Intelligent Drivesystems, Worldwide Services

GB

BU 0590

PROFINET Bus module

for NORD frequency inverters SK 5xxE

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.

CE-labelled drive power converters meet the requirements of the Low Voltage Directive 2006/95/EEC. The harmonised standards for drive power converters listed in the declaration of conformity are used.

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 safety functions which are described and 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 converter 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 connection

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 instructions can be found 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 applicable 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 0590 GB
Part No.:	607 59 02
Device series:	SK TU3-PNT (PROFINET® - Bus module) for SK 5xxE (entire series)

Version list

Designation of previous versions	Software Version	Remarks
BU 0590 GB, January 2012 Part No. 607 5901 / 0312	V 1.0 R4	First issue

Publisher

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NOTE

This supplementary operating manual is only valid in conjunction with the operating manual supplied for the respective frequency inverter (Manual BU0500).

Intended use of the frequency inverter

The **compliance** with the operating instructions is **necessary for fault-free operation** and the acceptance of possible 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 Ethernet module can only be used for the defined frequency inverter series (SK500E). The use of this module with other devices is not permitted and can lead to their destruction.

The Ethernet module and the associated frequency inverter are devices for fixed installation in control cabinets. All details regarding technical data and permissible conditions at the installation site must be complied with.

Commissioning (implementation 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 machine directive 2006/42/EEC (note EN 60204).

1 Introduction

1.1 General information

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.

1.2 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 TU3-PNT

- 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

Performance

- 100Mbit/s data communication
- Full duplex transmission
- Transmission of a maximum of five setpoints or actual values possible

1.3 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.

1.4 Scope of supply

SK TU3-PNT*	PROFINET Bus module for SK 500E frequency inverters *incl. screw for optional fixing to the FI	IP20

1.5 Certifications

1.5.1 European EMC Directive

If NORD frequency inverters or their 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.

1.5.2 RoHS compliance

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

1.6 Identification System

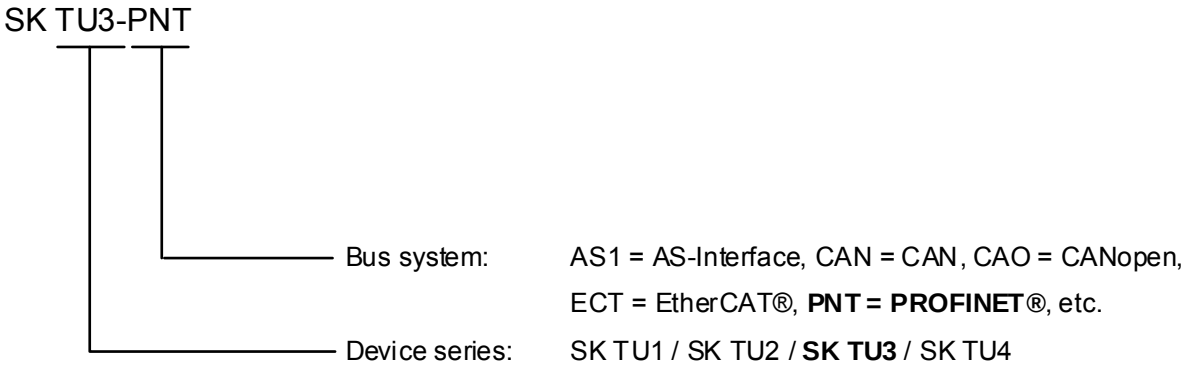


Fig. 1 Type Codes

2 Modules

2.1 SK 5xxE frequency inverters

By the use of various modules for display, control and parameterisation, the SK 5xxE can be easily adapted to various requirements.

Alphanumerical display and operating modules can be used for simple commissioning. For more complex tasks, various connections to a PC or an automation system can be selected.

The technology unit (Technology Unit, SK TU3-…) is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

In the delivery condition (without technology unit) 2 LEDs (green/red) are visible externally. These indicate the actual device status.

The green LED indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output.

The red LED signals actual error by flashing with a frequency which corresponds to the number code of the error (Manual BU 0500 Section 6).

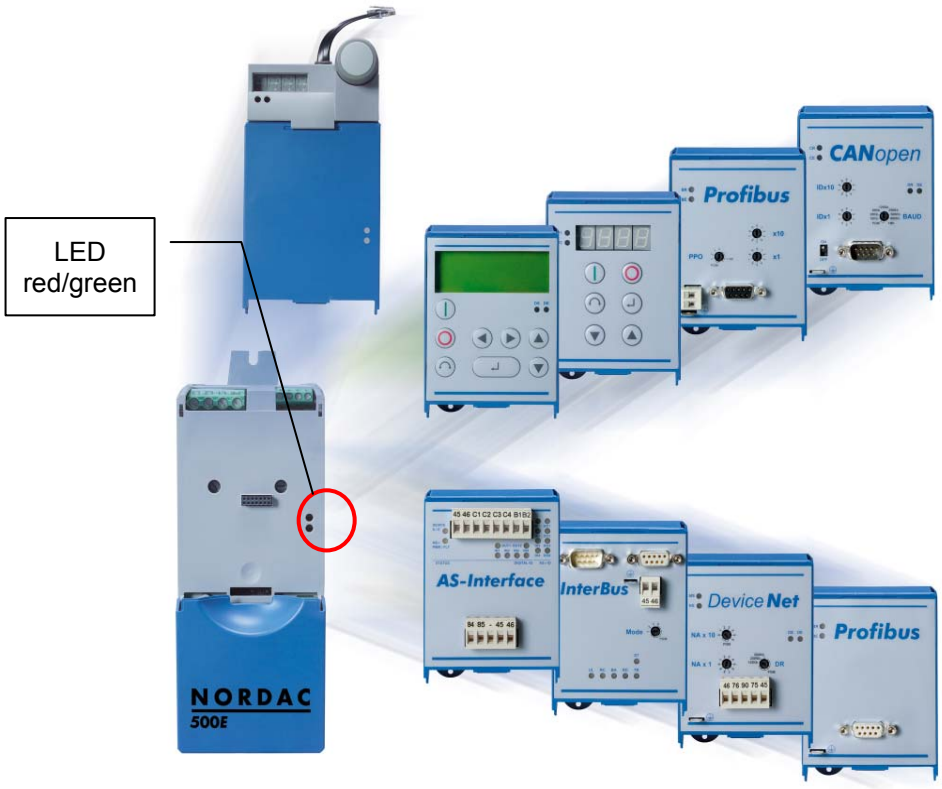


Fig. 2 Frequency inverters with SK TU3- optional modules (selection)

WARNING

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

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

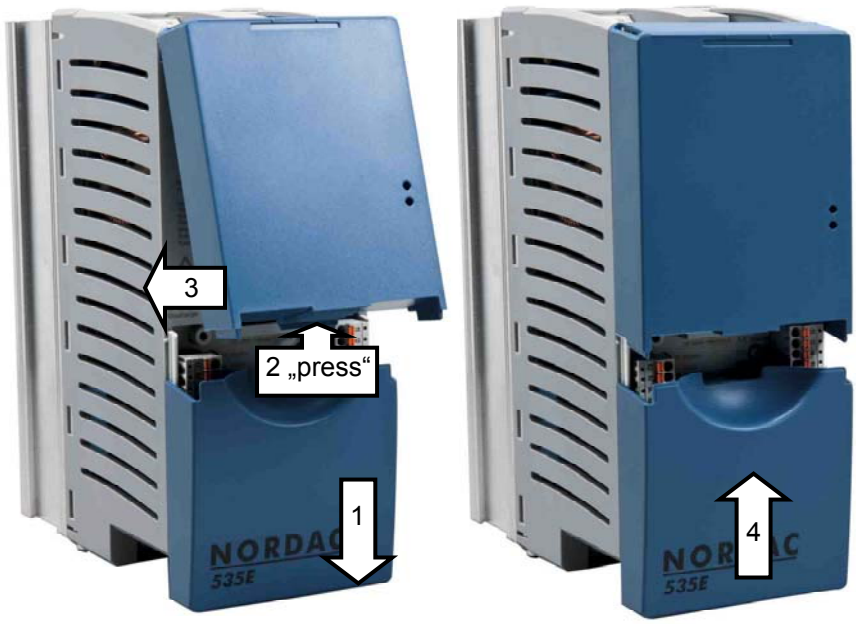
NOTE

2.2 PROFINET - BUS Module

2.2.1 Mounting

The technology units must be installed as follows:

