



EN

BU 2700

PROFIBUS DP bus interface

Supplementary manual options for NORD - Frequency Inverters



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1 Introduction

1.1 General

1.1.1 Documentation

Name: BU 2700
 Material number 6082702
 Series: **Field bus system PROFIBUS® DP**

1.1.2 Document History

Issue	Order number	Software version	Remarks
BU 2700, October 2016	6082702/ 4116	V 3.6 R0	<ul style="list-style-type: none"> Combination of manuals BU 0020 EN, June 2012, Part number 607 0201 / 2612 and BU 0220 EN, February 2012, Part number 607 2201 / 0912 Extensive revision

1.1.3 Copyright notice

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

Any editing or amendment or other utilisation of the document is prohibited.

1.1.4 Publisher

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1.1.5 About this manual

This manual is intended to assist you in the setup of bus interfaces PROFIBUS® DP from Getriebebau NORD GmbH & Co. KG in a field bus system. It is intended for all qualified electricians who plan, install and set up the field bus system (📖 Section 2.2 "Selection and qualification of personnel"). The information in this manual assumes that the qualified electricians who are entrusted with this work are familiar with the technology of the field bus system and programmable logic controllers (PLC).

This manual only contains information and descriptions of bus interfaces and frequency inverters manufactured by Getriebebau NORD GmbH & Co. KG. It does not contain any descriptions of the controllers and the necessary software for other manufacturers.

PROFIBUS® DP is a registered trademark.

1.2 Other applicable documents

This manual is only valid in combination with the Technical Information for the bus interface which is used and the operating instructions for the relevant frequency inverter. Only these documents contain all of the information that is required for safe commissioning of the bus interface module and the frequency inverter. A list of the documents can be found in 📖 Section 9.3 "Documents and software".

The "Technical Information" (TI) for the bus interface and the manuals (BU) for the NORD frequency inverters can be found under www.nord.com.

1.3 Presentation conventions

1.3.1 Warning information

Warning information for the safety of the user and the bus interfaces are indicated as follows:

 DANGER

This warning information warns against personal risks, which may cause severe injury or death.

 WARNING

This warning information warns against personal risks, which may cause severe injury or death.

 CAUTION

This warning information warns against personal risks, which may cause slight or moderate injuries.

NOTICE

This warning warns against damage to material.

1.3.2 Other information

 Information

This information shows hints and important information.

1.3.3 Text markings

The following markings are used to differentiate between various types of information:



Text

Type of information	Example	Marking
Instructions	1st 2nd	Instructions for actions whose sequence must be complied with are numbered sequentially.
Bullet points	•	Bullet points are marked with a dot.
Parameters	P162	Parameters are indicated by the prefix "P", a three-digit number and bold type.
Arrays	[-01])	Arrays are indicated by square brackets.
Factory settings	{ 0,0 }	Factory settings are indicated by curly brackets.
Software descriptions	"Cancel"	Menus, fields, buttons and tabs are indicated by quotation marks and bold type.

Numbers

Type of information	Example	Marking
Binary numbers	100001b	Binary numbers are indicated by the suffix "b"
Hexadecimal numbers	0000h	Hexadecimal numbers are indicated by the suffix "h"

Symbols used

Type of information	Example	Marking
Cross-reference	 Section 4 "NORD system bus"	Internal cross-reference A mouse click on the text calls up the stated point in the document.
	 Supplementary manual	External cross-reference
Hyperlink	http://www.nord.com/	References to external websites are indicated in blue and underlined. A mouse click calls up the website.

Type designations

Designation	Description
SK 1x0E	Series SK 180E frequency inverters
SK 2xxE	Series SK 200E frequency inverters
SK 2x0E-FDS	Series SK 250E-FDS frequency inverters
SK 5xxE	Series SK 500E frequency inverters
SK 54xE	SK 540E and SK 545E frequency inverters

1.3.4 List of abbreviations

Abbreviations used in this manual

Abbreviation	Meaning
AG	Absolute encoder
AK	Order label/response label
BusBG	Bus module
DIN	Digital input
DIP	Dual In-Line Package (= double row housing), compact switch block
DO	Digital output
DS	Device state (status)
EMC	Electromagnetic compatibility
I / O	Input/Output
FI	Frequency inverter
GSD	Generic Station Description
IND	Index
IP	Internet protocol
I/O	Input, Output
IW	Actual value
PDO	Process Data Object
PKE	Parameter label
PKW	Parameter label value
PNU	Parameter number
PPO	Parameter/Process Data Object
PWE	Parameter value
PZD	Process data
SDO	Service Data Object
SPI	Serial Peripheral Interface
PLC	Programmable Logical Controller
STW	Control word
SW	Setpoint
TCP	Transmission Control Protocol
USS	Universal serial interface
ZSW	Status word

2 Safety

2.1 Intended use

PROFIBUS DP bus interfaces from Getriebbau NORD GmbH & Co. KG are interfaces for PROFIBUS DP field bus communication, which may only be used in the following frequency inverters from Getriebbau NORD GmbH & Co. KG.

Bus interface	Frequency inverter
SK TU4-PBR	Series
SK TU4-PBR-C	SK 180E
SK TU4-PBR-M12	SK 200E
SK TU4-PBR-M12-C	SK 200E-FDS
SK CU4-PBR	SK 540E
SK TU3-PBR	SK 500E series
SK TU3-PBR-24V	

PROFIBUS DP bus interfaces from Getriebbau NORD GmbH & Co. KG are used for communication by the frequency inverter with a PLC in a PROFIBUS DP field bus system provided by the operator.

Any other use of the bus interfaces is deemed to be incorrect use.

2.2 Selection and qualification of personnel

The bus interface may only be installed and started up by qualified electricians. These must possess the necessary knowledge with regard to the technology of the field bus system, as well as configuration software and the controller (bus master) which are used.

In addition, the qualified electricians must also be familiar with the installation, commissioning and operation of the bus interfaces and the frequency inverters as well as all of the accident prevention regulations, guidelines and laws which apply at the place of use.

2.2.1 Qualified personnel

Qualified personnel includes persons who due to their specialist training and experience have sufficient knowledge in a specialised area and are familiar with the relevant occupational safety and accident prevention regulations as well as the generally recognised technical rules.


These persons must be authorised to carry out the necessary work by the operator of the system.


2.2.2 Qualified electrician

An electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to


- Switching on, switching off, isolating, earthing and marking power circuits and devices,
- Proper maintenance and use of protective devices in accordance with defined safety standards.
- Emergency treatment of injured persons.

2.3 Safety information

Only use bus interfaces and frequency inverters from Getriebebau NORD GmbH & Co. KG for their intended purpose,  Section 2.1 "Intended use".

