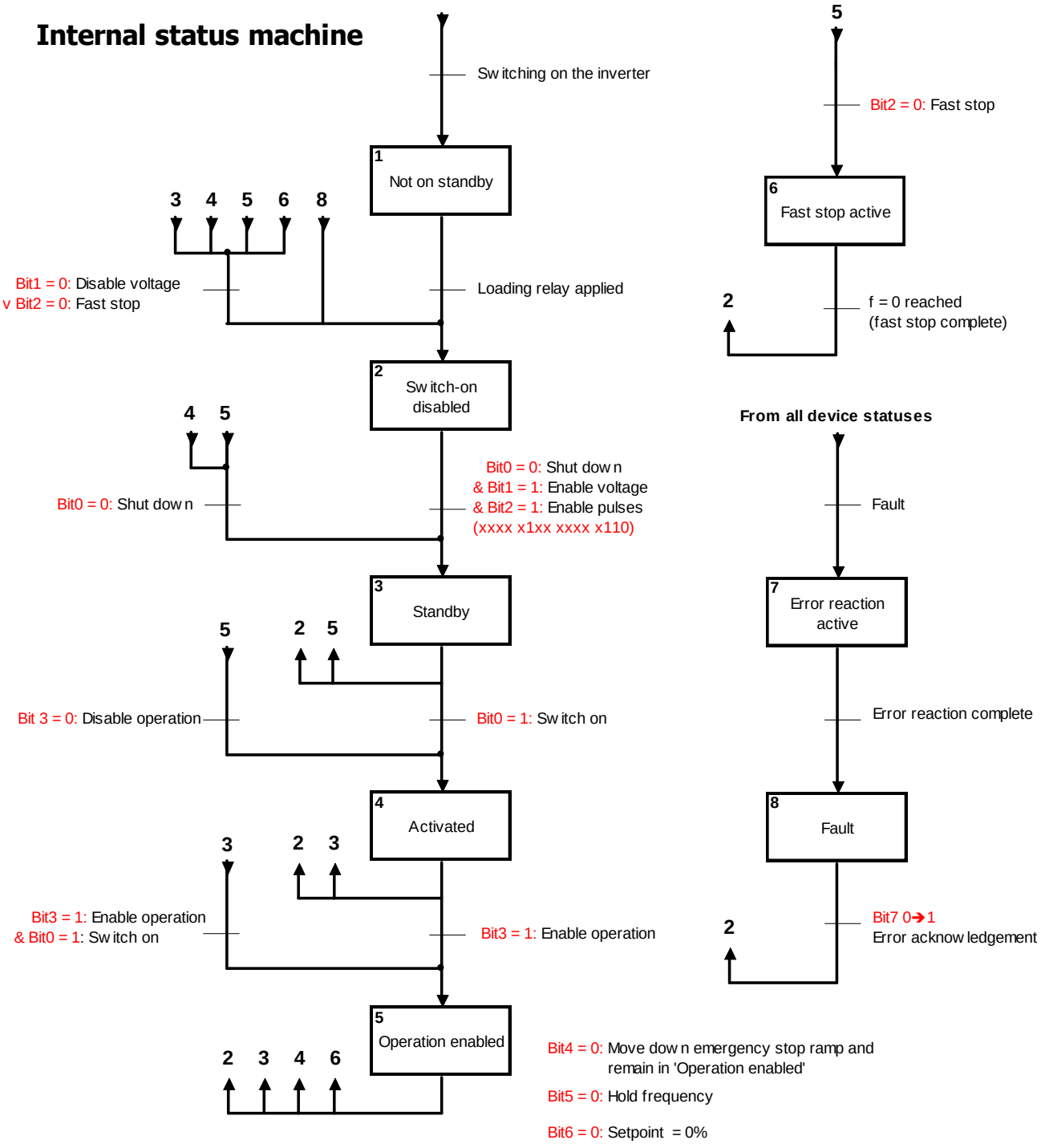
The frequency inverter passes through a status machine. The changes between various states are triggered by the respective control commands in the process data control word. The actual status is returned in the process data status word.

After switching on, the inverter is in **switch-on disabled** status. This status can only be ended by transmitting the “Shut down (Off 1)” command.

The answer to a master telegram normally does not yet contain a reaction to the control command. The controller must check the answers from the slaves as to whether the control command has been carried out.

Status	**Bit 6** Switch-on disable	**Bit 5** Emergency stop	**Bit 4** Disable voltage	**Bit 3** Fault	**Bit 2** Operation enabled	**Bit 1** Standby	**Bit 0** Ready for switch-on
Not ready to start	0	X	X	0	0	0	0
Starting disabled	1	X	X	0	0	0	0
Ready to start	0	1	1	0	0	0	1
Activated	0	1	1	0	0	1	1
Operation enabled	0	1	1	0	1	1	1
Fault	0	X	X	1	0	0	0
Error active	0	X	X	1	1	1	1
Emergency stop active	0	0	1	0	1	1	1

Table 18 Codes for FI status



Control bits
0. Ready for operation / shut down
1. Disable / enable voltage
2. Enable pulses / emergency stop
3. Disable / enable operation
4. Operation condition / block RUE
5. Enable / stop RUE
6. Enable / disable setpoint
7. Error acknowledgement (0➔1)
10. Control data valid / invalid
11. Rotation right
12. Rotation left
14. Parameter set Bit 0
15. Parameter set Bit 1

Priority of control commands:
1. Disable voltage
2. Fast stop
3. Shut down
4. Enable operation
5. Switch on
6. Disable operation
7. Reset error

Designation of statuses:
1: Bit 0 = 0
2: Bit 6 = 1
3: Bit 0 = 1
4: Bit 1 = 1
5: Bit 2 = 1
6: Bit 5 = 0
7: Bit 2 & Bit 3 = 1
8: Bit 3 = 1

Fig. 9 Diagram of the FI Status Machine

5.1.5 Setpoint and actual values

The meaning of setpoint values is determined via the FI parameters

- P546[-01] … [-03] (SK 2xxE)
- P546 to P548 (SK 500E … SK 535E)
- P546[-01] … [-05] (SK 54xE)

For the actual values, this determination is made via the FI parameters

- P543[-01] … [-03] (SK 2xxE)
- P543 to P545 (SK 500E … SK 535E)
- P543[-01] … [-05] (SK 54xE).

The transfer of setpoint and actual values is carried out by three different methods, which will be explained below.

Percentage transfer

The process value is transferred as a whole number with a value range of -32768 to 32767 (8000 hex to 7FFF hex). The value 16384 (4000 hex) is equal to 100%. The value -16384 (C000 hex) is equal to -100%.

For frequencies, the 100% value corresponds to the FI parameter "Maximum Frequency" (P105) and for currents, this is the FI parameter "Torque Current Limit" (P112) Frequencies and currents result from the following formulae.

$$Frequency = \frac{value \times P105}{16384} \qquad Current = \frac{value \times P112}{16384}$$

Value = the 16Bit actual or setpoint value transmitted via Ethernet

Formula 1 Formation of 16Bit setpoint/actual value

Binary transmission

Inputs and outputs as well as Digital In bits and Bus Out bits are evaluated for each bit.

Transmission of positions

In the FI, positions have a value range of +/- 50000,000 rotations. A motor rotation can be divided into a maximum of 1000 steps. This scaling is independent of the encoder which is used.

The 32Bit value range is divided into a Low and a High word, so that 2 setpoint/actual values are required for transmission.

Direction of transmission	Transmitted data (8 Byte)			
	1st word	2nd word	3rd word	4th word
... to SK TU4	Control word	32Bit setpoint		Setpoint 3
... from the SK TU4	Status word	Actual value 1	32Bit actual value	

Table 19 Depiction of 32Bit setpoint/actual values

It is also possible to only transmit the Low component of the position. This results in a limited value range from +32,767 to -32,768 rotations. This value range can be extended with the aid of the gear ratio factor (P607 & P608). However, it must be noted that there is an according reduction in the resolution.

5.1.6 Example for switching the frequency inverter on and off

In this example, a frequency inverter will be operated with a setpoint (setpoint frequency) and an actual value (actual frequency). The "Maximum Frequency" is 50Hz.

Parameter settings:

- P105 = 500
- P543 = 1
- P546 = 1

Control word	Setpoint 1	Status word	Actual value 1	Explanation
- - -	- - -	0000h	0000h	
- - -	- - -	xx40h	0000h	The mains voltage is switched on at the FI
047Eh	0000h	xx31h	0000h	FI is set to "Standby" status
047Fh	2000h	xx37h	2000h	FI is set to "Operation enabled" status and controlled with a 50% setpoint.
The FI is enabled, the motor is supplied with current and rotates with a frequency of 25Hz.				
0047Eh	2000h	xx31h	0000h	FI is set to "Standby" status, the motor runs up its parameterised ramp to speed 0 and is switched off.
The FI is disabled again and the motor is without current.				
047Fh	1000h	xx37h	1000h	FI is set to "Operation enabled" status and controlled with a 25% setpoint.
The FI is enabled, the motor is supplied with current and rotates with a frequency of 12.5Hz.				

Table 20 Example of setpoint specification

5.1.7 Timeout monitoring

The PROFINET IO data traffic can be monitored with a watchdog with the aid of the time set in parameter P151. If no further cyclical data is sent from the PROFINET IO controller, a module error is detected and set in the FI (E10.3).

Monitoring via the FI parameter P513 is also possible. This is triggered if the process data contact is interrupted or the process data is transferred with an invalid control word (Bit10 in control word = 0). This function is activated when the first valid process data telegram is received.

5.2 Parameter transfer

5.2.1 Function of PROFINET Records

The transfer of parameter data (Records) is performed acyclically. All parameters of the FI and the bus module can be accessed. For this the parameters of the SK TU4-PNT are assigned to Slot 2 and the parameters of the frequency inverters 1 ... 4 are assigned to Slot 3 ... 6.