1. Switch off the mains voltage (frequency inverter), observe the waiting period.
2. Push the control terminals cover down slightly or remove.
3. Remove the blank cover by pressing the release on the lower edge and pulling off with an upward turning movement. If necessary, the fixing screw next to the release must be removed.
4. Hook the technology unit onto the upper edge slots and press in lightly until engaged. Ensure full contact with the connector strip and fasten with the screws if necessary (separate packet).
5. Close the control terminal cover again.



Similar to illustration

Fig. 3 Installation of the Technology Unit (optional module)

Further detailed information can be found in the device manual BU 0500.

- www.nord.com –

2.2.2 Technical data

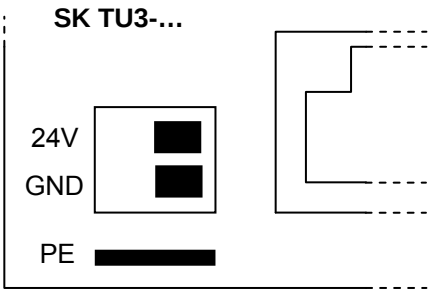
Specification	
PROFINET IO	Max. baud rate 100 MBaud
	Electrical isolation 500V_{eff}
Bus connection	2 × RJ45
Bus termination	Performed automatically by the SK TU3-… Technology Unit
Cable	Ethernet CAT-5 or better
Max. cable length	100m between two Ethernet bus modules
Supply voltage	24V ± 20%, current consumption ≈ 150mA 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. If several technology units are adjacent to each other, only one board needs to be connected to the PE.

Table 1 Electrical specifications of the SK TU3-PNT

2.2.3 Connections

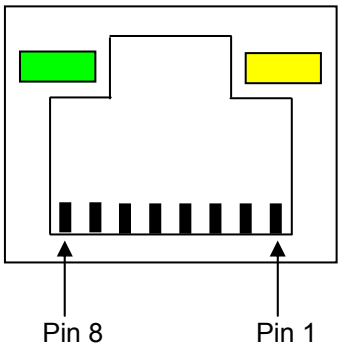
Name	Name
45	+24V
46	GND

Table 2 Power supply connections

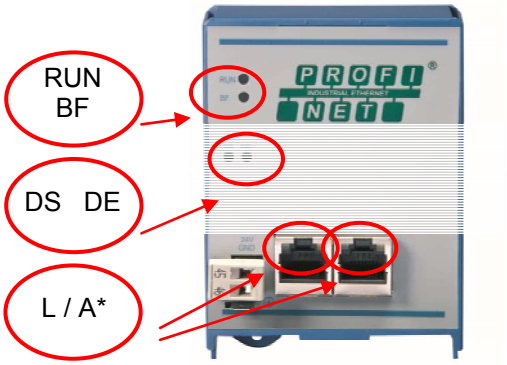


Signal	Name	RJ45 Pin
TX+	Transmission Data +	1
TX-	Transmission Data -	2
RX+	Receive Data +	3
RX-	Receive Data -	6

Table 3 RJ45 socket connections



2.2.4 Status display via LED



*L / A = Link / Active: on all RJ45 sockets

Fig. 4 Location and designation of the LEDs

RUN Green LED	State	Meaning
Off	Init	Device switched off or initialisation
Flashing	Waiting for AR	- No parameter communication - No process data communication
On	AR established	- Parameter communication active - Process data communication active

Table 4 Description of the RUN LED (Ethernet Status)

ERR Red LED	State	Meaning
Off	No error	PROFINET IO functioning normally
Double-flashing Cycle 2 x 0.25 sec Pause 1s	Timeout	The IO controller monitoring has detected an error (see parameter P151 or P513)
On	Ethernet error, no mains	TU3-PNT not connected to any Ethernet participant

Table 5 Description of the ERR LED (Ethernet errors)

L Green LED	A Yellow LED	Meaning
Off	**Off**	Port (RJ45 socket) is not connected to the PROFINET network
Flashing Cycle 0.50 sec	**Flashing** Cycle 0.50 sec	Identification signal of the station if a flashing test is performed in the planning tool
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 6 Description of the link / Activity LEDs

DS Green LED	DE Red LED	Meaning
Off	**Off**	The technology unit does not have a power supply
Off	**Flashing 1...7x** **Cycle 0.25sec** **Pause 1s**	The technology unit has a fatal system error
Flashing **Cycle 0.50 sec**	**Off**	Technology unit OK but no FI (frequency inverter) detected Causes → The FI has no power supply or the technology unit is not correctly plugged in
On	**Flashing 1x** **Cycle 0.25sec**	The FI is in an error condition
On	**Off**	Technology unit OK and FI detected

Table 7 Description of the DS and DE LEDs

3 Commissioning

3.1 Cabling

3.1.1 Topology

The SK TU3-PNT PROFINET IO modules can be connected to each other in star, tree, linear or ring topologies.

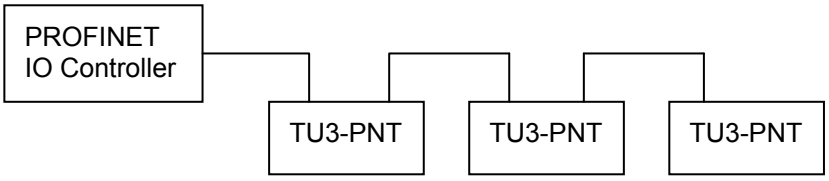


Fig. 5: Example of PROFINET IO linear topology

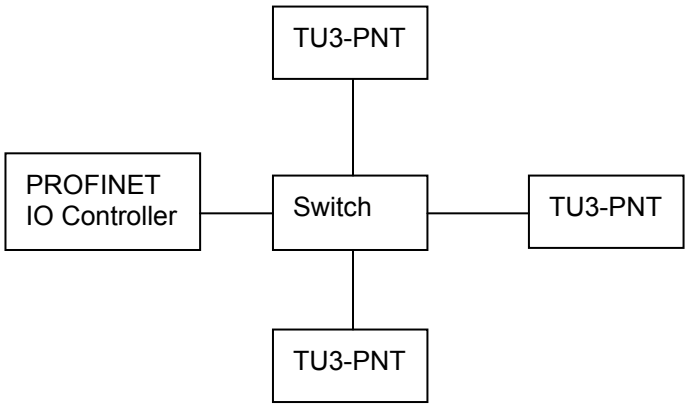


Fig. 6: Example of PROFINET IO star topology with switch

3.1.2 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 from 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 SK TU3- Ethernet module to the PE (Connection via the plug pin next to the 24V supply).

3.2 Commissioning the bus module

3.2.1 Connecting the bus module

- Connect the bus module to the PE via the plug pins
- Connect the 24V supply via the plug-in terminal. Note the consumption of each module (Technical Data)
- Connect the Ethernet cable

Bus direction	PROFINET
Incoming cable (from master / controller)	Left or right RJ45 socket Labelled "1" or "2"
Outgoing cable	**Left or right RJ45 socket Labelled "1" or "2"**
Both RJ45 sockets of the PROFINET module are internally connected via a switch.	