To ensure safe operation of the bus interface, observe all of the instructions in this manual, and in particular the warning information in the other applicable documents,  Section 9.3 "Documents and software".

Only commission bus interfaces and frequency inverters in their technically unchanged form and not without the necessary covers. Take care that all connections and cables are in good condition.

Work on and with bus interfaces and frequency inverters must only be carried out by qualified personnel,  Section 2.2 "Selection and qualification of personnel".

3 PROFIBUS DP basics

3.1 Characteristics

PROFIBUS DP (**PRO**cess **FI**eld**BUS** **D**ecentralized **P**eripherals) is a real time field bus system for the communication of data between central automation devices (e.g. PLC, PC) and field devices (e.g. frequency inverters). Communication is carried out via a serial port (RS485). PROFIBUS DP is specified in the standards IEC 61158 and IEC 61784.

PROFIBUS DP uses the layers 1 (Physical Layer), 2 (Data Link Layer) and 7 (Application Layer) of the OSI layer model.

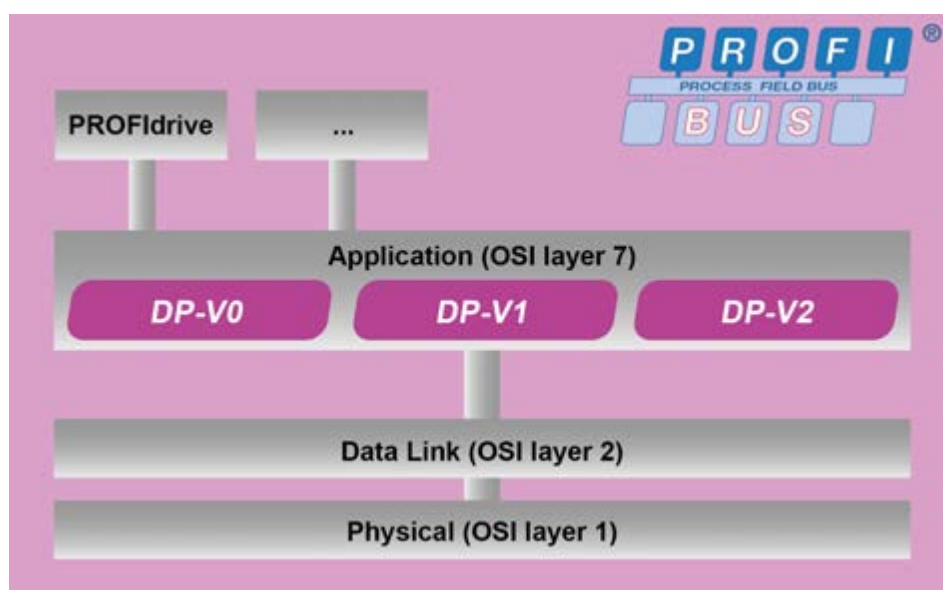


Figure 1: OSI Layer Model PROFIBUS DP

Item	Description
Physical	Physical layer, defines the hardware, coding, speed etc. of data transfer
Data Link	Link layer, defines the communication physics (access method in the field bus and data backup).
Application	Application layer, defines the interface to the application program with the application-orientated commands.
PROFdrive	PROFIBUS application profile, defines the behaviour and access method to drive data for electric drives to PROFIBUS.

PROFIBUS® is a registered trademark of PROFIBUS and PROFINET International (PI).

PROFIBUS DP is a master-slave- system. It can be configured as a mono or multi-master system.

The communication functions which are required by the field bus system are defined in the DP performance levels:

Performance level	Description
DP-V0	Basic functions of PROFIBUS DP: <ul style="list-style-type: none"> • Cyclical data exchange (process and parameter data) between the central controller (Master) and field devices (Slaves) • Device configuration (GSD) • Diagnostic functions
DP-V1	All functions of performance level DP-V0 as well as the following extensions: <ul style="list-style-type: none"> • Acyclic data exchange (for parameterisation, operation, monitoring and processing of alarms) between the central controller (Master) and field devices (Slaves), parallel to the cyclic exchange of data. • Status alarm, update alarm and alarm processing specific to the manufacturer. • Data exchange during the initialisation phase of the slave

Up to 126 participants (divided into segments with up to 32 participants) can be connected to a PROFIBUS DP field bus system. PROFIBUS DP participants are categorised into three types of devices:

Device type	Description
DPM1 DP Master Class1	Central controllers (PLC or PC), which exchange cyclic information with the decentralised field devices (Slaves) in a specified cycle. A DPM1 device has active bus access for reading device data (inputs) and writing setpoints (outputs) at fixed times.
DMP2 DP Master Class 2	Planning or operating device which is temporarily connected to the field bus for commissioning, configuration, maintenance and diagnosis. A DMP2 device has active access to the bus for reading and writing.
DP Slave	Peripheral device which reads in and/or uses output information, or which only provides input or output information. Slaves are passive communication participants, i.e. they only respond to order.

Addressing of PROFIBUS DP bus participants is carried out by:

- the unique identification number of the device,
- the assigned unique PROFIBUS address.

Performance description

Standards	IEC 61158, IEC 61784		
Possible number of bus participants	<ul style="list-style-type: none"> • max. 32 participants per segment without repeater • max. 126 participants per network with repeaters 		
Transfer rate	max. 12 Mbit		
Transfer Method	RS485		
Data transmission	Reading and writing of process and parameter data		
PROFIBUS DP performance level	SK TU3-PBR DP-V0	SK CU4-PBR DP-V1	SK TU4-PBR DP-V1
Wiring	Twisted, shielded two-conductor cable, Cable type A according to EN 50170		
Cable length	Depending on transmission speed:		
	Transmission rate [kBit/s]	Range per segment (without repeater) [m]	
	500	400	
	1500	200	
	3000	100	
	6000	100	
	12000	100	