The illustration below describes the function of Records

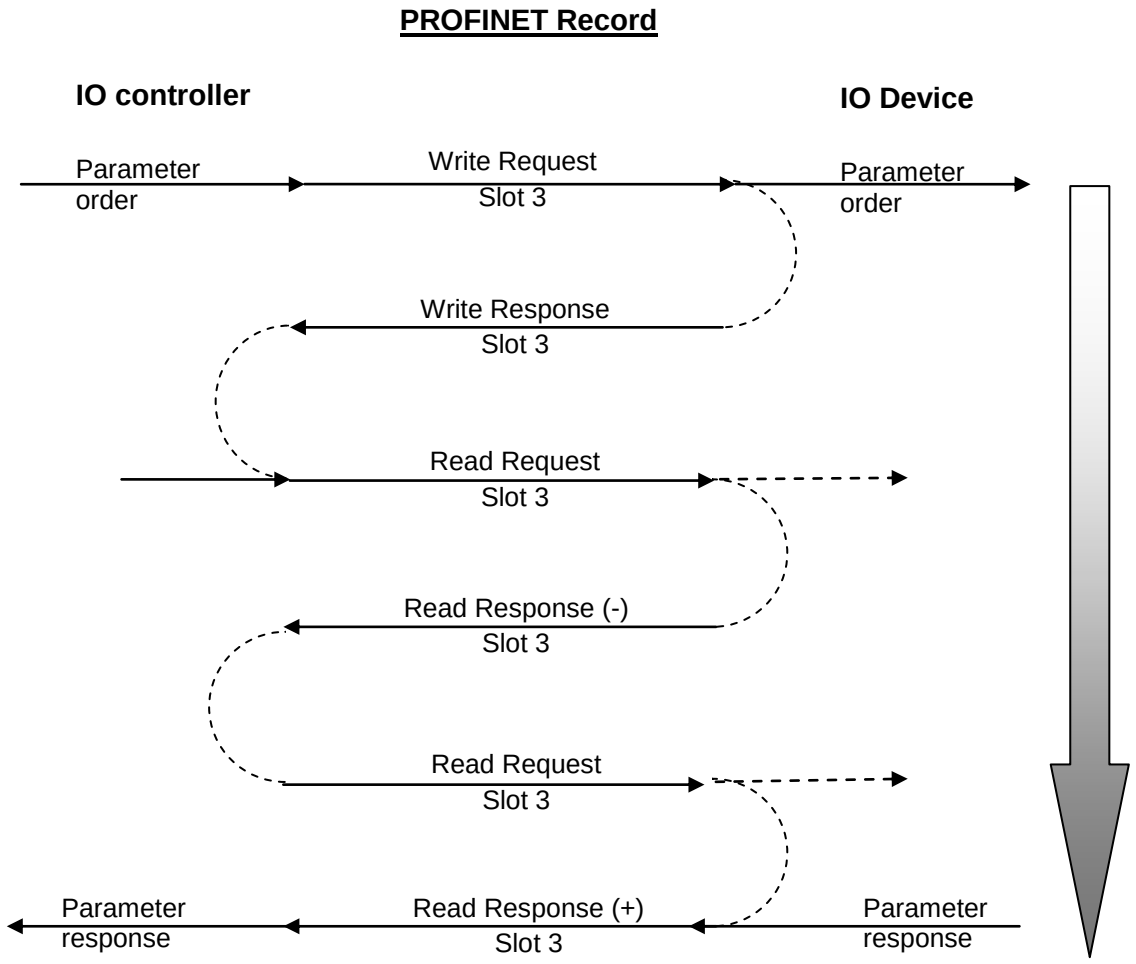


Fig. 10 Function of PROFINET Record

- By means of a "Write Request" the data record is transferred to the IO device (SK TU4-PNT) as a parameter order.
- With "Write Response" the IO controller receives confirmation of the receipt of the message.
- The IO controller requests a response from the SK TU4-PNT with "Read Request".
- The SK TU4-PNT responds with a "Read Response (-)", if processing is not yet complete.
- After processing of the parameter in the SK TU4-PNT the parameter order is concluded with the transfer of the parameter response to the IO controller by means of "Read Response (+)".

5.2.2 Data records

5.2.2.1 Data records 100 to 104

The data records are written to Slot 0. The number of the data record determines the relevant target device. For this:

DS 100 → Access to the technology unit (parameter range 150…199)

DS 101 → Access to the frequency inverter 1 (parameter range 0 … 999, except 150…199)

…

DS 104 → Access to the frequency inverter 4 (parameter range 0 … 999, except 150…199)

NOTE

The inverter parameters are mapped in the range 1000 to 1999, i.e. 1000 must be added to the parameter number for parameterisation (e.g. (P508) - P1508).

Field	Data size	Explanation
Parameter number and order label	2 Bytes	FI or SK TU4 parameter The parameter number is a 16 Bit value (+1000) and can be obtained from the relevant operating manual for the frequency inverter or technology unit. The order label is added to the parameter number. (upper Nibble)
Parameter index	2 Bytes	Parameter sub-index (see Section 5.2.3.2)
Parameter value	4 Bytes	New setting value (See Section 5.2.3.3).

Table 21 Structure of data records 100 and 101

5.2.2.2 Data record 47

This data record is written to Slot 0 and is then assigned to the relevant device on the basis of the axis. The format is compliant withe the ProfiDrive profile.

Field	Data size	Explanation
Order reference	1 Byte	The order reference is transferred from the IO controller and is used for the definitive allocation of the SK TU4-PNT response
Order label	1 Byte	Read / write parameter value etc. (see Section 5.2.3.1)
Axis	1 Byte	Access to SK TU4-PNT parameter or FI parameter 0 = SK TU4-PNT 1 = Frequency inverter 1 2 = Frequency inverter 2 3 = Frequency inverter 3 4 = Frequency inverter 4
Parameter number	2 Bytes	FI or SK TU4 parameter The parameter number is a 16 Bit value (+1000) and can be obtained from the relevant operating manual for the frequency inverter or technology unit.
Parameter index	2 Bytes	Parameter sub-index (see Section 5.2.3.2)
Parameter value	4 Bytes	New setting value (See Section 5.2.3.3).

Table 22 Structure of data record 47

5.2.2.3 Transfer of data record via PPO 1 and PPO 2

PPO1 and PPO2 objects are supported in order to simplify the conversion of an existing PROFIBUS DP system to a PROFINET IO system. In addition to the cyclical IO data, there are also the acyclical parameter data (see Section 5.2.4.4).

5.2.3 Data format

5.2.3.1 Order label field

The following table lists all the orders which can be transferred from the PROFINET IO controller to the frequency inverter. The right-hand column contains the response, which is normally sent (response label positive). Only certain response labels are possible, depending on the order label. In case of error (AK negative) the inverter will always supply the **value 7** in the response label (AK) to the IO controller.

AK	Function	Response label positive
0	No order	0
1	Order parameter value	1 / 2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
4	Reserved	-
5	Reserved	-
6	Order parameter value (array)	4 / 5
7	Change parameter value (array word)	4
8	Change parameter value (array double word)	5
9	Order the number of array elements	6
10	Reserved	-

Table 23 Orders from the controller with the associated response label of the inverter

The following table lists all the orders which can be transferred from the controller to the frequency inverter or the technology units. The right-hand column contains the response, which is normally sent (response label positive). Only certain response labels are possible, depending on the order label. In case of error (AK negative) the inverter always supplies the value 7 in the response label (AK) to the PROFINET IO controller.

AK	Function	Response label positive
11	Change parameter value (array double word) without writing into EEPROM	5
12	Change parameter value (array word) without writing into EEPROM	4
13	Change parameter value (double word) without writing into EEPROM	2
14	Change parameter value (word) without writing into EEPROM	1

Table 24 Orders from the controller with the associated response label of the inverter or technology unit

AK	Function
0	No response
1	Transfer parameter value (word)
2	Transfer parameter value (double word)
4	Transfer parameter value (array word)
5	Transfer parameter value (array double word)
7	Order cannot be executed (with error number in PWE2)

Table 25 Response labels - Meaning

In the response label "Order cannot be executed" (AK = 7), then an error message is added to the parameter value (**PWE2**) of the inverter response. For the meanings of the values transferred, please refer to the following table.

No.	Meaning
0	Invalid parameter number
1	Parameter value cannot be changed
2	Lower or upper value limit exceeded
3	Incorrect sub-index
4	No array
5	Invalid data type (at present only for SK 700E)
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
9	Description data not present
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

Table 26 Response labels – Explanation of error numbers for response label = 7

NOTE

Both the order label and the response label are abbreviated as AK. Therefore, care must be taken when reading or interpreting the order processing description in this section.

5.2.3.2 Parameter index field

The structure and function of the parameter index depends on the type of parameter to be transferred. For values which depend on the parameter set, the parameter set can be selected via Bits 8 and 9 of the Index (0 = parameter set 1, 1 = parameter set 2,...).

If the parameter to be processed is also an array parameter, then the sub-index of the required parameter can additionally be accessed via Bit 10 to Bit 15 of the sub-index (0 = array element 1, 1 = array element 2,…):

Array element	Parameter set	Index
5 (000101_{BIN})	2 (01_{BIN})	15_{HEX} = 0001 0101 $_{BIN}$
21 (010101_{BIN})	4 (11_{BIN})	57 $_{HEX}$ = 0101 0111 $_{BIN}$

Table 27 Example : Address formation for array elements or parameters depending on parameter sets

If a parameter is not dependent on the parameter set, then **Bits 8 – 15** are used for the sub-index.

Please refer to the operating instructions for details of the structure of the individual parameters and which values may be called up.

If the sub-index is used, nos. 6, 7, 8 or 11, 12 must be used as the order label (see Section), in order for the sub-index to be effective (refer to Section 5.2.3.1).

5.2.3.3 Parameter value field

For each parameter, the transfer of the parameter value is always as a word (16 Bit) or double word (32 Bit) For negative values, the High bytes must be filled up with FF $_{hex}$.

The parameter value is transferred as an integer value. For parameters with resolutions 0.1 or 0.01 the parameter value must be multiplied by the inverse of the resolution.

Example: A run-up time of 99.99 seconds is to be set.
99.99s $\rightarrow$ 99.99 * 1/99.99 = 99,99 * 100 = 9999.
Therefore the value 9999 $_{dec}$ = 270F $_{hex}$ must be transferred.