Table 8 Bus cable connections

- If the bus module is the last participant, the RJ45 socket remains open in the outgoing direction. The bus connection is performed automatically.

ATTENTION

Each bus module requires a separate PE connection via the plug pin. Otherwise, interference-free operation of the bus module cannot be guaranteed.

3.2.2 Parameter settings of the frequency inverter

The following settings must be made on the frequency inverter (SK 5xxE):

- Control via Ethernet TU → P509 = "8"
- Setpoint via Ethernet TU → P510 = "8" or "0" if P509 = "8"
- Setting of setpoints via P546, P547 and P548 (SK 500E … SK 535E)
  P546 [-01] … [-05] (SK 540E and above)
- Setting of actual values via P543, P544 and P545 (SK 500E … SK 535E)
  P543 [-01] … [-05] (SK 540E and above)

For a detailed description of the parameters, please refer to the frequency inverter operating manual (BU 0500).

The parameters can be set with NORD parameterisation tools (e.g. NORD CON, SimpleBox) or via the bus master / controller.

3.3 Configuration in the Bus system (example SIMATIC Manager)

In order to carry out planning with the **SK TU3-PNT**, first of all the GSDML file "GSDML-V2.2-NORD DRIVESYSTEMS-TU3PNT-20110606.xml" must be installed in the SIMATIC Manager. Select the relevant file in the Hardware Configurator.

The current files for SK 5xxE series frequency inverters can be found on the NORD homepage under NORD - Documentation - Software - NORDAC Options.

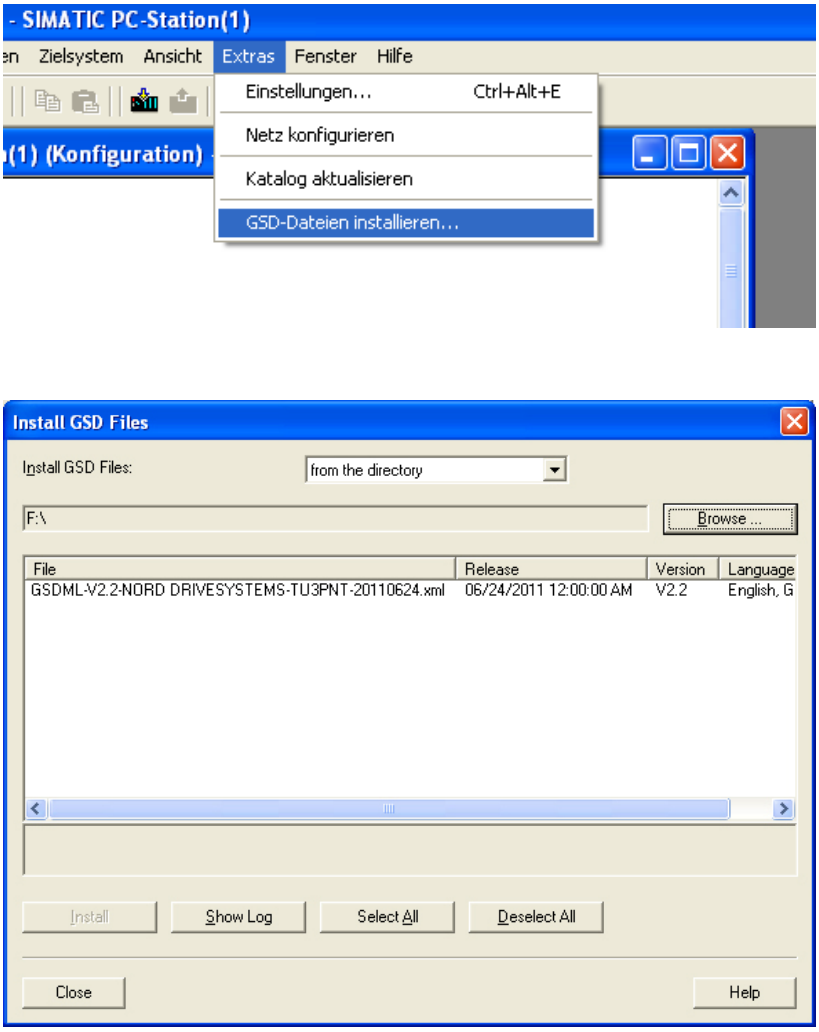


Fig. 7 Installation of the GSDML file in SIMATIC Manager

After this, the SK TU3-PNT from NORD DRIVESYSTEMS is can then be found in the hardware catalogue of the SIMATIC Hardware Manager and can then be entered into the PROFINET system.

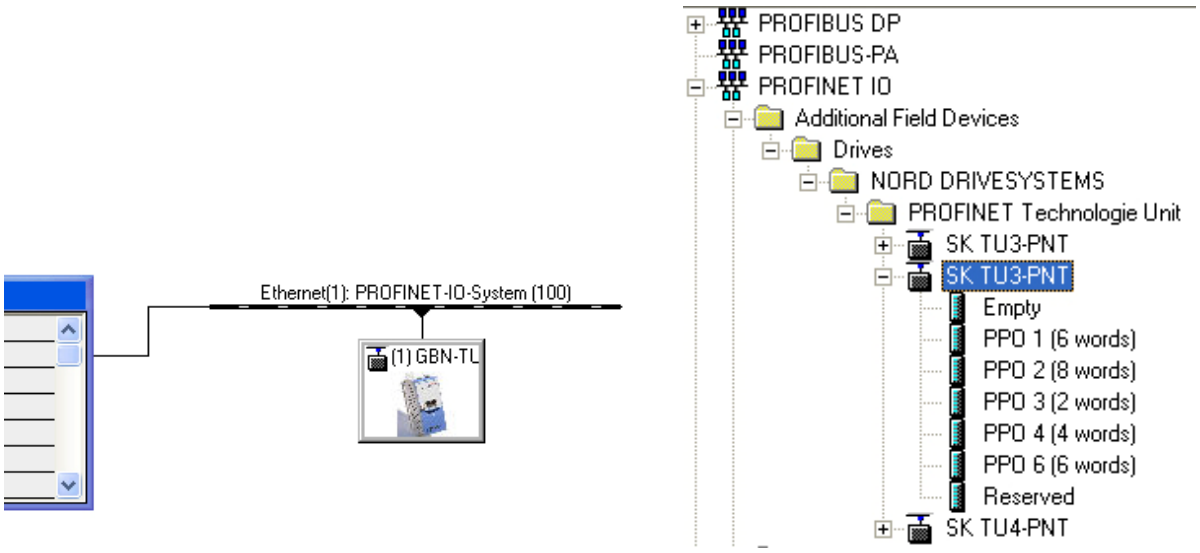


Fig. 8 Hardware Catalogue: Module selection and specification of data format

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.