3.2 Topology

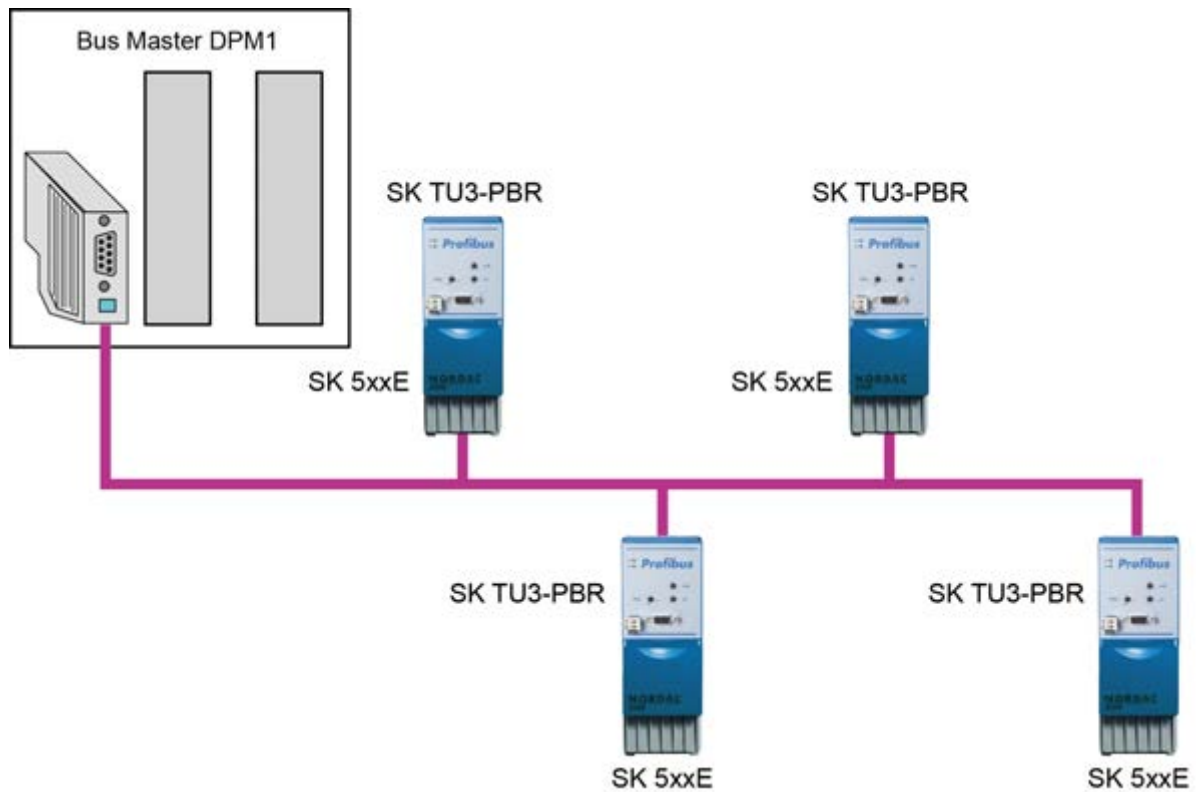


Figure 2: PROFIBUS DP linear topology (example)

PROFIBUS DP bus interfaces from Getriebebau NORD GmbH & Co. KG are connected in a linear structure. Up to 32 participants (Master and Slaves) can be connected in a single segment. An active bus termination which must be continuously supplied with power must be provided at the start and end of each segment. The bus termination of NORD SK xU4-PBR bus interfaces is made via DIP switches; the bus termination of NORD SK TU3-PBR bus interfaces must be made with the standard PROFIBUS plug connector.

For more than 32 bus participants, line amplifiers (repeaters) must be used to connect the bus segments.

3.3 Bus protocol

The following telegram formats are available for PROFIBUS DP data communication:

- Telegram without data field



- Fixed length telegram for 8 Byte of application data



- Variable length telegram (4...249 Bytes) for 1...246 Byte of application data



- Token telegram for communicating the authorisation for transmission from one Master (DPM1) to another (e.g. DPM2)



- Short telegram for the positive response to an order telegram



Abbreviation	Description
SD1...SD4	Start Delimiter, designates the telegram format: <ul style="list-style-type: none"> • SD1 = No data, coding "10h" • SD2 = Variable data length, coding "68h" • SD3 = Fixed data length, coding "A2h" • SD4 = Token telegram, coding "DCh"
SC	Short Confirmation = Short confirmation, coding "E5h" (response to telegrams which only require confirmation)
DA	Destination Address = Destination address of the PROFIBUS DP telegram
SA	Source Address = source address of the PROFIBUS DP telegram
FC	Function code
FCS	Check sum of the PROFIBUS DP telegram
ED	End Delimiter, marks the end of the telegram
PDU	Protocol Data Unit = Reference data area
LE	Length
LEr	Length repeated = details of repeated length

With the PROFIBUS communication protocol (decentralised peripherals) data communication between the bus master and the decentralised field devices is primarily cyclical (performance level DP-V0). In parallel with the cyclical transfer of application data, there may also be an acyclic transfer of information between the field devices for parameterisation, operation, monitoring and processing of alarms (performance level DP-V1).

PROFIBUS DP bus interfaces from Getriebebau NORD GmbH & Co. KG support performance levels DP-V0 and DP-V1..

Performance levels DP-V0

Basic function	Description
Functionality	<ul style="list-style-type: none"> • Cyclic transfer of application data between the DP master and slaves • Dynamic activation/deactivation of individual slaves • Checking the configuration of slaves • Diagnostic functions, 3 graduated alarm levels • Synchronisation of inputs and/or outputs • Option for addressing slaves via the field bus • Input/output data max. 244 Bytes per slave
Device types:	<ul style="list-style-type: none"> • DP Master Class 1 (DPM1), e.g. PLC or PC • DP Master Class 2 (DPM2), e.g. engineering or parameterisation tool • DP Slave, e.g. devices with binary or analogue inputs/outputs, drive units, valves, etc.
Bus access	<ul style="list-style-type: none"> • Token-passing procedure (assignment of permission for transmission) between masters • Master-Slave- procedure between bus master and slaves • Mono-Master or Multi-Master System
Communication	<ul style="list-style-type: none"> • Point-to-point or multicast application data traffic (control commands) • Cyclic master-slave application data traffic
Operating states	<ul style="list-style-type: none"> • "Operate" = Cyclic transfer of input and output data • "Clear" = Inputs are read, outputs remain in safe condition • "Stop" = Diagnosis and parameterisation, no transfer of application data
Synchronisation	<ul style="list-style-type: none"> • Control commands to synchronise inputs and outputs • "Sync Mode" = Outputs are synchronised • "Freeze Mode" = Inputs are synchronised
Protective functions	<ul style="list-style-type: none"> • Hamming Distance HD = 4 • Response monitoring of slaves, detects failure of master • Access protection for slave outputs • Monitoring of application data traffic with adjustable timer on the master

Performance levels DP-V1

In addition to the basic functions of performance level DP-V0, performance level DP-V1 also contains the following extensions:

Extension	Description	
Functionality	<ul style="list-style-type: none"> Acyclic data exchange between DP master and slaves (parameterisation etc. during operation) parallel to the cyclic exchange of data Confirmed alarm messages 	
Services	For acyclic data exchange between DPM1 and slaves:	
	Read	The master DPM1 reads the data block from the slave.
	Write	The master DPM1 writes a data block.
	Status	The slave sends a status message to the master. The status message is not confirmed.
	Depending on the connection, the data transfer is via an MS1 connection which is established by the master DPM1 and is coupled to the connection for cyclic data exchange. Via this connection data can only be sent from the master which has configured and parameterised the particular slave.	
	For acyclic data exchange between DPM2 and slaves:	
	Initiate/Abort	Initiate/abort a connection for acyclic data traffic between the master DPM2 and the slave.
	Read	The master DPM2 reads the data block from the slave.
	Write	The master DPM2 writes a data block to the slave.
	Data_Transport	The master DPM2 writes/reads application-specific data (according to a specified profile) acyclically into/from the slave.
	Depending on the connection, the data transfer is via an MS2 connection which is established with the "Initiate" service by the master DPM2 before the start of data transfer. After the end of the data exchange, the connection is disconnected with the "Abort" service.	