5.2.4 Examples

5.2.4.1 Reading of module parameter P170 Index 0 (actual error)

Data record 100 is used:

Field	Data size	Byte	Datum	Explanation
Order label + Parameter number	2 Byte	 2	0**1** h + 4 92 h **1**4 92 h	Request parameter value (Read) (refer to Section 5.2.3.1) + Parameter number P170 (170_{dec}+1000_{dec}) = 492 h
Parameter index	2 Bytes	3 4	00 h 00 h	Parameter sub-index (refer to Section 5.2.3.2)
Parameter value	4 Bytes	5 6 7 8	00 h 00 h 00 h 00 h	Setting value not set with read order

Table 28 Example telegram for reading parameter P170

S7 Code example:

```
CALL  "WRREC" , DB53              → WriteRequest
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=100                       → Data record 100
LEN   :=8                         → Length: 8 Bytes
DONE  :=#bEnde
BUSY  :=#bBusy
ERROR :=#bError
STATUS:=#wStatus
RECORD:=P#DB10.DBX0.0 BYTE 8      → Data: 14h,92h, 00h,00h, 00h,00h, 00h,00h

CALL  "RDREC" , DB52              → ReadResponse
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=100                       → Data record 100
MLEN  :=8
VALID := …
BUSY  := …
ERROR := …
STATUS:= …
LEN   := …
RECORD:=P#DB10.DBX12.0 BYTE 8     → Response: 14h,92h, 00h,00h, 00h,00h, 03h,FCh
```

The value read is P170 = 1020 (03FCh).

5.2.4.2 Writing the frequency inverter parameter P102 Index 1 (start-up time)

Data record 101 is used:

Field	Data size	Byte	Datum	Explanation
Order label + Parameter number	2 Byte	 2	0**2** h + 44E h _____ 0**2** 44E h	Change parameter value (Write) (refer to Section 5.2.3.1) + Parameter number P102 (102_{dec}+1000_{dec}) = 44E h
Parameter index (Data record)	2 Bytes	3 4	01 h 00 h	Parameter sub-index (refer to Section 5.2.3.2)
Parameter value	4 Bytes	5 6 7 8	00 h 00 h 00 h FA h	The time 2.5s (250 = FA h) is to be set

Table 29 Example telegram for reading parameter P102[-02]

S7 Code example:

```
CALL  "WRREC" , DB53              → WriteRequest
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=101                       → Data record 101
LEN   :=8                         → Length: 8 Bytes
DONE  :=#bEnde
BUSY  :=#bBusy
ERROR :=#bError
STATUS:=#wStatus
RECORD:=P#DB10.DBX0.0 BYTE 8      → Data: 24h, 4Eh, 01h, 00h, 00h, 00h, 00h, FAh

CALL  "RDREC" , DB52              → ReadResponse
REQ   :=#bStart
ID    :=DW#16#7FC                 → Reference
INDEX :=101                       → Data record 101
MLEN  :=8
VALID := …
BUSY  := …
ERROR := …
STATUS:= …
LEN   := …
RECORD:=P#DB10.DBX12.0 BYTE 8     → Response: 14h, 4Eh, 01h, 00h, 00h, 00h, 00h, 00h
```

5.2.4.3 Writing the frequency inverter parameter P105 Index 0 (maximum frequency)

The maximum frequency parameter is to be set to the value 60Hz in data record 1 (Index 0).
Data record 47 is used:

Field	Data size	Byte	Date	Explanation
Order reference	1 Byte	1	xx h	The order reference is used for the precise allocation of the SK TU4-PNT response
Order label	1 Byte	2	02 h	Write parameter value (refer to Section 5.2.3.1)
Axis	1 Byte	3	01 h	Access to FI parameter (0=TU4, 1=FU1, … 4=FU4)
Parameter number	2 Bytes	4 5	04 h 51 h	Parameter number P105 (+1000) = 451 h
Parameter index	2 Bytes	6 7	00 h 00 h	Parameter sub-index (refer to Section 5.2.3.2)
Parameter value	4 Bytes	8 9 10 11	00 h 00 h 02 h 58 h	The maximum frequency 60Hz (600 = 258 h) is to be set

Table 30 Example telegram for writing parameter P105[-01]

S7 Code example:

```
CALL  "WRREC" , DB53              → WriteRequest
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=47                        → Data record 47
LEN   :=11                        → Length: 11 Bytes
DONE  :=#bEnde
BUSY  :=#bBusy
ERROR :=#bError
STATUS:=#wStatus
RECORD:=P#DB10.DBX0.0 BYTE 8      → Data: xxh, 02h, 01h, 04h,51h, 00h, 00h, 00h, 00h, 02h, 58h

CALL  "RDREC" , DB52              → ReadResponse
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=47                        → Data record 47
MLEN  :=11
VALID := …
BUSY  := …
ERROR := …
STATUS:= …
LEN   := …
RECORD:=P#DB10.DBX12.0 BYTE 8     → Response: xxh, 02h, 01h, 04h,51h, 00h,00h, 00h,00h, 00h, 00h
```

5.2.4.4 Example of telegram structure with parameterisation via PPO1 or PPO2

When transferring parameter orders, it must be taken into account that the slave does not immediately respond to orders in the parameter channel of the master telegram, but a positive response can be delayed by one or more communication cycles. The master must therefore repeat the required order until the corresponding slave response is received. PPO type 1 or PPO type 2 must be selected.

The parameter (P102) "run-up time" (PNU = 102_{dec} / 66_{hex}) is to be set to the value 10sec in parameter set 3. (Only the PKW channel is evaluated.)
As the acceleration time has an internal inverter resolution of 0.01sec, a parameter value of 10 / 0.01 = 1000 ($3E8_{hex}$) must be transferred.

Procedure:

1) Specify order label ("Change parameter value (array word)" → AK = 7)
2) Select parameter (P 102_{dec} = P 66_{hex})
3) Select parameter set 3 (IND = 02)
4) Set parameter word (1000_{dec} / $3E8_{hex}$)
5) Check response telegram (positive for array word = 4)

The telegram is composed as follows in hexadecimal notation:

Word	1		2		3		4	
Byte	0	1	2	3	4	5	6	7
Designation	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	70	66	02	00	00	00	03	E8

When the order has been fully implemented by the inverter, it responds with (hexadecimal):

Word	1		2		3		4	
Byte	3	4	5	6	7	8	9	10
Designation	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	40	66	02	00	00	00	03	E8

ATTENTION

If parameter changes are made (i.e. requests via the PKW area by the control master), care must be taken that the maximum number of permissible writing cycles to the frequency inverter EEPROM (100,000 cycles) is not exceeded. I.e. continuous cyclical writing must be prevented.

For certain applications it is sufficient if the values are only saved in the RAM memory of the frequency inverter. The corresponding setting is made via parameter (P560) "Save in EEPROM".

6 Parameters

In order to enable communication via PROFINET IO, the frequency inverter and the PROFINET IO technology unit must be parameterised accordingly.

6.1 Parameters for frequency inverter SK200E

The following list of parameters for the frequency inverter series SK 200E are directly relevant for the operation of the frequency inverter via PROFINET IO. A complete list of parameters for the frequency inverter (SK 200E) can be found in the relevant manual (BU0200).

6.1.1 Basic parameters (P1xx)

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P120 **… [-01] ... … [-04]**	**Option monitoring** *(Options monitoring)*	SK 2xxE	S	
0 ... 2 { 1 }	**Array levels:** **… [-01] =** Extension 1 (BUS TB) **… [-02] =** Extension 2 *(2 .I/O-TB)* (ZBG2) **… [-03] =** Extension 3 *(1st. I/O TB)* (ZBG1) **… [-04] =** Extension 4 (reserved)			

Setting value for each array:

0 = Monitoring OFF

1 = Auto, communication is only monitored if an existing communication is interrupted. If a module which was previously present is not found when the network is switched on, this does not result in an error. Monitoring only becomes active when the extension begins communication with the FI.

2 = Monitoring active immediately; the FI starts monitoring the corresponding module immediately after it is switched on. If the module is not detected on switch-on, the FI remains in the status "not ready for switch-on" for 5 seconds and then triggers an error message.

6.1.2 Control terminal parameter (P4xx)

Parameters {Factory setting}		Setting value / Description / Note	Device	Supervisor	Parameter set
P420	**… [-01]** **...** **… [-04]**	**Digital inputs** *(Digital inputs)*	SK 2xxE		

0 ... 77
{ [-01] = 01 }
{ [-02] = 02 }
{ [-03] = 04 }
{ [-04] = 05 }

In the SK 200E, up to 4 freely programmable digital inputs are available. The only restriction is with the versions SK 215E and SK 235E. Here, the fourth digital input is always the input for the function "Safe Stop".

... [-01] = Digital input 1 (DIN1)**, Enable right** as factory setting, control terminal 21

... [-02] = Digital input 2 (DIN2)**, Enable left** as factory setting, control terminal 22

… [-03] = Digital input 3 (DIN3)**, fixed frequency 1** (P465 [-01]) as factory setting, control terminal 23

… [-04] = Digital input 4 (DIN4)**, fixed frequency 2** (P465 [-02]) as factory setting, not with SK 215/235E → "Safe Stop", control terminal 24

Various functions can be programmed. For the complete list, please refer to the SK 200E frequency inverter manual (BU0200).

NOTE: The additional digital inputs of the field bus group are managed via parameter (P480).

Excerpt...

Value	Function	Description	Signal
00	No function	Input switched off.	---
… **14** [1] **…**	Remote control	With bus system control, low level switches the control to control via control terminals.	High

[1] Also effective for bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)

Parameters {Factory setting}		Setting value / Description / Note	Device	Supervisor	Parameter set
P480	**... [-01]** **...** **... [-12]**	**Function of BusIO In Bits** *(Function Bus I/O In Bits)*	SK 2xxE		

0 ... 77
{ [-01] = 01 }
{ [-02] = 02 }
{ [-03] = 05 }
{ [-04] = 12 }
{ [-05...-12] = 00 }

The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420).

These I/O bits can also be used in combination with the AS Interface (SK 225E or SK 235E) or the I/O extension (SK CU4-IOE or SK TU4-IOE).