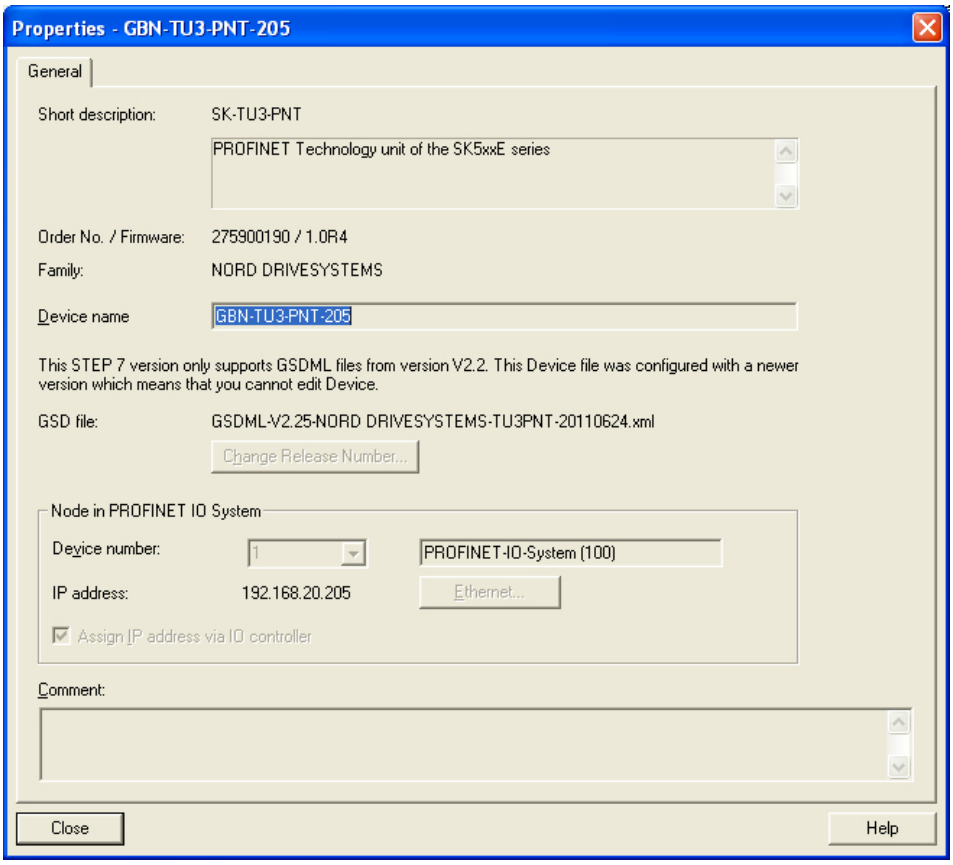


Fig. 9 Module properties

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

4 Communication

4.1 Process data

Control words and setpoints are transferred from the bus master / controller to the SK TU3-…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 I/O 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].

4.1.1 Process data structure

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

4.1.1.1 Pure process data communication

Direction of transmission	Transmitted data (4 Byte)	
	1st word	2nd word
... to SK TU3	Control word	Setpoint 1
... from the SK TU3	Status word	Actual value 1

Table 9: PPO 3

Direction of transmission	Transmitted data (8 Byte)			
	1st word	2nd word	3rd word	4th word
... to SK TU3	Control word	Setpoint 1	Setpoint 2	Setpoint 3
... from the SK TU3	Status word	Actual value 1	Actual value 2	Actual value 3

Table 10: PPO 4

Direction of transmission	Transmitted data (12 Byte)					
	1st word	2nd word	3rd word	4th word	5th word	6th word
... to SK TU3	Control word	Setpoint 1	Setpoint 2	Setpoint 3	Setpoint 4	Setpoint 5
... from the SK TU3	Status word	Actual value 1	Actual value 2	Actual value 3	Actual value 4	Actual value 5

Table 11: PPO 6

4.1.1.2 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 TU3	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO	Control word	Setpoint 1
... from the SK TU3	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO	Status word	Actual value 1

Table 12: PPO 1

Direction of transmission	Transmitted data (16 Byte)			
	1st word	2nd word	3rd word	4th word
... to SK TU3	Parameter number and order label	Parameter index	Parameter value HI	Parameter value LO
... from the SK TU3	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 TU3	Control word	Setpoint 1	Setpoint 2	Setpoint 3
... from the SK TU3	Status word	Actual value 1	Actual value 2	Actual value 3

Table 13: PPO 2

4.1.2 Control word

Bit	Value	Meaning	Remarks	
0	0	OFF 1	Reverse with the brake ramp, with disconnection from supply at f=0Hz	
	1	ON	Ready for operation	
1	0	OFF 2	Cut off voltage; the inverter output voltage is switched off; the FI enters a state where switching on is disabled.	
	1	Operating condition	OFF 2 is cancelled	
2	0	OFF 3	Quick stop with programmed quick stop time; with disconnection from supply at f=0Hz; the FI switches to starting disabled condition.	
	1	Operating condition	OFF 3 is cancelled	
3	0	Disable operation	Cut off 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	Lock ramp generator	Ramp generator is set to zero; no disconnection from supply at f=0Hz; FI remains in the operation enabled state.	
	1	Operating condition	Enable ramp generator	
5	0	Stop ramp generator	The setpoint currently provided by the ramp generator is "frozen" (frequency is maintained).	
	1	Enable ramp generator	Enable setpoint on ramp generator	
6	0	Disable setpoint	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	Note: When a digital input has been programmed for the "ack.fault" function, this bit must not permanently be set to 1 via the bus (otherwise, edge evaluation would be prevented).	
8	0			
	1	Bit 8 active	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	Bit 9 active	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	PZD invalid	The transmitted process data is invalid.	
	1	PZD valid	Valid process data is transferred from the master. **Note:** If setpoints only are transferred via the bus (setting: interface), this Bit must be set so that the setpoint transferred is valid.	
11	0			
	1	Rotational direction: right	Rotation right (priority) is on.	
12	0			
	1	Rotational direction: left	Rotation left is on.	
13	0/1		Reserved	
14	0/1	Bit 0 to switch parameter set	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	Bit 1 to switch parameter set		

Table 14 Meaning of individual control word bits

4.1.3 Status word

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: No command has 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 disabled	
	1	Operation enabled	The output voltage is enabled; ramp to the existing setpoint
3	0	No fault	
	1	Fault	Drive fault resulting in stoppage; this state is changed to starting disabled after the fault has been successfully acknowledged
4	0	OFF 2	OFF2 command applied
	1	No OFF 2	
5	0	OFF 3	OFF3 command applied
	1	No OFF 3	
6	0	Starting not disabled	
	1	Starting disabled	Switches first to OFF1, then to ready-to-start status
7	0	No warning	
	1	Warning	Drive operation continues, no acknowledgement necessary
8	0	Actual value not O.K.	Actual value does not match the setpoint (with *posicon*: failure to reach setpoint position)
	1	Actual value O.K.	Actual value matches required setpoint (setpoint has been reached) (with *posicon*: setpoint has been reached)
9	0	Local guidance	Guidance on local device has been activated
	1	Guidance requested	The master has been requested to assume guidance.
10	0		
	1	Bit 10 active	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481.
11	0		
	1	Rotational direction: right	Inverter output voltage is turning right
12	0		
	1	Rotational direction: left	Inverter output voltage is turning left
13	0		
	1	Bit 13 active	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481.
14	0/1	Currently active parameter set 0	00 = Parameter set 1 01 = Parameter set 2
15	0/1	Currently active parameter set 1	10 = Parameter set 3 11 = Parameter set 4