Addressing of the data for the cyclic and acyclic exchange of information is carried out via the PROFIBUS DP device model. According to this, DP slaves are subdivided into functional units (modules). The data receive a label, which determines the type of the module (input, output or input/output combination). The total of all labels gives the configuration of the slave, which is checked by the bus master (DPM1) when the field bus is booted.

Addressing is by means of a slot/index combination. The slots and indices of NORD bus interfaces and frequency inverters are read by the bus master from the device description file (📖 Section 5.2 "Integration into the bus master").



Figure 3: Example – PROFIBUS DP device model for decentralised devices

Designation	Description
TU	Bus interface
F11...F14	Frequency inverters 1...4 (SK 1x0E, SK 2xxE decentralised inverters)

4 NORD system bus

Communication between the bus interface and frequency inverters from Getriebebau NORD GmbH & Co. KG is carried out via a separate NORD system bus. The NORD system bus is a CAN field bus; communication is via the CANopen protocol.

One or more frequency inverters in the field bus system can be accessed via a bus interface.

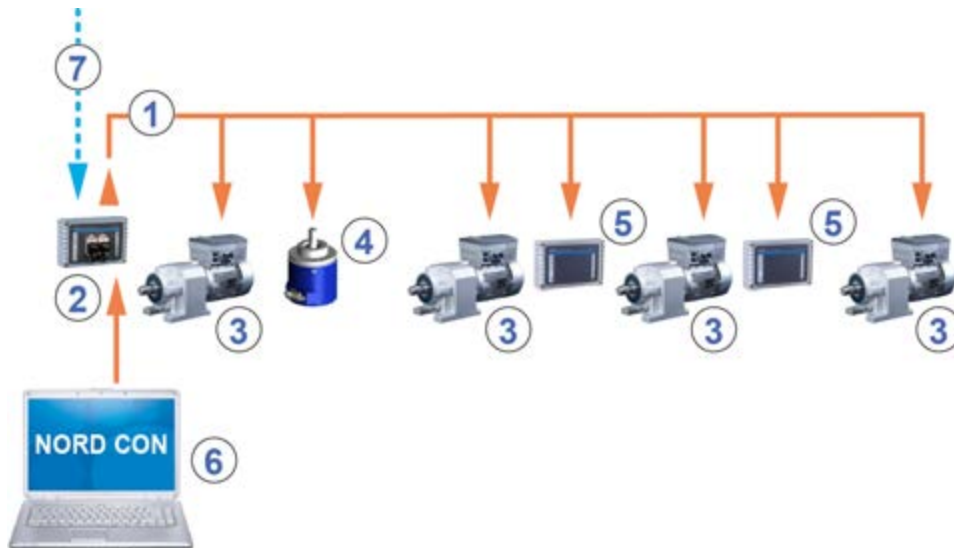



Figure 4: Example of the structure of a NORD system bus

Item	Description
1	NORD system bus (CAN field bus)
2	SK TU4 bus interface
3	Frequency inverter
4	Absolute encoder
5	Input/output extension SK TU4-IOE
6	NORD CON computer (on Windows® based PC, on which the NORD CON parameterisation and control software is installed)
7	Field bus

4.1 NORD system bus participants

Possible number of bus nodes on a system bus:

	Decentralised frequency inverters		Central frequency inverters	
	SK 1x0E	SK 2xxE	SK 500–535E	SK 54xE
Frequency inverter	4	4	1	1
Input/output extensions	8	8	—	8
CANopen encoder	4	4	1	1
Bus interface	1	1	1	1
NORD CON computer	1	1	1	1


All participants on the NORD system bus must be assigned a unique address (CAN ID). The address of the bus interface is pre-set at the factory and cannot be changed. Connected IO extensions must be assigned to the frequency inverters ( Technical Information/Data Sheet of the relevant IO extension). Depending on the device, the addresses of the frequency inverter and the connected absolute encoder can be set via the parameter **P515 CAN address** or via the DIP switches.

If absolute encoders are used, these must be assigned directly to a frequency inverter. This is carried out using the following equation:

$$\text{Absolute encoder address} = \text{CAN ID of the frequency inverter} + 1$$


This results in the following matrix:

Device	FI 1	AG1	FI 2	AG2	...
CAN-ID	32	33	34	35	...


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

Information

SK 5xxE series, SK 511E and above

Setup of a system bus with SK 5xxE series devices is only possible for SK 511E devices and above and is made via their RJ45 sockets. It must be noted that the RJ45 sockets must have a 24 V DC supply in order to enable communication via the system bus ( Frequency inverter manual).

4.2 Access to parameters and control options


Communication by NORD control devices (SimpleBox and ParameterBox) and the NORD CON software with the bus interfaces and the frequency inverters on the NORD system bus is carried out via the USS protocol ( Manual [BU 0050](#))

Information

Access to bus interface parameters

- Access to bus interface parameters is only possible via the NORD CON software or the ParameterBox, not however via the SimpleBox (SK CSX-3...).
- Access to the parameters of a SK TU4 is possible via the NORD system bus by connection to a frequency inverter or also directly by connection to the RJ12 interface of the SK TU4.
- Access to the parameters of a SK CU4 is only possible via the NORD system bus (CANopen) by connection to a frequency inverter.

4.2.1 Access via the NORD SimpleBox

By connection of the SimpleBox ( Manual [BU 0040](#)) to a frequency inverter a **point-to-point USS bus communication** is established. The SimpleBox only communicates with the frequency inverter to which it is connected.


4.2.2 Access via the NORD ParameterBox

Access via the ParameterBox ( Manual [BU 0040](#)) can be obtained by several methods:

- Connection of the ParameterBox to a frequency inverter for **point-to-point USS bus communication**. The ParameterBox only communicates with the frequency inverter to which it is connected.
- Connection of the ParameterBox to a frequency inverter for **USS communication** with a maximum of 6 participants (5 devices plus ParameterBox). This requires an installed USS bus:
 - Wired,
 - Termination resistors set,
 - USS bus participants addressed.
- Connection of the ParameterBox to a bus interface or frequency inverter for **system bus communication (CANopen)** with a maximum of 6 participants (5 devices plus ParameterBox).