… [-01] = Bus I/O In Bit 0
… [-02] = Bus I/O In Bit 1
… [-03] = Bus I/O In Bit 2
… [-04] = Bus I/O In Bit 3
… [-05] = Bus I/O In Bit 4
… [-06] = Bus I/O In Bit 5
… [-07] = Bus I/O In Bit 6
… [-08] = Bus I/O In Bit 7
… [-09] = Flag 1
… [-10] = Flag 2
… [-11] = Bit 8 BUS control word
… [-12] = Bit 9 BUS control word

The possible functions for the bus In bits can be found in the table of functions for the digital inputs in parameter (P420).

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P481 **... [-01] ... ... [-10]**	**Function of BusIO Out Bits** *(Function Bus I/O Out Bits)*	SK 2xxE		
0 ... 39 { [-01] = 18 } { [-02] = 08 } { [-03] = 30 } { [-04] = 31 } { [-05...-10] = 00 }	The bus I/O Out bits are perceived as multi-function relay outputs. They can be set to the same functions (P434). These I/O bits can also be used in combination with the AS Interface (SK 225E or SK 235E) or the I/O extension (SK CU4-IOE or SK TU4-IOE). **… [-01] =** Bus I/O Out Bit 0 **… [-02] =** Bus I/O Out Bit 1 **… [-03] =** Bus I/O Out Bit 2 **… [-04] =** Bus I/O Out Bit 3 **… [-05] =** Bus I/O Out Bit 4 **… [-06] =** Bus I/O Out Bit 5 **… [-07] =**Flag 1 **… [-08] =** Flag 2 **… [-09] =** Bit 10 BUS status word **… [-10] =** Bit 13 BUS status word The possible functions for the bus Out bits can be found in the table of functions for the relay (P434)			
P482 **... [-01] ... ... [-10]**	**Norm. BusIO Out Bits** *(Standardisation of bus I/O Out bits)*	SK 2xxE		
-400 … 400 % { all 100 }	Adjustment of the limit values of the bus Out bits. For a negative value, the output function will be output negative. Once the limit value is reached and positive values are delivered, the output produces a High signal, for negative setting values a Low signal.			
P483 **... [-01] ... ... [-10]**	**Hyst. BusIO Out Bits** *(Hysteresis of bus I/O Out bits)*	SK 2xxE	S	
1 … 100 % { all 10 }	Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

6.1.3 Supplementary parameters (P5xx)

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P509	**Source Control Word** *(Source control word)*	SK 2xxE	S	
0 ... 4 { 0 }	Selection of the interface via which the FI is controlled. **0 = Control terminals or keyboard control**** with the SimpleBox (if (P510)=0), the ParameterBox or via BUS I/O Bits. **1 = Only control terminals ***, the FI can only be controlled via the digital and analog input signals or via the bus I/O bits. **2 = USS ***, the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies. **3 = System bus** *, the control signals (enable, direction of rotation, ...) are transferred via the system bus (the field bus module and the frequency inverter communicate via the system bus). I.e. the setting "3" - "System bus" must be selected in parameter (P509) for control of the frequency inverter via the field bus. **4 = System bus broadcast *** *) Keyboard control (SimpleBox, ParameterBox, PotentiometerBox) is disabled, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will disable without an error message.			
NOTE:	For details of the optional bus systems, please refer to the relevant supplementary bus manuals (BU02x0). As an alternative to setting the parameter, **System Bus** can also be selected with DIP switch 3.			

P510 ... [-01] ... [-02]	**Setpoint source** *(Setpoint source)*	SK 2xxE	S	
0 ... 4 { [-01] = 0 } { [-02] = 0 }	Selection of the setpoint source to be parameterised. **… [-01] =** Main setpoint source **… [-02] =** Subsidiary setpoint source Selection of the interface via which the FI receives the setpoint. **0 = Auto:** The setpoint source is automatically derived from the setting in the parameter P509 >Control word source<. **1 = Control terminals**, digital and analog inputs control the frequency, including fixed frequencies **2 = USS** **3 = System bus** **4 = System bus broadcast**			

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P513	**Telegram timeout** *(Telegram timeout)*	SK 2xxE	S	
-0.1 / 0.0 / 0.1 ... 100.0 s { 0.0 }	If the frequency inverter is directly controlled via the CAN protocol or via RS485, this communication path can be monitored via parameter (P513). Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the FI reports an error and switches off with the error message E010 >Bus Time Out<. The inverter monitors the system bus communication via parameter (P120). Therefore parameter (P513) must usually be left in the factory setting {0.0}. Parameter (P513) must only be set to {-,0,1} if faults detected by the optional module (e.g. communication errors on the field bus level) are not to result in the drive unit being switched off. **0.0 =** **Off**: Monitoring is **switched off**. **-0.1 =** **No error**: Even if the bus module detects an error, this does not cause the frequency inverter to be switched off. 0.1… = **On**: Monitoring is activated. Note: If a setting is made in this parameter in spite of this, values lower than 0.6s cause an error in the FI due to the fixed definition of the system bus baud rate.			
P514	**CAN baud rate** *(CAN baud rate (system bus))*	SK 2xxE	S	
0 ... 7 { 5 }**	Setting of the transfer rate (transfer speed) via the system bus interface. All bus participants must have the same baud rate setting. **5 =** 10kBaud **8 =** 100kBaud **11 =** 500kBaud **6 =** 20kBaud **9 =** 125kBaud **12 =** 1Mbaud * **7 =** 50kBaud **10 =** 250kBaud** *) Reliable operation cannot be guaranteed **) for communication with the bus module, the parameter must be left at the factory setting (250kBaud) otherwise no communication is possible.			
P515 **... [-01]** **…** **... [-03]**	**CAN bus address** *(CAN address (system bus))*	SK 2xxE	S	
0 ... 255 dec { all 32 dec} or { all 20 hex}	Setting of the system bus address. **… [-01] =** Receive address for system bus **… [-02] =** Broadcast – Receive address for system bus (slave) **… [-03] =** Broadcast – Transmit address for system bus (master)			
	NOTE: If up to four SK 200E are to be linked via the system bus, the addresses must be set as follows →FI 1 = 32, FI 2 = 34, FI 3 = 36, FI 4 = 38. The system bus addresses should be set via the DIP switches 1/2 (Fig. 3)			

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P543 … [-01] ... … [-03]	**Actual bus value 1 … 3** *(Actual bus value 1 … 3)*	SK 2xxE	S	P

0 ... 22
{ [-01] = 01 }
{ [-02] = 04 }
{ [-03] = 09 }

The return value can be selected for bus actuation in this parameter.

NOTE: For further details, please refer to the description of (P418).

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

Possible values which can be set:

0 = Off
1 = Actual frequency
2 = Actual speed
3 = Current
4 = Torque current (100% = P112)
5 = State of digital inputs and outputs[2]
6 = ... 7 Reserved
8 = Setpoint frequency
9 = Error number
10 = ... 11 Reserved
12 = Bus Out bits 0...7
13 = ... 16 Reserved
17 = Value analog input 1 (P400)
18 = Value analog input 2 (P400)
19 = Setpoint frequency master value (P503)
20 = Setpoint frequency after master value ramp
21 = Actual frequency without master value slip
22 = Speed from encoder

P546 … [-01] ... … [-03]	**Fnct. Bus setpoint 1 ... 3** *(Function of bus setpoint 1 ... 3)*	SK 2xxE	S	P

0 ... 24
{ [-01] = 01 }
{ [-02] = 00 }
{ [-03] = 00 }

In this parameter, a function is allocated to the output setpoint during bus actuation.

NOTE: For further details please refer to the description of (P400).

… [-01] = Bus setpoint value 1
… [-02] = Bus setpoint value 2
… [-03] = Bus setpoint value 3

Possible values which can be set:

0 = Off
1 = Setpoint frequency (16 bit)
2 = Frequency addition
3 = Frequency subtraction
4 = Minimum frequency
5 = Maximum frequency
6 = PI process controller actual value
7 = PI process controller setpoint
8 = Actual frequency PID
9 = Actual PID frequency limited
10 = Actual PID frequency monitored
11 = Limiting torque current
12 = Torque current switch-off limit
13 = Limiting current
14 = Current switch-off limit
15 = Ramp time
16 = Lead torque (P214) multiplication
17 = Servo mode torque
18 = Curve travel calculator
19 = Digital In bits 0...7
20 = ...24 reserved for Posicon

[2] The assignment of the digital inputs for P543 = 5

Bit 0 = DigIn 1 (FU)	Bit 1 = DigIn 2 (FU)	Bit 2 = DigIn 3 (FU)	Bit 3 = DigIn 4 (FU)
Bit 4 = PTC input (FU)	Bit 5 = Reserved	Bit 6 = DigOut 3 (DO1, 1.SK…IOE)	Bit 7 = DigOut 4 (DO2, 1.SK…IOE)
Bit 8 = DigIn 5 (DI1, 1.SK…IOE)	Bit 9 = DigIn 6 (DI2, 1.SK…IOE)	Bit 10 = DigIn 7 (DI3, 1.SK…IOE)	Bit 11 = DigIn 8 (DI4, 1.SK…IOE)
Bit 12 = DigOut 1 (FU)	Bit 13 = mech. brake (FU)	Bit 14 = DigOut 2 (FI) (SK 2x0E)	Bit 15 = Reserved

Parameters {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P552 **… [-01]** **… [-02]**	**CAN master cycle** *(CAN master cycle time (system bus))*	SK 2xxE	S	
0 / 0.1 … 100.0 ms { 0 }	In this parameter, the cycle time for the system bus master mode and the CAN open encoder is set (see P503/514/515): **… [01] =** Cycle time for system bus master functions **… [02] =** Cycle time for system absolute value encoder With the setting **0 = "Auto"** the default value (see table) is used. According to the Baud rate set, there are different minimum values for the actual cycle time:			

Baud rate	Minimum value t_Z	Default system bus master	Default system bus abs.
10kBaud	10ms	50ms	20ms
20kBaud	10ms	25ms	20ms
50kBaud	5ms	10ms	10ms
100kBaud	2ms	5ms	5ms
125kBaud	2ms	5ms	5ms
250kBaud	1ms	5ms	2ms
500kBaud	1ms	5ms	2ms
1000kBaud:	1ms	5ms	2ms

P560	**Parameter, saving mode** *(Parameter, saving mode)*	SK 2xxE	S	
0 ... 1 { 1 }	**0 =** Changes to the parameter settings are no longer saved on the EEPROM. Previously saved settings remain stored, even if the FI is disconnected from the mains; however new changes are not saved after a mains failure. **1 =** All parameter changes are automatically written to the EEPROM and remain stored there even if the FI is disconnected from the mains supply. **NOTE:** If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles (100,000 x) in the EEPROM is not exceeded.			