Table 15 Meaning of individual status word bits

4.1.4 FI Status Machine

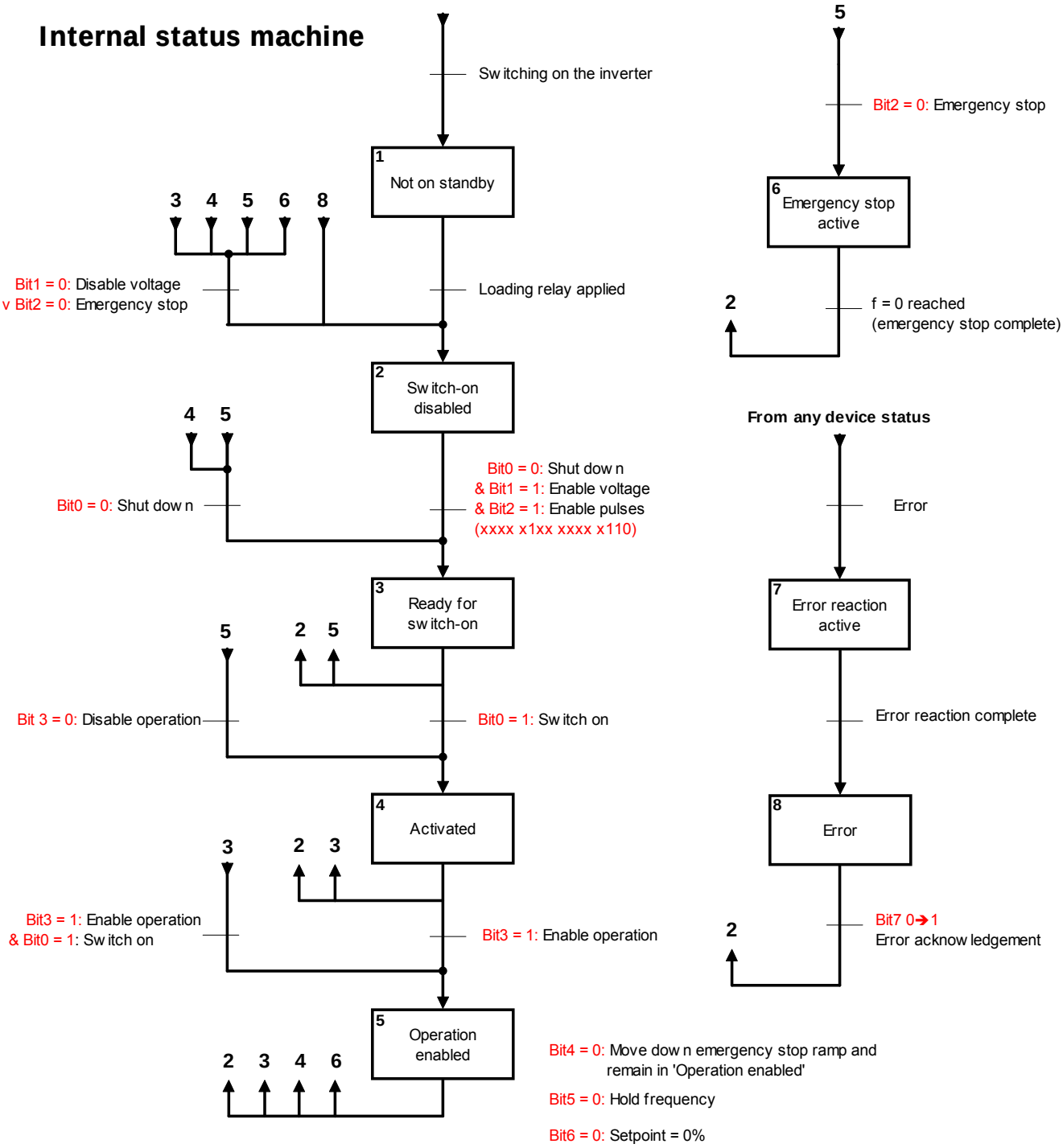
The frequency inverter passes through a status machine. The changes between various states are triggered by the respective control commands in the process data control word. The actual status is returned in the process data status word.

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 has to 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 16 Codes for FI status



Control bits
0. Standby / Shut down
1. Disable / enable voltage
2. Enable pulses / emergency stop
3. Disable / enable operation
4. Betriebsbedingung / HLG sperren
5. Enable / stop RUE
6. Enable / disable setpoint
7. Error acknowledgement (0➔1)
10. Control data valid / invalid
11. Direction of rotation clockwise
12. Direction of rotation anticlockwise
14. Parameter set Bit 0
15. Parameter set Bit 1

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

Coding of status:
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. 10 Diagram of the FI Status Machine

4.1.5 Setpoint and actual values

The meanings of setpoints are defined via the FI parameters P546 to P548 (SK 540E and above: P546[-01] … [-05]). For the actual values, this determination is made via the FI parameters P543 to P545 (SK 540E and above: P543[-01] … [-05]).

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)			
	1. word	2. word	3. word	4. word
... to SK TU3	Control word	32Bit setpoint		Setpoint 3
... from the SK TU3	Status word	Actual value 1	32Bit actual value	

Table 17 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.

4.1.6 Example for switching the frequency inverter on and off

In this example, a FI 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 18 Example of setpoint specification

4.1.7 Timeout monitoring

The PROFINET data traffic can be monitored with a watchdog with the aid of the time set in parameter P513. 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.

4.2 Parameter transfer

4.2.1 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 TU3-PNT are assigned to Slot 2 and the parameters of the frequency inverter to Slot 3.

The illustration below describes the function of Records

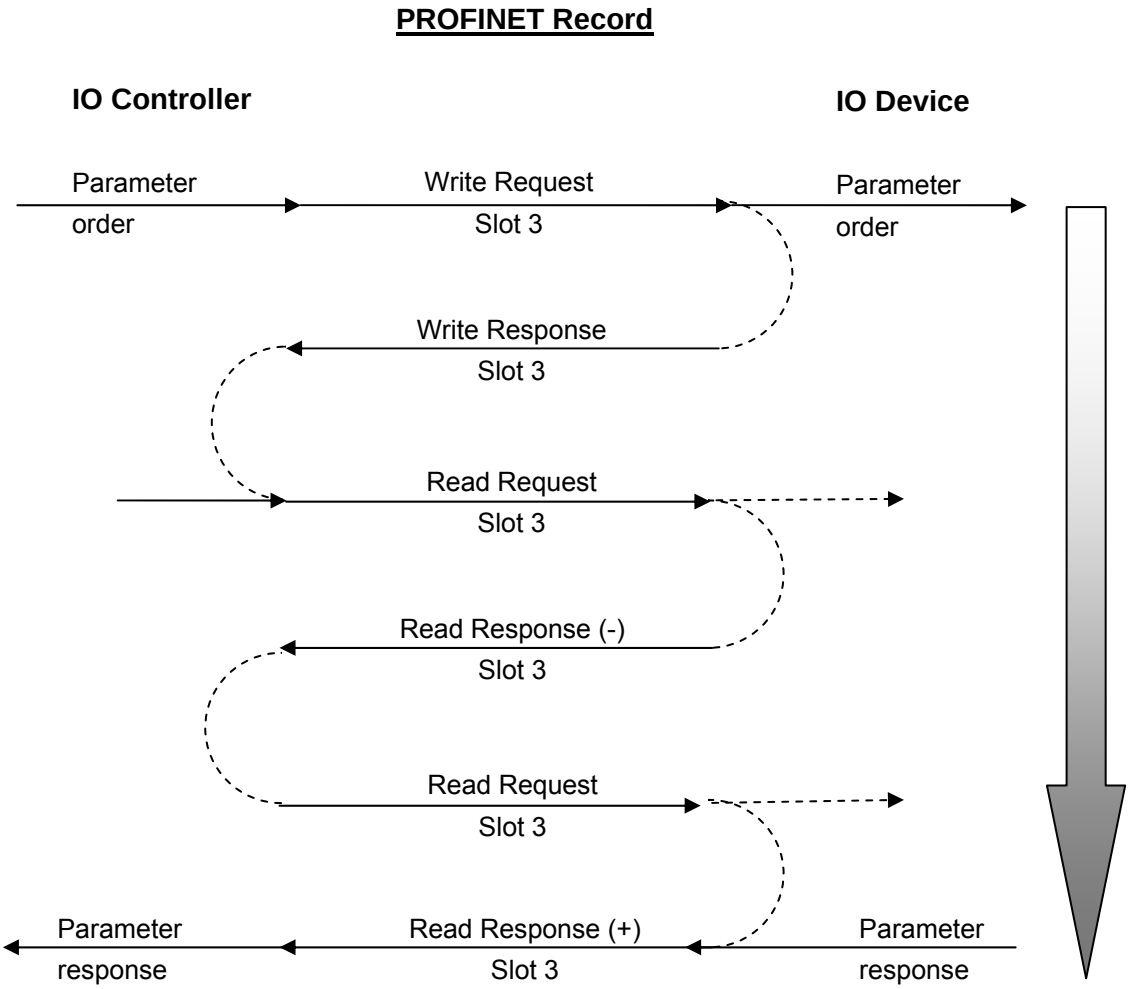


Fig. 11 Function of PROFINET Record

- By means of a "Write Request" the data record is transferred to the IO device (SK TU3-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 TU3-PNT with "Read Request".
- The SK TU3-PNT responds with a "Read Response (-)", if processing is not yet complete.
- After processing of the parameter in the SK TU3-PNT the parameter order is concluded with the transfer of the parameter response to the IO controller by means of "Read Response (+)".