Information

Connection of the ParameterBox to an SK 5xxE

Necessary information for connection of the ParameterBox to SK 5xxE series frequency inverters  [BU 0500](#) or [BU 0505](#) (SK 54xE), section "Connection of several devices to a parameterisation tool".

This requires an installed system bus:

- Wired,
- Termination resistors set,
- System bus participants addressed, USS addresses set to the factory setting ("0"). If the ParameterBox detects an active system bus, a USS address is automatically assigned to all of the participants which are detected.

Communication is via the USS protocol. The CANopen interface of the bus interface or the device with which the ParameterBox is connected acts as a gateway.

4.2.3 Access via NORD CON software

Access via the NORD CON software (Manual [BU 0000](#)) can be obtained by several methods:

- Connection of the NORD CON computer to a frequency inverter for **point-to-point USS bus communication**. The NORD CON software only communicates with the frequency inverter to which it is connected.
- Connection of the NORD CON computer to a frequency inverter for **USS communication** with a maximum of 32 participants (31 devices plus ParameterBox). This requires an installed USS bus:
 - Wired,
 - Termination resistors set (only for RS485 connection. This is not necessary for an RS232 connection).



Information

USS address


It is not necessary to set a USS address.


- Connection of the NORD CON computer to a bus interface or frequency inverter for **system bus communication (CANopen)** with a maximum of 32 participants (31 devices plus NORD CON). This requires an installed system bus:
 - Wired,
 - Termination resistors set,
 - System bus participants addressed, USS addresses set to the factory setting ("0"). If the NORD CON software detects an active system bus, a USS address is automatically assigned to all of the participants which are detected.

Communication is via the USS protocol. The CANopen interface of the bus interface or the device with which the NORD CON software is connected acts as a gateway.

5 Initial setup

The bus interface must be set up in order to commission the field bus system. This consists of the following work:

Type of work	Description 
Connect the bus interface to the frequency inverter	Section 5.1 "Connecting the bus interface"
Configure the control project	Section 5.2 "Integration into the bus master"
Assign the bus address	
Make the required parameter settings	Section 7 "Parameters"

An example of the procedure for setting up the field bus system can be found at the end of this section ( Section 5.3 "Example: Commissioning the PROFIBUS bus module").


Detailed information about EMC compliant installation can be found in the Technical Information [TI 80_0011](#) under www.nord.com

5.1 Connecting the bus interface



Information

Bus address via DIP switch


Before connecting the bus interface, read the information for setting the bus address in the technical information and in this manual ( Section 5.2.4 "PROFIBUS DP field bus address"). If the bus address is set with the DIP switches, this must be carried out before the bus interface is connected, as the DIP switches are no longer accessible after this.

Connection of the bus interface to the frequency inverter and the PROFIBUS DP field bus is described in the corresponding technical information:

Bus interface	Frequency inverter	Documentation
SK TU3-PBR	SK 5xxE series	Technical Information/Data Sheet TI 275900030
SK TU3-PBR-24V		Technical Information/Data Sheet TI 275900160
SK TU4-PBR	SK 1x0E and SK 2xxE series	Technical Information/Data Sheet TI 275900100
SK TU4-PBR-M12		Technical Information/Data Sheet TI 275281200
SK TU4-PBR-C		Technical Information/Data Sheet TI 275281150
SK TU4-PBR-M12-C		Technical Information/Data Sheet TI 275281250
SK CU4-PBR		Technical Information/Data Sheet TI 275271000
SK CU4-PBR-C		Technical Information/Data Sheet TI 275271500

5.2 Integration into the bus master

The bus master must first be configured for communication with the bus interface (PLC project). The configuration must be produced with a software system for PROFIBUS DP field bus systems (e.g. "Simatic Step 7" from Siemens AG).

For integration of NORD frequency inverters into the Siemens AG SIMATIC Manager, Getriebbau NORD GmbH & Co. KG provides standard S7 modules, which can be used for both PROFIBUS DP as well as for PROFINET IO field bus systems,  Manual [BU 0940](#).

5.2.1 Installing the device description file

The bus master needs a device description file so that the bus interface and the frequency inverter can be identified by the bus master during the bus scan. The current device description file which is necessary for detection of the CANopen bus interface and the frequency inverter can be downloaded from our website www.nord.com, directly under the link

[NORDAC Options](#)

The file contains descriptions

- of the device characteristics of the bus interface,
- parameters of the bus interface,
- parameters of the associated frequency inverter.

The characteristics of all bus interface types are described in the device description file. The relevant type must be selected in the PROFIBUS DP configuration software.

At present the following device description versions are available:

File	Bus interface	Frequency inverter
NORD_1_5.gsd	SK TU3-PBR	SK 5xxE series
NORD_12.gsd	SK TU3-PBR-24V	
NORD0BA8.gsd	SK CU4-PBR	SK 2xxE series
	SK TU4-PBR	



Information

Number of connected frequency inverters


As delivered, the device description file is set to a connected frequency inverter (FI1) If several frequency inverters are connected, these must be set in the configuration software after installation of the device description file.

5.2.2 Automatic device detection

In order that the bus interface and the connected frequency inverters can be automatically detected by the bus master in the bus scan, the following settings must be made in the configuration software after installation of the device description file:


- Enter the bus interface in the PROFIBUS DP field bus system
- Set the bus address of the bus interface

5.2.3 Format of process data


For the cyclic transfer of process data for the bus interface and the frequency inverter, the data format must be specified in the configuration project. For detailed information about process data, please refer to  Section 6.4 "Transfer of process data".

5.2.4 PROFIBUS DP field bus address

In order for the bus interface and the connected frequency inverters to be detected by the bus master, the bus address, and if necessary the termination resistor (if the bus interface is the last participant on the bus) must be set on the bus interface.

Setting	Setting via	bus interface	
Field bus address	DIP switch or	SK xU4-PBR	Technical Information/Data Sheet
	PROFIBUS-specific parameters P160 Profibus address		following section
	Rotary coding switches	SK TU3-PBR-24V	Technical Information/Data Sheet
	Parameter P508 Profibus address of the connected frequency inverter	SK TU3-PBR	following section
Terminating resistance	DIP switch	SK xU4-PBR	Technical Information/Data Sheet
	SUB-D9-PROFIBUS standard plug connector	SK TU3-PBR-24V	
		SK TU3-PBR	


The settings are read out by the bus interface when the bus interface is connected to the power supply ("POWER ON").