6.1.4 Information parameters (P7xx)

Parameters	Setting value / Description / Note	Device	Supervisor	Parameter set
P700 **[-01] ... [-03]**	**Present operating status** *(Present operating status)*	SK 2xxE		
0.0 ... 25.4	Display of current messages for the present operating status of the frequency inverter such as errors, warnings or the reason why switch-on is disabled. For details of the messages, see BU 0200. **[-01] = Present fault,** shows the currently active (unacknowledged) fault. **[-02] = Present warning,** indicates a current warning message. **[-03] = Reason for disabled starting,** indicates the reason for an active start disable. **NOTE** *SimpleBox/ControlBox:* with the SimpleBox or ControlBox only warning messages and errors can be displayed. Display of the messages is in encoded form. *ParameterBox:* with the ParameterBox the messages are displayed in plain text. In addition, the reason for a possible disabling of starting can also be displayed. *Bus:* The display of bus-level error messages is made in decimal integer format. If this value is divided by 10, the display corresponds to that in the SimpleBox or ControlBox. Example: Display: 20 → Error number: 2.0			
P701 **... [-01] ... ... [-05]**	**Last fault 1..5** *(Last fault 1 ... 5)*	SK 2xxE		
0.0 ... 25.4	This parameter stores the last 5 faults. Further details are described in the frequency inverter manual (BU0200). With the SimpleBox the corresponding memory location 1...5 (Array parameter), must be selected and confirmed with the ENTER key in order to read the stored error code.			
P740 **... [-01] ... ... [-13]**	**Process data bus In** *(Process data bus in)*	SK 2xxE	S	
0000 ... FFFF (hex)	This parameter provides information about the actual control word (STW) and the setpoints (SW1-3) that are transferred via the bus systems. For values to be displayed, a bus system must be selected in P509.			
	... [-01] = Control word — Control word, source from P509.			
	... [-02] = Setpoint 1 (P546 [-01]) **... [-03] =** Setpoint 2 (P546 [-02]) **... [-04] =** Setpoint 3 (P546 [-03]) — Setpoint data from main setpoint P510 - 01.			
	... [-05] = Bus I/O In bits (P480) — The displayed value depicts all Bus In bit sources linked with *OR*.			
	... [-06] = Parameter data In 1 **... [-07] =** Parameter data In 2 **... [-08] =** Parameter data In 3 **... [-09] =** Parameter data In 4 **... [-10] =** Parameter data In 5 — Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)			
	... [-11] = Setpoint 1 **... [-12] =** Setpoint 2 **... [-13] =** Setpoint 3 — Setpoint data from master function value (Broadcast), if P509/510 = 4 (P502/P503)			

Parameters	Setting value / Description / Note	Device	Supervisor	Parameter set
P741 **... [-01]** **...** **... [-10]**	**Process data bus Out** *(Process data bus out)*	SK 2xxE	S	

0000 ... FFFF (hex)

This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.

… [-01] = Status word	Status word
... [-02] = Actual value 1 (P543 [-01]) **... [-03] =** Actual value 2 (P543 [-02]) **... [-04] =** Actual value 3 (P543 [-03])	
... [-05] = Bus I/O Out Bit (P481)	The displayed value depicts all bus Out bit sources linked with *OR*.
… [-06] = Parameter data Out 1 **… [-07] =** Parameter data Out 2 **… [-08] =** Parameter data Out 3 **… [-09] =** Parameter data Out 4 **… [-10] =** Parameter data Out 5	Data during parameter transfer.

P748	**CANopen status** *(CANopen status (system bus status))*	SK 2xxE		

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

Shows the status of the system bus.

Bit 0:	24V Bus supply voltage	
Bit 1:	CANbus in "Bus Warning" status	
Bit 2:	CANbus in "Bus Off" status	
Bit 3:	Bus module is online	
Bit 4:	Additional module 1 is online	
Bit 5:	Additional module 2 is online	
Bit 6:	The protocol of the CAN module is	0 = CAN / 1 = CANopen
Bit 7:	Vacant	
Bit 8:	"Bootup Message" sent	
Bit 9:	CANopen NMT State	
Bit 10:	CANopen NMT State	

CANopen NMT State	Bit 10	Bit 9
Stopped	0	0
Pre- Operational	0	1
Operational	1	0

P749	**Status of DIP switches** *(Status of DIP switches)*	SK 2xxE		

0000 ... 00FF (hex)
or
0 ... 255 (dec)

This parameter shows the current setting of the FI (Fig. 3) DIP switch.

Bit 0:	DIP switch 1	Bit 4:	DIP switch 5
Bit 1:	DIP switch 2	Bit 5:	DIP switch 6
Bit 2:	DIP switch 3	Bit 6:	DIP switch 7
Bit 3:	DIP switch 4	Bit 7:	DIP switch 8

6.2 Parameterisation of the bus module (SK TU4-…)

The following parameters affect the bus modules.

6.2.1 BUS module standard parameters (P15x)

Parameters {Factory setting}	Setting value / Description / Note	Device	Parameter type	
P150	**Set relays** *(Set relays / digital outputs)*	SK TU4-PNT	8 bit	
0 ... 4 { 0 }	**0 =** Via bus **1 =** Outputs OFF **2 =** Output 1 ON (DO1) **3 =** Output 2 ON (DO2) **4 =** Outputs 1 and 2 ON			
P151	**Timeout for external bus** *(Timeout for external bus)*	SK TU4-PNT	16 bit	
0 ... 32767 ms { 0 }	Monitoring function of the active bus technology unit. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the inverter reports an error and switches off with the error message E010 / E10.2 >Bus Time Out< >Bus Time Out<. **0 = OFF:** Monitoring is switched off. Behaviour is identical to parameter (P513) telegram timeout for SK 200E.			
P152	**Factory setting** *(Load factory setting)*	SK TU4-PNT	8 bit	
0 ... 1 { 0 }	By selecting the appropriate value and confirming it with the ENTER key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0. **0 = No change:** Does not change the parameterisation. **1 = Load factory settings:** The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost.			
P153 **… [-01]** **… [-02]**	**Min. system bus cycle** *(Minimum system bus cycle time)*	SK TU4-PNT	16 bit	
0 ... 250 ms { [-01] = 10 } { [-02] = 05 }	In order to reduce the bus load, an inhibit time for the system bus can be set in this parameter. **… [-01] =** SDO Inhibit time **… [-02] =** PDO Inhibit time			
P154 **… [-01]** **… [-02]**	**TB-IO access** *(Access to technology unit IOs)*	SK TU4-PNT	8 bit	
0 ... 5 { [-01] = 0 } { [-02] = 0 }	The writing and reading rights of the connected frequency inverter to the inputs and outputs of the technology unit are assigned in this parameter. **… [-01] =** Inputs — **… [-02] =** Outputs **0 = Off**, no effect — **3 = FI 2**, reads and writes to the IOs **1 = Broadcast**, read all FIs — **4 = FI 3**, reads and writes to the IOs **2 = FI 1**, reads and writes to the IOs — **5 = FI 4**, reads and writes to the IOs			

6.2.2 Parameters specific to PROFINET IO modules (P16x)

Access: Read / Write

Parameters {Factory setting}	Setting value / Description / Note	Device	Parameter type	
P160 **… [-01] … … [-04]**	**IP address** *(IP address)*	SK TU4-PNT	8 bit	
0 ... 255 { [-01] = 192 } { [-02] = 168 } { [-03] = 20 } { [-04] = 200 }	Parameterised IP address consisting of four bytes. In case of a change to the IP address (e.g. with NORD CON), this is only saved by writing it to Index 4. **NB:** Saving is prevented if the IP address which is entered does not correspond to the convention. If there are contradictions between the IP address and the mask (P161), the mask is corrected automatically. Deletion of the IP settings (IP+sub-net mask) is performed by entering IP 0.0.0.0. **[-01] =** IP High (NET-ID) **[-03] =** IP (NET ID) **[-02] =** IP (NET-ID) **[-04] =** IP Lo (Host)			
P161 **… [-01] … … [-04]**	**IP sub-net mask** *(IP sub-net mask)*	SK TU4-PNT	8 bit	
0 ... 255 { [-01] = 255 } { [-02] = 255 } { [-03] = 255 } { [-04] = 0 }	Parameterised IP mask consisting of four bytes. In case of a change to the IP mask (e.g. with NORD CON), this is only saved by writing it to Index 4. **NB:** Saving is prevented if the entered IP address is inconsistent with the IP address. **Example:** IP-Add: 192.168.20.200, IP mask: 255.255.255.0 → Correct IP-Add: 192.168.20.200, IP mask: 255.0.0.0 → Error			
P162	**Device name** *(Device name)*	SK TU4-PNT	8 bit	
45 ... 122	The device name can be queried or changed with this parameter. Character strings with a length of up to 240 characters are possible. Characters 45 to 122 from the ASCII Code can be used. The name is saved after the entry of a 0 at the end of the character string.			
P163 **… [-01] … … [-07]**	**Alarm test** *(Test alarm)*	SK TU4-PNT	8 bit	
0 ... 255 all { 0 }	This parameter is used, e.g to trigger a diagnostic alarm from a slot during commissioning. A frequency inverter error can be simulated by entering the value of the error (e.g. link circuit overvoltage = E005.0 → Value 50) in the slot of the relevant inverter (e.g.: Slot 3). An "incoming" alarm is triggered. If the value is reset to 0 the alarm is "outgoing". **Example:** Trigger alarm with error 5.0 on Slot 2: P163[-04] = 50 → ChannelErrorType= 0x100+50=0x132 **[-01] =** Slot 0 (DAP - reserved) **[-05] =** Slot 4 (FU 2) **[-02] =** Slot 1 (reserved) **[-06] =** Slot 5 (FU 3) **[-03] =** Slot 2 (TU) **[-07] =** Slot 6 (FU 4) **[-04] =** Slot 3 (FU 1)			