4.2.2 Data records

4.2.2.1 Data records 100 and 101

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 (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 TU3 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 4.2.3.2)
Parameter value	4 Bytes	New setting value (See Section 4.2.3.3).

Table 19 Structure of data records 100 and 101

4.2.2.2 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 TU3-PNT response
Order label	1 Byte	Read / write parameter value etc. (see Section 4.2.3)
Axis	1 Byte	Access to SK TU3-PNT parameter or FI parameter 0 = SK TU3-PNT 1 = Frequency inverter
Parameter number	2 Bytes	FI or SK TU3 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 4.2.3.2)
Parameter value	4 Bytes	New setting value (See Section 4.2.3.3).

Table 20 Structure of data record 47

4.2.2.3 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 system to a PROFINET system. In addition to the cyclical IO data, there are also the acyclical parameter data (see Section 4.2.4.4).

4.2.3 Data format

4.2.3.1 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 21 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 22 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 23 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 24 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.

4.2.3.2 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 25 Example: Address formation for array elements or parameters depending on parameter sets

If a parameter is not dependent on the parameter set, then **Bit 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 4.2.3.1), in order for the sub-index to be effective.

4.2.3.3 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 / 0.01 = 99.99 * 100 = 9999

Therefore the value 9999_{dec} = $270F_{hex}$ must be transferred.

4.2.4 Examples

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

Data record 100 is used:

Field	Data size	Byte	Date	Explanation
Order label + Parameter number	2 Byte	 2	01 h +492 h ——— 1492 h	Read parameter value (see Section 4.2.3) + Parameter number P170 (+1000) = 492 h
Parameter index	2 Bytes	3 4	00 h 00 h	Parameter sub-index (see Section 4.2.3.2)
Parameter value	4 Bytes	5 6 7 8	00 h 00 h 00 h 00 h	Setting value not set with read order

Table 26 Example telegram for reading parameter P170

S7 Code example:

```
CALL  "WRREC" , DB53              → WriteRequest
REQ   :=#bStart
ID    :=DW#16#7FC                 → Diagnosis address
INDEX :=100                       → Data set 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 set 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).

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

Data record 101 is used:

Field	Data size	Byte	Date	Explanation
Order label + Parameter number	2 Byte	 2	02 h + 44E h _____ 244E h	 Read parameter value (see Section 4.2.3) + Parameter number P102 (+1000) = 44E h
Parameter index (Data record)	2 Bytes	3 4	01 h 00 h	Parameter sub-index (see Section 4.2.3.2)
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 27 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
```