The address which is currently set can be read out via the Parameter **P180 Profibus address** ( Section 7.1.4 "PROFIBUS DP information parameters").

5.2.4.1 Setting parameters

Setting of the PROFIBUS DP address via parameter **P160** or **P508** must be carried out in the NORD CON software.

Requirement

- The PROFIBUS DP field bus system has been installed and commissioned according to the manufacturer's instructions.
- A NORD CON computer is available ( BU 0000).
- DIP switches 3...8 of the bus interface SK xU4-PBR are set to "OFF".

Procedure

1. Open the required device (bus interface or frequency inverter) with a double click in the tree directory of the NORD CON software, call up the standard parameter **P160 Profibus address** (SK xU4-PBR) or the additional parameter **P508 Profibus- address** (SK TU3-PBR); enter the address (permissible range "3"...."125") and save with "ENTER".



Information

DIP switches on the bus interface

If one of the DIP switches 3...8 on the bus interface SK xU4-PBR is not in the "OFF" position, the setting of parameter **P160** is ignored and the PROFIBUS DP address is read from the setting of the DIP switches.

2. Restart the bus interface (switch the power supply off and on again) so that the parameter setting is read in.

5.3 Example: Commissioning the PROFIBUS bus module

The following example contains an overview of the necessary steps for commissioning the bus interface in a PROFIBUS field bus system. The example does not include any details of application-specific settings (motor data, control parameters, etc.).







Example:

Via a bus interface, 3 frequency inverters are to be independently controlled in positioning operation with a single speed and a single position specification.

Device type	Name	Connected motor	Characteristics
Bus interface SK TU4-PBR	BusBG ¹		
SK 2x5E frequency inverter	FI 1	4-pole/n=1390 rpm/50 Hz	Motor with CANopen absolute encoder AG1
SK 2x5E frequency inverter	FI 2	4-pole/n=1390 rpm/50 Hz	Motor with CANopen absolute encoder AG2
SK 2x5E frequency inverter	FI3 ¹	4-pole/n=1390 rpm/50 Hz	Motor with CANopen absolute encoder AG3

¹ The bus interface and frequency inverter FI3 are physically the last participants on the NORD system bus.

Communication	Step	Explanation	
NORD system bus	1	Before connecting the bus interface to the frequency inverter: Set the termination resistors.	
		Set DIP switch 1 (of 12) on the bus interface to the "ON" position.	
		Set DIP switch S2 on frequency inverter FI3 to the "ON" position. All other DIP switches (termination resistors) must be in the "OFF" position.	
	2	Set up system bus.	A 24 V supply is required! (📖 Technical Information for the bus interface)
	3	Set the system bus address of the frequency inverter	Preferably with the DIP switches (📖 BU 0200):
			FI1 Address "32"
			FI2 Address "34"
			FI3 Address "36"
			AG1 Address "33"
			AG2 Address "35"
AG3 Address "37"			
		The address of the bus interface is pre-set and cannot be changed.	
4	Set the system bus baud rate.	Set "250 kBaud" on FI1 to FI3 as well as on AG1 to AG3.	

Communication	Step	Explanation																		
	5	<p>Set the parameters for system bus communication.</p> <p>Set the following parameters on each frequency inverter:</p> <table border="1"> <tr> <td>P509</td> <td>3 (system bus)</td> </tr> <tr> <td>P510, [-01]</td> <td>0 (Auto)</td> </tr> <tr> <td>P510, [-02]</td> <td>0 (Auto)</td> </tr> <tr> <td>P543, [-01]</td> <td>1 (actual frequency)</td> </tr> <tr> <td>P543, [-02]</td> <td>10 (actual position incl.Low word)</td> </tr> <tr> <td>P543, [-03]</td> <td>15 (actual position incl. High word)</td> </tr> <tr> <td>P546, [-01]</td> <td>1 (setpoint frequency)</td> </tr> <tr> <td>P546, [-02]</td> <td>23 (setpoint frequency incl.Low word)</td> </tr> <tr> <td>P546, [-03]</td> <td>24 (setpoint frequency incl. High word)</td> </tr> </table>	P509	3 (system bus)	P510 , [-01]	0 (Auto)	P510 , [-02]	0 (Auto)	P543 , [-01]	1 (actual frequency)	P543 , [-02]	10 (actual position incl.Low word)	P543 , [-03]	15 (actual position incl. High word)	P546 , [-01]	1 (setpoint frequency)	P546 , [-02]	23 (setpoint frequency incl.Low word)	P546 , [-03]	24 (setpoint frequency incl. High word)
P509	3 (system bus)																			
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P510 , [-02]	0 (Auto)																			
P543 , [-01]	1 (actual frequency)																			
P543 , [-02]	10 (actual position incl.Low word)																			
P543 , [-03]	15 (actual position incl. High word)																			
P546 , [-01]	1 (setpoint frequency)																			
P546 , [-02]	23 (setpoint frequency incl.Low word)																			
P546 , [-03]	24 (setpoint frequency incl. High word)																			
PROFIBUS field bus	6	<p>Set up the bus interface for field bus communication.</p> <p> Sections 5.1 "Connecting the bus interface" to 5.2 "Integration into the bus master" 5.3</p> <p>Set the following parameters on the bus interface ( Section 7.1.1 "NORD standard parameters"):</p> <table border="1"> <tr> <td>P151</td> <td>200 ms (Timeout external bus)</td> </tr> </table>	P151	200 ms (Timeout external bus)																
P151	200 ms (Timeout external bus)																			
NORD system bus	7	<p>Set the parameters for system bus monitoring.</p> <p>Set the following parameters on each frequency inverter ( BU 0200):</p> <table border="1"> <tr> <td>P120, [-01]</td> <td>1 (Auto) or 2 (monitoring active immediately)</td> </tr> </table>	P120 , [-01]	1 (Auto) or 2 (monitoring active immediately)																
P120 , [-01]	1 (Auto) or 2 (monitoring active immediately)																			
	8	<p>Check the system bus communication.</p> <p>Check the display of the following information parameters on all frequency inverters ( BU 0200):</p> <table border="1"> <tr> <td>P748</td> <td>"System bus status"</td> </tr> <tr> <td>P740, [-01]</td> <td>"Control word" (047Eh = "Ready for switch-on"¹)</td> </tr> <tr> <td>P740, [-02]</td> <td>"Setpoint 1"</td> </tr> <tr> <td>P741, [-01]</td> <td>"Status word" (0B31h = "Ready for switch-on")</td> </tr> <tr> <td>P741, [-02]</td> <td>"Actual value 1"</td> </tr> </table> <p>Check the display of the following bus interface information parameters ( Section 7.1.3 "NORD information parameters"):</p> <table border="1"> <tr> <td>P173</td> <td>"Module status"</td> </tr> </table>	P748	"System bus status"	P740 , [-01]	"Control word" (047Eh = "Ready for switch-on" ¹)	P740 , [-02]	"Setpoint 1"	P741 , [-01]	"Status word" (0B31h = "Ready for switch-on")	P741 , [-02]	"Actual value 1"	P173	"Module status"						
P748	"System bus status"																			
P740 , [-01]	"Control word" (047Eh = "Ready for switch-on" ¹)																			
P740 , [-02]	"Setpoint 1"																			
P741 , [-01]	"Status word" (0B31h = "Ready for switch-on")																			
P741 , [-02]	"Actual value 1"																			
P173	"Module status"																			
PROFIBUS field bus	9	<p>Check the field bus communication.</p> <p>Check the display of the following bus interface information parameters ( Section 7.1.3 "NORD information parameters"):</p> <table border="1"> <tr> <td>P173</td> <td>"Module status"</td> </tr> <tr> <td>P740</td> <td>"Process data Bus In"</td> </tr> <tr> <td>P177</td> <td>"Process data Bus Out"</td> </tr> </table>	P173	"Module status"	P740	"Process data Bus In"	P177	"Process data Bus Out"												
P173	"Module status"																			
P740	"Process data Bus In"																			
P177	"Process data Bus Out"																			