6.2.3 BUS module information parameters, general (P17x)

Parameters	Setting value / Description / Note	Device	Parameter type	
P170 **... [-01]** **... [-02]**	**Present error** *(Present fault / error)*	SK TU4-PNT	16 bit	
0 ... 9999	Actual error present. Further details in Section 7.2 "Error messages". **… [-01]** = Current module error **… [-02]** = Last module error **Possible values:** **1000 =** EEPROM error **1010 =** System bus 24V missing **1020 =** System bus timeout (see time in P151) **1030 =** System bus OFF **Specific to PROFINET IO)** **5500 =** No Ethernet connection **5501 =** Hardware error			
P171 **... [-01]** **...** **... [-03]**	**Software version** *(Software version / revision)*	SK TU4-PNT	16 bit	
0,0 ... 9999.9	This parameter shows the software and revision numbers in the module. Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version. **… [-01]** = Software version **… [-02]** = Software revision **… [-03]** = Special version			
P172	**Configuration** *(Configuration)*	SK TU4-PNT	16 bit	
0 ... 3	The version can be queried in this parameter. **Possible displayed values:** **0 =** Internal module (SK CU4) **1 =** External module (SK TU4) **2 =** Bus TB via SPI (SK TU3)			

Parameters	Setting value / Description / Note	Device	Parameter type	
P173	**Module status** *(Module status)*	SK TU4-PNT	16 bit	
0 ... FFFF (hex)	**Explanation of bits:** Bit 0 = Initialisation Bit 1 = AR installed Bit 2 = Reserved Bit 3 = Timeout (P151 / P513) Bit 4 = Reserved Bit 5 = Ethernet connection Bit 6 = System bus “BUS WARNING” Bit 7 = System bus "BUS OFF" Bit 8 = Status FI 1 Bit 9 = Status FI 1 Bit 10= Status FI 2 Bit 11= Status FI 2 Bit 12= Status FI 3 Bit 13= Status FI 3 Bit 14= Status FI 4 Bit 15= Status FI 4 **Status for FI x:** Bit High Bit Low status 0 0 FI is offline 0 1 unknown FI 1 0 FI is online 1 1 FI missing or switched off			
P174	**Status of digital input** *(Status of digital inputs)*	SK TU4-PNT	8 bit	
0 ... 255_{dec} $(00000000 ... 11111111)_{bin}$	Instantaneous view of input level logic. **Possible displayed values:** Bit 0= Input 1 ((DIN1) (of BUS module)) Bit 1= Input 2 ((DIN2) (of BUS module)) Bit 2= Input 3 ((DIN3) (of BUS module)) Bit 3= Input 4 ((DIN4) (of BUS module)) Bit 4= Input 5 ((DIN5) (of BUS module)) Bit 5= Input 6 ((DIN6) (of BUS module)) Bit 6= Input 7 ((DIN7) (of BUS module)) Bit 7= Input 8 ((DIN8) (of BUS module))			
P175	**Relay status** *(Status of relays / Digital outputs)*	SK TU4-PNT	8 bit	
0 ... 3_{dec} $(00 ... 11)_{bin}$	Instantaneous view of output level logic. **Possible displayed values:** Bit 0= Output 1 ((DO1) (of BUS module)) Bit 1= Output 2 ((DO2) (of BUS module))			

Parameters	Setting value / Description / Note	Device	Parameter type	
P176 **... [-01]** **...** **... [-25]**	**Process data Bus In** *(process data, Bus In)*	SK TU4-PNT	16 bit	
-32768 ... 32767	Bus data received from PROFINET IO controller			

... [-01] = Bus module outputs
... [-02] = Control word FI 1
... [-03] = Setpoint 1 for FI 1
... [-04] = Setpoint 2 for FI 1
... [-05] = Setpoint 3 for FI 1
... [-06] = Setpoint 4 for FI 1
... [-07] = Setpoint 5 for FI 1
... [-08] = Control word FI 2
... [-09] = Setpoint 1 for FI 2
... [-10] = Setpoint 2 for FI 2
... [-11] = Setpoint 3 for FI 2
... [-12] = Setpoint 4 for FI 2
... [-13] = Setpoint 5 for FI 2
...
... [-25] = Setpoint 5 for FI 4

Parameters	Setting value / Description / Note	Device	Parameter type	
P177 **... [-01]** **...** **... [-25]**	**Process data Bus Out** *(Process data Bus Out)*	SK TU4-PNT	16 bit	
-32768 ... 32767	Bus data sent from PROFINET IO controller			

... [-01] = Bus module inputs
... [-02] = Status word FI 1
... [-03] = Actual value 1 for FI 1
... [-04] = Actual value 2 for FI 1
... [-05] = Actual value 3 for FI 1
... [-06] = Actual value 4 for FI 1
... [-07] = Actual value 5 for FI 1
... [-10] = Status word FI 2
... [-11] = Actual value 1 for FI 2
... [-12] = Actual value 2 for FI 2
... [-13] = Actual value 3 for FI 2
... [-14] = Actual value 4 for FI 2
... [-15] = Actual value 5 for FI 2
...
... [-25] = Actual value 5 for FI 5

6.2.4 Module information parameters specific to the bus (P18x)

Access: Read only

Parameters		Setting value / Description / Note	Device	Parameter type	
P180	**... [-01]** **...** **... [-07]**	**PPO TYPE** *(PPO Type / Module ID)*	SK TU4-PNT	8 bit	
0 ... 7		The module ID (see gsdml file) for the slots can be queried with this parameter. Caution: meaningful values can only be read out with an existing AR. **Possible values:** **0 = Empty slot** **1 = Reserved slot** **2 = DIG-IO,** Process data for the TU **3 = PPO3,** Process data for the FI **4 = PPO4,** Process data for the FI **5 = PPO6,** Process data for the FI **6 = PPO1,** Process or parameter data for the FI **7 = PPO2,** Process or parameter data for the FI **[-01] =** Reserved **[-02] =** Reserved **[-03] =** Slot 3 (FI) **[-04] =** Reserved **[-05] =** Reserved **[-06] =** Reserved **[-07] =** Reserved			
P181	**... [-01]** **...** **... [-06]**	**MAC address** *(MAC address)*	SK TU4-PNT	8 bit	
0 ... 255		The Ethernet address (MAC address) can be read out from this parameter. **[-01] ... [-03]** PROFINET identification **[-04] ... [-06]** Manufacturer's address range (NORD: from 03.60.00) **Example:** (00:0E:CF:03:60:00)			
P185	**... [-01]** **...** **... [-04]**	**Present IP address** *(Present IP address)*	SK TU4-PNT	8 bit	
0 ... 255		The present IP address can be read out from this parameter. This may deviate from the saved address (P160) if the PROFINET IO controller reconfigures the parameter. **[-01] ... [-04]** IP address			
P186	**... [-01]** **...** **... [-04]**	**Present IP sub-net mask** *(Present IP sub-net mask)*	SK TU4-PNT	8 bit	
0 ... 255		The present IP mask can be read out from this parameter. This may deviate from the saved mask (P161) if the PROFINET IO controller reconfigures the parameter. **[-01] ... [-04]** IP mask			

NOTE

When activated, the functions **Disable Current**, **Quick Stop**, **Remote Control** and **Acknowledge Error**, are available at the (local) terminals. To operate the drive, a High signal must be present on the digital inputs being used before the drive can be enabled.

7 Error monitoring and error messages

7.1 Error monitoring

The majority of bus module and frequency inverter functions and operating data are continuously monitored and simultaneously compared with limiting values. If a deviation is detected, the bus module or inverter reacts with a warning or an error message.

For detailed information, please refer to the relevant main manual of the frequency inverter.

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

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

1. Switching the mains off and on again,
2. by means of a correspondingly programmed digital input
   (SK 200E: (P420) [-…], function {12} or
   SK 500E: (P420 ... P425), function {12}),
3. by switching off the “enable” on the frequency inverter
   (if no digital input is programmed for acknowledgement),
4. by Bus acknowledgement or
5. by parameter (P506), "automatic error acknowledgement".

Visualisation of the inverter error codes is made via the frequency inverter (see relevant manual).

Errors which are attributable to bus operation are visualised via the bus module. The precise error message is displayed in parameter (P170).

NOTE

An error relating to the PROFINET IO communication is only displayed (P170 [-01]) for as long as it is active. Once the error is remedied, the message is automatically deleted and is archived in parameter (P170 [-02]) as the last error message.

If the power supply is interrupted before the error is remedied, the error is lost, i.e. it is not archived.

NOTE

The display of a bus error is shown in the operating display of the SimpleBox **SK CSX-3H** by means of the error group number **E1000**. In order to obtain the precise error number, the module information parameter (P170) must be selected. The current error is shown in Array [-01] of this parameter, the last error is stored in Array [-02].

7.1.1 Error monitoring details

Various monitoring functions are available to ensure reliable bus operation.

- Timeout monitoring at the field bus level (PROFINET IO) by means of
  - PROFINET watchdogs
  - Parameter (P151)
- Timeout monitoring at system bus level
  - Parameter (P120) or (P513)
- Function monitoring within the bus module
  - Parameter (P170)

With the aid of the "Timeout Monitoring" communication problems are detected, which are either related to general functionalities ("No bus communication") or are related to special modules ("Failure of a participant").

General process data monitoring of a Technology Unit (SK xU4-…)

The parameter (P151) "Timeout external bus" generally monitors the existence of bus communication. If no process data is received within the parameterised monitoring time (The content of the process data is irrelevant) the subscriber assumes that the bus communication to this subscriber is generally faulty and reports an error.

This error is also triggered if process data with an invalid control word (Bit 10 in control word = 0) is received. This function is activated when the first valid process data telegram is received.

General monitoring of frequency inverter process data

SK 500E series frequency inverters offer the facility for monitoring the active bus interface by means of the parameter (P513) "Telegram timeout". If the frequency inverter does not receive a telegram within the time entered here, it assumes that there is a general fault with the bus communication and reports an error.