4.2.4.3 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 TU3-PNT response
Order label	1 Byte	2	02 h	Write parameter value (see Section 4.2.3)
Axis	1 Byte	3	01 h	Access to FI parameter (0=TU3, 1=FI)
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 (see Section 4.2.3.2)
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 28 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
```

4.2.4.4 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). (Only the PKW channel is evaluated.)

As the acceleration time has a frequency-internal resolution of 0.01sec, a parameter value of 10 / 0.01 = 1000 ($3E8_{hex}$) must be transferred for 10 sec.

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 value (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".

5 Parameter

5.1 Parametersiation of PROFINET bus module SK TU3-PNT

The following parameters affect the bus modules.

5.1.1 BUS module standard parameters (P15x)

Access: Read/Write

Parameter {Factory setting}	Setting value / Description / Note	Device	Parameter type	
P152	**Factory setting** *(Factory setting)*	SK TU3-PNT	16 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 is reset to the factory setting. All originally parameterised data are lost.			

5.1.2 Parameters specific to PROFINET BUS modules (P16x)

Access: Read/Write

Parameter {Factory setting}	Setting value / Description / Note	Device	Parameter type	
P160 … [-01] … … [-04]	**IP address** *(IP address)*	SK TU3-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. **CAUTION:** 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 TU3-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. **ATTENTION:** 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			

Parameter {Factory setting}	Setting value / Description / Note	Device	Parameter type	
P162	**Device name** *(Device name)*	SK TU3-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]**	**Test alarm** *(Test alarm)*	SK TU3-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) **[-02] =** Slot 1 (reserved) **[-03] =** Slot 2 (TU) **[-04] =** Slot 3 (FI)		**[-05] =** Slot 4 (reserved) **[-06] =** Slot 5 (reserved) **[-07] =** Slot 6 (reserved)	

5.1.3 BUS module information parameters, general (P17x)

Access: Read only

Parameter	Setting value / Description / Note	Device	Parameter type	
P170 **...** **... [-02]**	**Present error** *(Present error)*	SK TU3-PNT	16 bit	
0 ... 5420	Actual errors in the PROFINET module. The error message is reset when the supply voltage is switched off. **Possible error codes:** - 1020 Bus Time Out via P151 (TU4-PNT) or P513 (TU3-PNT)			
	[-01] = Actual module error		**[-02] =** Actual module error	
P171 **... [-01]** **...** **... [-03]**	**Software-Version** *(Software Version / Revision)*	SK TU3-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] = Version **[-02] =** Revision		**[-03] =** Special version	

Parameter	Setting value / Description / Note	Device	Parameter type	
P172	**Configuration** *(Configuration level)*	SK TU3-PNT	16 bit	
0 ... 2	The version can be queried in this parameter. **Possible values:** **0 = Internal module**, (SK CU4) **1 = External module**, (SK TU4) **2 = Module SK TU3-PNT**			
P173	**Option status** *(Module status)*	SK TU3-PNT	16 bit	
0 ... 0xFFFF	**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 = Reserved Bit 7 = Reserved Bit 8 = Frequency inverter status Bit 9 = Frequency inverter status **Explanation of frequency inverter status** Bit9 | Bit8 0 0 FI is offline 0 1 FI not supported 1 0 FI is online			
P176 … [-01] … … [-27]	**PZD bus IN** *(Process data bus IN)*	SK TU3-PNT	16 bit	
-32768 ... 32767	Allocation of process data which have been received (data sent from PROFINET IO controller). **[-01] =** Bus module outputs **[-02] =** Control word for FI1 **[-03] =** Setpoint 1 for FI1 **[-04] =** Setpoint 2 for FI1 **[-05] =** Bus module outputs **[-06] =** Control word for FI1 **[-07] =** Setpoint 1 for FI1 **[-08] =** Setpoint 2 for FI1			
P177 … [-01] … … [-27]	**PZD bus OUT** *(Process data bus OUT)*	SK TU3-PNT	16 bit	
-32768 ... 32767	Allocation of process data which have been transmitted (data sent to the PROFINET IO controller). **[-01] =** Bus module inputs **[-02] =** Status word from FI1 **[-03] =** Actual value 1 from FI1 **[-04] =** Actual value 2 from FI1 **[-05] =** Bus module inputs **[-06] =** Status word from FI1 **[-07] =** Actual value 1 from FI1 **[-08] =** Actual value 2 from FI1			

5.1.4 BUS module information parameters, bus-specific (P18x)

Access: Read only

Parameter		Setting value / Description / Note	Device	Parameter type	
P180	**... [-01] ... ... [-07]**	**PPO TYPE** *(PPO Type / Module ID)*	SK TU3-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 TU3-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: 6000 … 6FFF) **Example:** (00:0E:CF:03:60:00)			

5.2 SK5xxE inverter parameters (selection)

The parameters listed below relate the the frequency inverter in combination with the PROFINET bus module. A complete list of inverter parameters can be found in the manual for the frequency inverter (BU0500)).

NOTE: The structure of individual parameters of the frequency inverter versions SK 500E to SK 535E differs from the structure of the versions SK 540E and SK 545E. Because of this, the relevant parameters descriptions are listed twice.

5.2.1 Extra functions

Access: Read/Write

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P509	**Source Control Word** *(Source control word)*	SK 5xxE		
0 ... 10 { 0 }	Selection of the interface via which the FI is controlled (for details see BU0500). Also note parameter (P350). **0 = Control terminals or keyboard** **1 = Control terminals** **2 = USS (or Modbus RTU: SK 540E and above)** **3 = CAN** **4 = Profibus** **5 = InterBus** **6 = CANopen** **7 = DeviceNet** **8 = Ethernet TU** **9 = CAN Broadcast** **10 = CANopen Broadcast**			
P510 **[-01]** **[-02]**	**Source setpoints** *(Source setpoints)*	SK 5xxE	S	
0 ... 10 { all 0 }	Selection of the setpoints to be parameterised (For details see BU0500). Also note parameters (P350) and (P351). **[-01] = Main setpoint** source **[-02] = Auxiliary setpoint** source **0 = Automotive** **1 = Control terminals** **2 = USS (or Modbus RTU: SK 540E and above)** **3 = CAN** **4 = Profibus** **5 = InterBus** **6 = CANopen** **7 = DeviceNet** **8 = Ethernet TU** **9 = CAN Broadcast** **10 = CANopen Broadcast**			
P513	**Telegram time-out** *(Telegram time out)*	SK 5xxE	S	
-0.1 / 0.0 / 0.1 ... 100.0 sec { 0.0 }	Monitoring function of the active bus interface. 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<. **0.0 = Off**: Monitoring is switched off. **-0.1 = no error**: Even if communication between BusBox and FI is interrupted (e.g. 24V error, Box removed, etc.), the FI will continue to operate unchanged.			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P543	**Bus actual value 1** *(Actual bus value 1)*	up to SK 535E	S	P
0 ... 24 { 1 }	The return value 1 can be selected for bus actuation in this parameter. The possible analog functions can be found in the following table. **NOTE:** For further details please refer to the manual BU0500 (P418, P543), the relevant Bus operating manual or the supplementary POSICON manual BU0510.			
P543 [-01] ... [-05]	**Bus actual value** *(Actual bus values)*	SK 540E and above	S	P
0 ... 57 { [-01] = 1 } { [-02] = 4 } { [-03] = 9 } { [-04] = 0 } { [-05] = 0 }	In this parameter the return value for bus actuation can be selected. **NOTE:** The actual values 4 and 5 must be supported by the relevant bus module. For further details please refer to the manual BU0500 (P418, P543), the relevant BUS operating manual, the supplementary POSICON manual BU0510 or the supplementary PLC manual BU0550. **[-01] =** Actual bus value 1 **[-02] =** Actual bus value 2 **[-03] =** Actual bus value 3 **[-04] =** Actual bus value 4 **[-05] =** Actual bus value 5 **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Electricity **4 =** Torque current (100% = P112) **5 =** Digital IO status [1] **6 =** ... 7 Reserved **8 =** Setpoint frequency **9 =** Error number **10 =** ... 11 Reserved **12 =** BusIO Out Bits 0...7 **13 =** ... 16 Reserved **17 =** Value analog input 1 **18 =** Value analog input 2 **19 =** Setpoint frequency master value *(P503)* **20 =** Set Freq. After Ramp "Setpoint frequency master value after ramp" **21 =** Act. Freq. w/o Slip "Actual frequency without slip master value" **22 =** Speed encoder *(only possible with SK 520E and encoder feedback)* **23 =** Act. freq. with slip, "Actual frequency with slip" (SW V2.0 and above) **24 =** Lead.act.freq.+slip, "Master value, actual frequency with slip" (SW V2.0 and above) **53 =** *... 57 Reserved*			
P544	**Bus actual value 2** *(Actual bus value 2)*	up to SK 535E	S	P
0 ... 24 { 0 }	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			

[1] The assignment of the digital inputs in P543/ 544/ 545 = 5

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = DigIn 5	Bit 5 = DigIn 6 (SK 520E and above)	Bit 6 = DigIn 7 (SK 520E and above)	Bit 7 = Dig. func. AIN1
Bit 8 = Dig. func. AIN2	Bit 9 = DigIn 8 (SK 540E and above)	Bit 10 = DigIn 1, 1st IOE (SK 540E and above)	Bit 11 = DigIn 2, 1st IOE (SK 540E and above)
Bit 12 = Out 1/ MFR1	Bit 13 = Out 2/ MFR2	Bit 14 = Out 3/ DOUT1 (SK 520E and above)	Bit 15 = Out 4/ DOUT2 (SK 520E and above)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P545	**Bus actual value 3** *(Actual bus value 3)*	up to SK 535E	S	P
0 ... 24 { 0 }	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			
P546	**Function Bus setpoint 1** *(Function of bus - setpoint 1)*	up to SK 535E	S	P