¹ On condition that the PLC has already sent the control word. Otherwise "0h" is displayed in the parameter.

6 Data transmission


6.1 Introduction

With the data communication between the frequency inverter (via the bus interface) and the bus master (PLC) process data and parameter data are exchanged.

The process data are transferred via PDOs (Process Data Objects) and the parameter data via SDOs (Service Data Objects).

6.1.1 Process data

- Process data are the control word and up to 3 setpoints, as well as the status word and up to 3 actual values. Control words and setpoints are communicated from the bus master to the frequency inverters. Status words and actual values are communicated from the frequency inverters to the bus master.
- Process data are necessary to control the frequency inverter.
- The transfer of process data is carried out cyclically with priority between the bus master and the frequency inverters.
- In the PLC the process data are stored directly in the I/O area.
- Process data are not saved in the frequency inverter.

 Section 6.4 "Transfer of process data".

6.1.2 Parameter data

- Parameter data are the setting values and device data for the bus interface and the connected frequency inverter.
- Transfer of the parameter data is carried out cyclically without priority..
- If PROFIBUS performance level DP-V1 is supported (bus interfaces SK CU4-PBR and SK TU4-PBR) transfer of the parameters can also be carried out acyclically and in parallel to the transfer of process data.

 Section 6.5 "Parameter data transmission".

6.2 Structure of application data

The cyclic exchange of application data between the bus master and the frequency inverters is carried out via two areas:

- PKW area = **Parameter Label Value** (parameter level)
- PZD area = **ProcessData** (process data level)

Parameter values can be read and written via the PKW area. These are essentially configuration, monitoring and diagnostic tasks.

The frequency inverter is controlled via the PZD area. This is done by transfer of the control word, the status word and by setpoint and actual values.

An access always consists of an order and a response telegram. In the order telegram, the application data is transferred to the slave from the bus master. In the response telegram, the application data is transferred from the slave to the bus master.

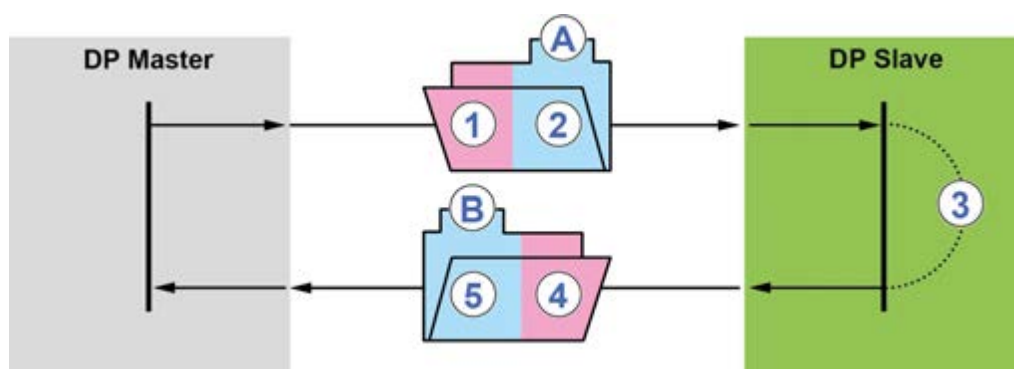


Figure 5: Structure of the application data area – Telegram traffic

Item	Meaning
A	Order telegram
1	Control word and setpoints (PZD area)
2	Parameter order (PKW area)
3	Processing
B	Response telegram
4	Status word and actual values (PZD area)
5	Parameter response (PKW area)

Processing of the process data is carried out in the FI with high priority, in order to ensure a rapid response to control commands or a change in status can be transmitted to the bus master without delay.

Processing of PKW data is carried out with low priority and can take considerably longer.

The cyclic data traffic is carried out via parameter process data objects (PPO) which are defined in PROFIBUS, with which both process data (PZD) as well as parameters (PKW) are transferred from the bus master to the slave. NORD frequency inverters can process PPO types 1, 2, 3, and 4.

PPO Type	Description
PPO1	Extended parameter telegram with parameter value (32 Bit) and process data
PPO2	Telegram with extended process data (1 main setpoint, 2 ancillary setpoints) and parameter value (32 Bit)
PPO3	Process data telegram with main setpoint without parameter data
PPO4	Extended process data telegram (1 main setpoint, 2 ancillary setpoints) without parameter data

i Information

PPO3 and PPO4

PPO3 and PPO4 are purely process data objects for applications which do not require cyclic parameter processing.

Structure of PPO types:

Type	PKW				PZD			
	PKE	IND	PWE	PWE	PZD1	PZD2	PZD3	PZD4
					STW	SW1	SW2	SW3
					ZSW	IW1	IW2	IW3
	1st word	2nd word	3rd word	4th word	5th word	6th word	7th word	8th word
PPO1								
PPO2								

	PZD			
	PZD1	PZD2	PZD3	PZD4
	STW	SW1	SW2	SW3
	ZSW	IW1	IW2	IW3
	1st word	2nd word	3rd word	4th word
PPO3				
PPO4				

6.3 Sync and Freeze mode

Getriebebau NORD GmbH & Co. KG PROFIBUS SP bus interfaces support the Sync and Freeze functions of the PROFIBUS DP system.

DP slaves can be synchronised by events with "Sync" (synchronisation) and "Freeze" (freezing), e.g. for the simultaneous adoption of new setpoints or the simultaneous recording of new actual values by connected frequency inverters.