Note: With SK 200E series frequency inverters, the function of this parameter is implemented by parameter (P120). Communication errors are therefore reported via the bus module. Parameterisation of (P513) is therefore not necessary. (P513) should be left at the factory setting.

Option monitoring

With the parameter (P120) "Option monitoring", SK 200E series frequency inverters provide the facility for monitoring connected technology units (SK xU4-…) with regard to their current functional status. Generally, this function corresponds to monitoring via parameter (P513). This parameter (P513) should therefore be left at the factory setting.

7.1.2 PROFINET error monitoring

An error in the frequency inverter (P700) or in the SK TU4-PNT (P170) results in a diagnostic alarm which is transmitted to the control unit as an "incoming event". The error value is coded as follows:

Error number (Value from P700 or P170) + 100 h = Alarm number of the diagnostic alarm

Example:

During operation, the error E10.3 (P700 Index 1 = 103) = Timeout occurs via the P151 monitoring. The SK TU4-PNT sends a diagnostic alarm with the value 359 (= 100h + 103 = 256 + 103 = 359) to the control unit.

Format	Error number	Alarm code	Alarm number
Decimal	10.3 = 103_{dec}	256_{dec}	103 + 256 = 359_{dec}
Hexadecimal	= 67_{hex}	100_{hex}	= 167_{hex}

If the error is no longer present a diagnostic alarm ("incident removed") is sent, which resets the error in the control unit.

With the aid of parameter P163, e.g. during commissioning, various alarms can be sent in order to test the operation of the control program.

Loss or switch-off of an inverter connected via the system bus:

On loss of connection of the SK TU4-PNT to an FU connected via the system bus an alarm with the error number 1000 (in the diagnostic buffer of the IO controller --> 256+1000=1256) is sent. This error is not saved in P170 and is only intended to give information about the loss of the FU as a switch-off of the connected FU may be part of the application.

7.2 Error messages

7.2.1 Table of possible error messages (caused by the bus) in the frequency inverter

The following error messages concern bus-related messages which are indicated on the frequency inverter. A complete list of error messages for the frequency inverter (SK 200E) can be found in the relevant manual (BU0200).

Error number Display in the SimpleBox		**Fault** **Text in the ParameterBox**	**Cause** **Remedy**
Group	Details in P700 / P701		
E010	**10.0**	**Connection error**	Contact to SK TU4-PNT interrupted. (SK 500E)
	10.3	**Timeout via (P151)**	Telegram transfer is faulty. Check watchdog time (P151) Check physical bus connections Contains cyclic telegrams
	10.4	**Hardware error, IOs**	An error has occurred at the IO interfaces Check connections (short circuit) Restart the module
	10.5	**General PROFINET configuration error**	A general configuration error has occurred. No Ethernet connection.
	10.8	**Timeout - connection error**	The connection between the FI and the SK TU4-PNT had a timeout
	10.9	**Module missing / P120**	The module entered in parameter (P120) is not available.

7.2.2 Table of possible error messages in the bus module

The following error messages concern bus-related messages, which are indicated on the PROFINET module SK TU4-PNT(-…)) All SK TU4-PNT error messages are displayed in parameter (P170) of the bus module and trigger an error in the connected FI. This is permanently stored in the FI error statistics. The error messages in the bus module memory (P170) parameter are lost when the 24V supply voltage is switched off.

Error number		**Fault** **Text in the ParameterBox**	**Cause** **Remedy**
Group	Details in P170		
E1000	**1000**	**EEPROM error**	Module faulty
	1010	**System bus 24V missing**	Check connections and supply cables Ensure 24V voltage supply
	1020	**System bus timeout**	Check time set in parameter (P151). Telegram transfer is faulty. Check external connection Check bus protocol program process. Check bus master.
	1030	**System bus OFF**	Check connections and supply cables Ensure 24V voltage supply Check bus master.
	5500	**No Ethernet**	No Ethernet connection Connect module to Ethernet
	5501	**Hardware error, IO chip**	EMC fault or IO chip defective Check connections, shielding, cable run Restart module

8 Additional information

8.1 Bus Configuration

In an industrial environment the correct installation of the bus system is particularly important in order to reduce potential interference. The following points are designed to help prevent interference and problems right from the start. The installation guidelines are not complete and applicable safety and accident prevention guidelines must be complied with.

8.1.1 Layout of the PROFINET IO bus cable

A PROFINET IO network can consist of an almost unlimited number of participants. In can be set up as a linear structure (NORD standard), as a tree structure, or as a ring system. There are practically no restrictions to the extent of the network, as each participant functions as a repeater and amplifies the bus signal. Only the distance between neighbouring participants is limited to 100m.

8.1.2 Cable material

Copper cables should be used for the bus. The cables must at least fulfil the Ethernet standard CAT-5.

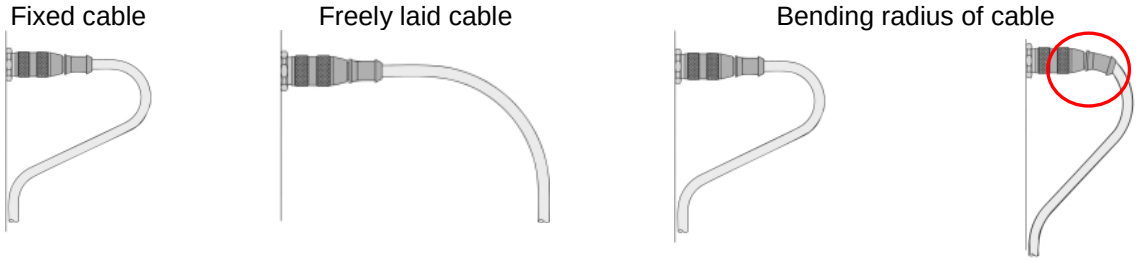
8.1.3 Cable layout and shielding (EMC measures)

If EMC measures are not in place, high-frequency interference which is mainly caused by switching processes or lightning often causes electronic components in the bus participants to be faulty and error-free operation can no longer be ensured.

Correct laying of the bus cable dampens the electrical influences which may occur in an industrial environment. The following points must be observed:

- Implement long connections between bus participants by the shortest possible distances.
- Connect each SK TU4-PNT module to the PE.
- Only use plugs with a metal housing.
- For the production of PROFINET cables, lay the shielding on as wide an area of the plug as possible.
- With the parallel installation of bus cables, a minimum distance of 20 cm should be maintained from other cables carrying a voltage greater than 60V. In particular, this must be observed especially for cables to motors or chopper resistors. This applies to cables laid both inside and outside of control cabinets.
- The minimum distances for parallel installation may be reduced by shielding cables carrying voltage or by means of earthed metal dividers in the cable ducts.

Special attention should be paid to bending radii:



NOTE

If earthing potential values are different, transient current may flow through shielding which is connected on both sides. This may be a danger to electronic components. Differences in potential must be reduced by means of adequate potential equalisation.

8.2 Cable glands and shielding connections

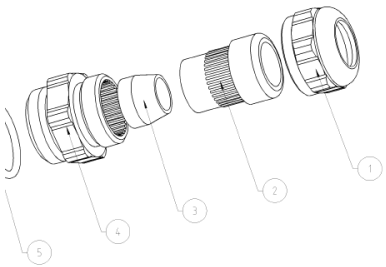
Nowadays, field bus systems are a normal part of plant technology. The sensitivity of these systems to electromagnetic interference (EMC) means that it is essential to protect bus systems from outside interference by means of uninterrupted or complete screening. Therefore the use of shielded cables and metal screw couplings or plug connectors has become standard. Assuming correct installation (e.g.: 360° screen connection - including at contact points, compliance with tightening torques, bending radii, IP protection classes (≥IP66),…), the operational reliability of the field bus system can be optimised.

The EMC effect of a cable shield is largely dependent on its contacts to the housing and its earthing on one or both ends. The shielding effect of a housing must not be influenced by incoming or outgoing screened cables. It is recommended that the shield is exposed directly at the point of entry and connection of the cable gland with the reference potential surface and the use of an EMC cable. At the same time this opening in the housing is "sealed" against the electromagnetic field. The connection from the cable shield to the housing must have a DC and and inductive resistance which is as low as possible. This depends on the frequency. This low contact resistance is achieved by the use of a ring-shaped 360° contacting of the cable shielding and short connections to the housing via the connecting thread.

8.2.1 Fixed connection (cable gland)

Metallic EMC cable glands with a shielding concept should be used to minimise EMC problems.

1 Pressure screw
2 Earthing insert
3 Inner earthing cone
4 Metric fitting
5 O-ring mounted



These special M16 x 1.5 EMC cable glands must be fitted in the relevant connection unit (SK TI4-…(-BUS)) of the frequency inverter or the PROFINET IO module.

Assembly

For the M16 x 1.5 EMC cable gland, 5 mm of the shielding of the cable /conductor is exposed and slightly spread out. The insulating foil of the Profibus cable must be cut off and must not be folded back.

Function

When the pressure screw is tightened, the sealing insert presses the shielding mesh onto the cone of the earthing insert. The entire circumference (360°) of the shielding mesh is contacted. The mesh ends in the cable gland. This produces a large area, low resistance conductive connection between the shield, the earthing insert and the screw fitting and the housing.

For further information regarding the correct installation of EMC cable glands, please refer to the relevant manufacturer´s data sheets.

8.2.2 Connection with M12 round plug connectors

In order to implement detachable connections, the cable connections for the system bus and for sensors and actuators, as well as for the 24V- supply voltage can be designed with plug-in connectors.
Here, freely adjustable M12 flanged connectors with metric M16 x 1.5 threads should be used for installation in the relevant housing (SK TI4-…(-BUS)).
This allows the use of angled or straight M12 round plug connectors for the cable connection.
If required, Getriebebau Nord GmbH can equip the device to be delivered accordingly, or can enclose the required plug with the delivery.

Flanged coupling

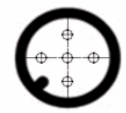
Flanged plug connector

EMC compatible assembly is carried out in the same manner as for the assembly of the cable glands (Section 8.2.1 "Fixed connection (cable gland)").