0 ... 55 { 1 }	In this parameter, a function is allocated to the output setpoint 1 during bus actuation. The possible analog functions can be found in the following table. **NOTE:** For further details please refer to the manual BU0500 (P400, P546), the relevant BUS operating manual or the supplementary POSICON manual BU0510.			
P546 [-01] ... [-05]	**Function Bus setpoint** *(Function bus - setpoints)*	SK 540E and above	S	P
0 ... 57 { [-01] = 1 } all other { 0 }	In this parameter, during bus actuation a function is allocated to the setpoint provided. **NOTE:** The setpoints 4 and 5 must be supported by the relevant bus module. For further details, please refer to manual BU0500 (P400, P546), the relevant BUS operating manual or the supplementary POSICON manual BU0510. **[-01] =** Bus setpoint 1 **[-02] =** Bus setpoint 2 **[-03] =** Bus setpoint 3 **[-04] =** Bus setpoint 4 **[-05] =** Bus setpoint 5			

0 = Off
1 = Setpoint frequency
2 = Torque current limit *(P112)*
3 = Actual frequency PID
4 = Frequency addition
5 = Frequency subtraction
6 = Current limit *(P536)*
7 = Maximum frequency *(P105)*
8 = Actual PID frequency limited
9 = Actual PID frequency monitored
10 = Torque servo mode *(P300)*
11 = Torque precontrol *(P214)*
12 = *Reserved*
13 = Multiplication
14 = Process controller actual value
15 = Process controller setpoint
16 = Process controller lead
17 = BusIO In Bits 0...7
18 = Curve travel calculator
19 = Set relays, *"Output status"* (P434/441/450/455=38)
20 = Set analog output (P418=31)
21 = *...45 reserved from SK 530E and above → BU 0510*
46 = Setval.torque p.reg., *"Setpoint torque process controller"*
47 = *reserved from SK 530E and above → BU 0510*
48 = Motor temperature *(SK 540E and above)*
49 = *reserved from SK 540E and above → BU 0510*
53 = d-correction F process *(SK 540E and above)*
54 = d-correction Torque *(SK 540E and above)*
55 = d-correction F+torque *(SK 540E and above)*
56 = *reserved from SK 540E and above → BU 0510*
57 = *reserved from SK 540E and above → BU 0510*

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P547	**Function Bus setpoint 2** *(Function of bus - setpoint 2)*	up to SK 535E	S	P
0 ... 55 { 0 }	This parameter is identical to P546.			
P548	**Function Bus setpoint 3** *(Function of bus - setpoint 3)*	up to SK 535E	S	P
0 ... 55 { 0 }	This parameter is identical to P546.			

5.2.2 Information parameters

Access: Read only

Parameter	Setting value / Description / Note	Device	Parameter type	
P740 **[-01]** ... **[-13]**	**PZD bus in** *(Process data bus in)*	up to SK 535E	S	

0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems. For display, a BUS system must be selected in P509	**[-01]** = Control word	Control word, source from P509.
		[-02] = Actual bus value 1 **[-03]** = Actual bus value 2 **[-04]** = Setpoint 3	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 the master function value (Broadcast), if P509 = 9/10 (P510 [-02])

Parameter	Setting value / Description / Note		Device	Parameter type	
P740 **[-01] ... [-23]**	**PZD bus in** *(Process data bus in)*		SK 540E and above	S	
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems. For display, a BUS system must be selected in P509	**[-01]** = Control word		Control word, source from P509.	
		[-02] = Actual bus value 1 **[-03]** = Actual bus value 2 **[-04] =** Setpoint 3 **[-05] =** Setpoint 4 **[-06] =** Setpoint 5		Setpoint data from main setpoint (P510 [-01]).	
		[-07] = Bus I/O In Bits (P480)		The displayed value depicts all Bus In Bit sources linked with *or*.	
		[-08] = Parameter data In 1 **[-09]** = Parameter data In 2 **[-10]** = Parameter data In 3 **[-11]** = Parameter data In 4 **[-12]** = Parameter data In 5		Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)	
		[-13] = Setpoint 1 **[-14]** = Setpoint 2 **[-15]** = Setpoint 3 **[-16]** = Setpoint 4 **[-17]** = Setpoint 5		Setpoint data from the master function value (Broadcast), if P509 = 9/10 (P510 [-02])	
		[-18] = PLC control word		Control word, source PLC	
		[-19] = Setpoint 1 **[-20]** = Setpoint 2 **[-21]** = Setpoint 3 **[-22]** = Setpoint 4 **[-23]** = Setpoint 5		Setpoint data from the PLC.	
P741 **[-01] ... [-13]**	**PZD bus out** *(Process data bus out)*		up to SK 535E	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, source from P509.	
		[-02] = Actual value 1 (P543) **[-03]** = Actual value 2 (P544) **[-04]** = Actual value 3 (P545)			
		[-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.	
		[-11] = Actual value 1 master function **[-12] =** Actual value 2 master function **[-13] =** Actual value 3 master function		Actual value of master function 502/P503.	

Parameter	Setting value / Description / Note	Device	Parameter type	
P741 **[-01] ... [-23]**	**PZD bus out** *(Process data bus out)*	SK 540E and above	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, source from P509.
		[-02] = Actual value 1 (P543 [-01]) **[-03]** = Actual value 2 (P543 [-02]) **[-04]** = Actual value 3 (P543 [-03]) **[-05]** = Actual value 4 (P543 [-04]) **[-06]** = Actual value 5 (P543 [-05])	
		[-07] = Bus I/O Out Bit (P481)	The displayed value depicts all Bus Out Bit sources linked with *or*.
		[-08] = Parameter data Out 1 **[-09]** = Parameter data Out 2 **[-10]** = Parameter data Out 3 **[-11]** = Parameter data Out 4 **[-12]** = Parameter data Out 5	Data during parameter transfer.
		[-13] = Actual value 1 master function **[-14] =** Actual value 2 master function **[-15] =** Actual value 3 master function **[-16] =** Actual value 4 master function **[-17] =** Actual value 5 master function	Actual value of master function 502/P503.
		[-18] = PLC status word	Status word via PLC
		[-19] = Actual value 1 PLC **[-20]** = Actual value 2 PLC **[-21]** = Actual value 3 PLC **[-22]** = Actual value 4 PLC **[-23]** = Actual value 5 PLC	Actual value data via PLC

P745	**Option version** *(Module version)*	SK 5xxE		
0.0 ... 999.9	Version status (software version) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. Have this data available if you have a technical query.			

P746	**Option status** *(Module status)*	SK 5xxE	S	
0000 ... FFFF (hex)	Actual status (readiness, error, communication) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. **Example:** 0603_{hex} High byte = 06_{hex} => Profibus Low byte = 03_{hex} => Module ready + connection to master Code details can be found in the respective BUS module manual. Different contents are shown depending on the modules.			

NOTE

When activated, the functions **block current**, **quick stop**, **remote control** and **cancel error** are available at the (local) control terminals. To operate the drive, a high signal must be present on the digital inputs being used before the drive can be enabled.

6 Error monitoring and error messages

According to the cause, frequency inverters and technology units generate appropriate messages if they deviate from their normal operating status.

6.1 PROFINET error monitoring

An error in the frequency inverter (P700) or in the SK TU3-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 (P700 or P170) = Alarm number of the diagnostic alarm – 0x100

Example:

During operation, the error E10.3 (P700 Index 1 = 103) = Timeout occurs via the P513 monitoring. The SK TU3-PNT sends a diagnostic alarm with the value 359 (= 100h + 103 = 256 + 103 = 359) to 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.

6.2 Error messages in the Bus module SK TU3-PNT

All SK TU3-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.

6.3 Error messages in the SK 5xxE 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 an appropriately programmed digital input (P420 ... P425 / P470 = Function 12),
3. By switching of the “enable” on the frequency inverter (if no digital input is programmed for acknowledgement),
4. By Bus acknowledgement or
5. By P506, the automatic error acknowledgement.

The following error messages are directly associated with the Bus module SK TU3-PNT.

FI Error Code	Error register
0	No error
10.3	Timeout via P513 monitoring
10.5	General PROFINET configuration error
10.8	The connection between the FI and the SK TU3-PNT had a timeout

Table 29 SK5xxE error messages associated with the SK TU3-PNT

For a complete overview of the error messages relating to the frequency inverter, please refer to the frequency inverter manual BU0500.

7 Lists / Index

7.1 Abbreviations

AIN ..... Analog input
AOUT ... Analogue output
DI (DIN) Digital input
DO (DOUT) Digital output
I / O ..... Input /Output
EEPROM Non-volatile memory
EMC ..... Electromagnetic compatibility
FI ……. Frequency inverters
HSW ..... Main setpoint
I/O ..... In / Out (Input / Output)
ISD ..... Field current (Current vector control)
LED..... Light-emitting diode
NSW..... Auxiliary setpoint
P-Box ... ParameterBox
PDO..... Process Data Object
S ..... Supervisor Parameter, P003
SW ..... Software version, P707
STW ..... Control word
TU ..... Technology Unit (technology module, e.g.: PROFINET Bus module)
ZSW..... Status word

7.2 Keyword Index

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.

DAP ……. Device Access Point, designates the PROFINET IO Bus interface

Jitter ……. Designates a slight fluctuation in precision in the transmission pulse, or the variation in the transmission time of data packages.

XML ……. "Extensible Markup Language", abbreviated XML , contains all essential information concerning the bus module and all parameters of FIs which can be connected.

7.3 Figures

7.4 Tables

7.5 Keyword index

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