8.2.3 Round plug connectors

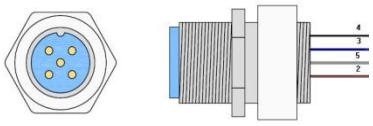
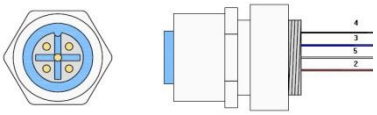
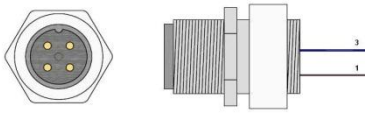
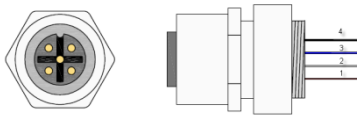
Getriebebau Nord GmbH offers a selection of suitable plug connectors and couplings, which can be installed in the connection units of the frequency inverters or the field bus module, or enclosed with the delivery as required. The corresponding plug connectors, couplings and Y connectors are also commercially available. However, a limited selection can also be obtained from Getriebebau NORD GmbH.

Coding
Round plug connectors are coded. Coding is by means of a pin or a groove on the contact base. The most common codings are the so-called A and B coding. This serves to protect against incorrect coupling of the various field bus systems.

Designation	A coding	B coding	D coding
Example Connector (socket)			
Format	M12	M12	M12
Coupling version	with coding groove	with coding pin	with coding pin and groove
Plug connector version	with coding pin	with coding groove	with coding groove and pin
Field of use	System bus CANopen DeviceNet 24V supply Sensors and actuators	PROFIBUS DP	EtherCAT PROFINET EtherNet/IP POWERLINK

8.2.3.1 M12 flanged connector

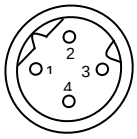
The following flanged plugs and flanged couplings are available for installation in devices.

System components	Description	Data
System bus		
SK TIE4-M12-SYSS Part No. 275274506 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect the<u>incoming</u> system bus cable to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 not used PIN 2 +24V brown PIN 3 GND blue PIN 4 Sys-H black PIN 5 Sys-L grey Plastic body and screw cap in **light blue**
SK TIE4-M12-SYSM Part No. 275274505 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect the<u>outgoing</u> system bus cable to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 not used PIN 2 +24V brown PIN 3 GND blue PIN 4 Sys-H black PIN 5 Sys-L grey Plastic body and screw cap in **light blue**
External voltage supply		
SK TIE4-M12-POW Part No. 275274507 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect a<u>24V- supply</u> to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 +24V (out) brown PIN 2 not used PIN 3 GND blue PIN 4 not used PIN 5 not used Plastic body and screw cap in **black**
Sensors and actuators		
SK TIE4-M12-INI Part No. 275274503 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect <u>sensors and actuators</u> to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 +24V (out) brown PIN 2 Diagnosis /opener white PIN 3 GND blue PIN 4 Sensor or control signal black PIN 5 not used Plastic body and screw cap in **grey**

8.2.3.2 M12 round plug connector (cable connector)

The following plug connectors are recommended by Getriebebau NORD GmbH.

M12 connector
D coded



Supplier	Designation	Part no.:	
		straight	angled
Franz Binder GmbH	**Plug connector** M12, 6..8mm, 4-pin, screwed, IP67	99 3729 810 04	99 3729 820 04
Phoenix Contact	**Plug connector** M12, 6..8mm, 4-pin, screwed, IP67	1521258	Not applicable
Phoenix Contact	**Ethernet cable plug connector (straight) to open ends,** M12, CAT5e, 4-pin, AWG24 flex., shielded	2m 1524006 5m 1524019 10m 1524022 15m 1524035	No details
Phoenix Contact	**Ethernet cable plug connector (straight) to plug connector (straight),** M12, CAT5e, 4-pin, AWG24 flex., shielded	0.5m 1523078 2m 1521533 5m 1524051 15m 1524077	No details
Phoenix Contact	**Ethernet cable plug connector (RJ45) to plug connector (straight),** M12, CAT5e, 4-pin, AWG26 flex., shielded	0.5m 1657562 1.0m 1657575 2.0m 1657588 5m 1657591	No details

NOTE

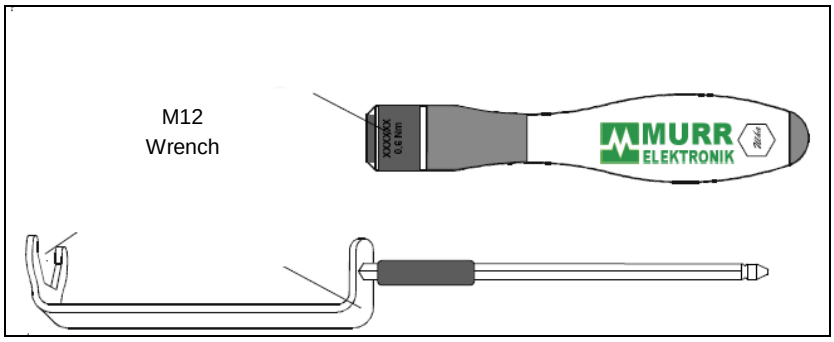
For preference, pre-assembled PROFINET bus cables and connection components should be used.

For certain applications, vibration-proof round plug connectors should be used.

8.2.3.3 Assembly tools

The observance of the tightening torques for making plug connections is of vital importance. For M12 plug connectors, the optimum torque is 0.6Nm.

Suitable assembly tools are commercially available.




Anwenderhinweise

MURR ELEKTRONIK

Mit Sicherheit dicht!

Der Montageschlüssel hilft ihnen bei der Überprüfung des optimalen Anzugsmomentes (0,6 Nm) bei ihren M12 - Rundsteckverbindern.

Bitte beachten Sie:
Durch das Setzverhalten der Dichtung im Verteiler bzw. in der M12-Buchse kann der Rundsteckverbinder bereits nach kurzer Zeit nachgezogen werden.
Dies ist bereits in dem definierten Anzugsdrehmoment (0,6Nm) berücksichtigt!
Bei ordnungsgemäßem Einsatz ist der Schutzgrad IP 67 ohne Nachziehen gewährleistet.

Ein einmaliges Nachziehen ist möglich. Von einem regelmäßigen Nachziehen der Steckverbinder wird allerdings abgeraten, da dies Einfluss auf die elastischen Eigenschaften und die Funktionstüchtigkeit der Dichtung hat.

Supplier	Designation	Part no.:
MURR Elektronik	M12 wrench set for M12 round plug connectors with calibrated torque of 0.6Nm	7000-99102-0000000
Franz Binder GmbH	M12 torque wrench for M12 round plug connectors with calibrated torque of 0.6Nm	07-0079-000

NOTE

In order to ensure a secure, sealed and vibration-proof connection, connecting components with hexagonal fittings should be used.

Special tools enable tightening to a defined torque (operational reliability).

8.3 System bus

With NORD inverter technology, units or modules communicate via a dedicated system bus. With the introduction of the SK 200E frequency inverter series and the associated components SK CU4-… and SK TU4-… functions and interfaces were implemented in this system bus, which allow users to make useful adaptations without having detailed knowledge of the function of the bus system (data allocation / error handling, etc.).

A decisive advantage is provided by the fact that the system bus is no longer restricted to a single inverter and a directly connected module, but rather that up to 4 frequency inverters can jointly use a BUS interface (e.g.: PROFINET IO). This increases the number of possible participants on a field bus system (by a factor of 4) with comparatively low investment costs.

The system bus address of the BUS modules (SK CU4-… and SK TU4-…) is set to "5". The system bus address of the up to 4 frequency inverters which can be connected are set by means of DIP switches (see manual BU 0200) on the relevant frequency inverter, optionally between 32 / 34 / 36 and 38, whereby no address may be doubly assigned within a system bus system.

8.4 Repairs

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

NORD Electronic DRIVESYSTEMS GmbH
Tjüchkampstr. 37
26605 Aurich, Germany

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG
Tel.: 04532 / 289-2515
Fax: 04532 / 289-2555

If a frequency inverter or accessories are sent in for repair, no liability can be accepted for any added components, e.g. such as line cables, potentiometer, external displays, etc.!
Please remove all non-original parts from the frequency inverter.

NOTE

If possible, the reason for returning the component/device should be stated. If necessary, at least one contact for queries should be stated.
This is important in order to keep repair times as short and efficient as possible.
On request you can obtain a suitable goods return voucher from us.

9 Index

9.1 Keyword Index:

Address	Assigned or defined designation of a bus subscriber
ASIC	Application Specific Integrated Circuit”,
Baud rate	The transmission rate for serial interfaces in bits per second
Binary code	The designation for a code in which messages are communicated by "0" and "1" signals.
Bit / Byte	A bit (binary digit) is the smallest unit of information in the binary system. A byte has 8 bits.
Broadcast	In a network, all slave participants are addressed simultaneously by the master.
EMCY message	Emergency messages (error telegrams)
GSD	Device master data, format for the description of automation devices which communicate via PROFIBUS
GSDML	GSD Markup Language, format for the description of automation devices which communicate via PROFINET
Jitter	Designates a slight fluctuation in precision in the transmission pulse, or the variation in the transmission time of data packages.

9.2 Abbreviations used:

Abs.	Absolute
BE	Bus error (fault)
Size	Bus module
BR	Bus ready
BS	BUS state (status)
D, DI, DIN	Digital IN
DE	DEVICE error (fault)
DO, DOUT	Digital OUT
DS	DEVICE state (status)
EMC	Electromagnetic compatibility
FI	Frequency inverter
GND	Earth
HW	Hardware
I16	16 bit value (integer)
I/O	IN / OUT, input and output
IND	Index
IW	Actual value
NMT	Network Management
P	parameter which depends on a parameter set
PPO	Process data object
PZD	Process data
RO	Read Only
RW	Read and Write
SDO	Service Data Object
STR	String value
STW	Control word
SW	Software / Setpoint
TU	Technologie Unit (external technology unit)
U8 (U16 / U32)	8 bit (16 / 32 bit) value, unsigned (without prefix)
ZBG	Additional module
ZSW	Status word

10 Listings

10.1 List of illustrations

10.2 List of tables

10.3 Keyword index

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