In addition to the automatic exchange of data, the corresponding commands are sent from the PROFIBUS DPM1 master to a group, or to all connected DP slaves simultaneously (multicast transmission).

Sync mode

After receipt of the Sync command by the particular bus interface, the current state of its outputs (setpoints) is "frozen". During the following transfer of application data, the output data of the bus interface are saved by the bus master, however the output states remain unchanged. The saved output data are only transferred to the bus interface on receipt of a further Sync command. The Sync mode is terminated with an "Unsync" command.

Freeze mode

After receipt of the Freeze command by the particular bus interface, the current state of its outputs (actual values) is "frozen". During the following transfer of application data, the input data of the bus interface are saved by the bus master, however the input states remain unchanged. After receipt of a further Freeze command, the saved input data are transferred to the bus interface. The Freeze mode is terminated with an "Unfreeze" command.

6.4 Transfer of process data

The control word (STW) and up to 3 setpoints (SW) are transferred from the bus master to the frequency inverter and the status word (ZSW) and up to 3 actual values (IW) are transferred from the frequency inverter to the bus master as process data (PZD).

The length and structure of the process data are determined by the PPO types (📖 Section 6.2 "Structure of application data")



Assignment of PPO types

The PPO types are defined in the PROFIBUS profile and must be allocated to the connected bus participants during the initial setup:

- By reading in from the installed device description file (📖 Section 5.2 "Integration into the bus master"),
- On configuration of the bus master (PLC project) by allocation of the slots (DP device model, 📖 Section 3.3 "Bus protocol"),
- On commissioning of the SK TU3-PBR-24V bus interface via the rotary coding switch "PPO" (📖 Technical Information/Data Sheet).

6.4.1 Control word

The control word (STW) is the first word of a process data telegram which is sent from the bus master to the frequency inverter (order telegram) To switch the drive unit to standby, the frequency inverter must be set to "Ready for switch-on" status by transfer of the first control command "047Eh" ("10001111110b").

Bit	Designation	Value	Control command	Priority ¹
0	Ready for operation	0	Reverse with brake ramp, with voltage enabled at f=0 Hz (ready for operation)	3
		1	Set the frequency inverter to standby.	5
1	Disable voltage	0	Switch off the frequency inverter output voltage (the frequency inverter goes into the status "Switch-on block").	1
		1	Cancel "Disable voltage"	—
2	Emergency stop	0	Emergency stop with programmed emergency stop time. At f = 0 Hz voltage enable (the FI goes into "Switch-on block" status)	2
		1	Cancel operating condition "Emergency stop"	—
3	Enable operation	0	Block voltage: Switch off the frequency inverter output voltage (the frequency inverter goes into the status "Ready for switch-on").	6
		1	Enable output voltage Acceleration of the frequency inverter to the present setpoint.	4
4	Enable pulses	0	Acceleration encoder is set to zero; at f = 0 Hz no voltage enable (FI remains in "Operation enabled" status).	—
		1	Enable acceleration encoder	—
5	Enable ramp	0	Freeze the setpoint currently provided by the acceleration encoder (maintain frequency).	—
		1	Enable setpoint on acceleration encoder	—
6	Enable setpoint	0	Set the selected setpoint on the acceleration encoder to 0	—
		1	Activate the selected setpoint on the acceleration encoder.	—
7	Acknowledge the error (0→1)	0	With the switch from 0 to 1, inactive errors are acknowledged.	7
		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, as otherwise, flank evaluation would be prevented.	
8	Start function 480.11	0		—
		1	Bus bit 8 of the control word is set  Parameter P480 in the frequency inverter manual.	
9	Start function 480.12	0		—
		1	Bus bit 9 of the control word is set  Parameter P480 in the frequency inverter manual.	
10 ²	Control data valid	0	The transmitted process data are invalid.	—
		1	The bus master transfers valid process data	
11	Rotation right is on	0		—
		1	Switch on rotation right (priority).	
12 ³	Rotation left is on	0		—
		1	Switch on rotation left.	
13	Reserved			
14	Parameter set Bit 0 On	0	00 = Parameter set 1	—
		1	01 = Parameter set 2	
15	Parameter set Bit 1 On	0	10 = Parameter set 3	—
		1	11 = Parameter set 4	



¹ If several control bits are set simultaneously, the priority stated in this column applies.

² The telegram is only interpreted as valid by the frequency inverter and the setpoints which are communicated via the field bus are only set if control bit 10 is set to 1.

³ If Bit 12 = 0, "rotational direction right ON" applies

6.4.2 Status word

The status word (ZSW) is the first word of a process data telegram which is sent from the frequency inverter to the bus master (response telegram). With the status word, the status of the frequency inverter is reported to the bus master. As the response to the control word command "047Eh" the frequency inverter typically responds with "0B31h" ("101100110001b") and therefore indicates the status "Ready for switch-on".

Bit	Meaning	Value	Status message
0	Ready to start	0	
		1	Initialisation completed, charging relay switched on, output voltage disabled
1	Ready for operation	0	No switch-on command present, or there is a fault, of the command "Disable voltage" or "Emergency stop" is present, or the status is "Switch-on block".
		1	There is a switch-on command and there is no fault. The inverter can be started with the command "Enable operation"
2	Operation enabled	0	
		1	The output voltage is enabled; ramp of the frequency inverter up to the existing setpoint
3	Fault	0	
		1	Drive unit defective and therefore "Not ready for operation". After acknowledgement, the frequency goes into status "Switch-on block".
4	Voltage enabled	0	"Disable voltage" command present.
		1	
5	Emergency stop	0	"Emergency stop" command present.
		1	
6	Starting disabled	0	
		1	With the command "Standby" the frequency goes into status "Ready for switch-on".
7	Warning active	0	
		1	Drive operation continues, no acknowledgement necessary
8	Setpoint reached	0	Actual value does not correspond to the setpoint With use of POSICON: Setpoint position not reached.
		1	Actual value matches the setpoint (setpoint reached) With use of POSICON: setpoint position has been reached
9	Bus control active	0	Control on local device active
		1	The master has been requested to take over control.
10	Start function 481.9	0	
		1	Bus bit 10 of the status word is set  Parameter P481 in the frequency inverter manual.
11	Rotation right is on	0	
		1	The frequency inverter output voltage has a right-hand rotation field.
12	Rotation left is on	0	
		1	The frequency inverter output voltage has a left-hand rotation field.
13	Start function 481.10	0	
		1	Bus bit 13 of the status word is set  Parameter P481 in the frequency inverter manual.
14	Parameter set Bit 0 ON	0	00 = Parameter set 1 01 = Parameter set 2
		1	
15	Parameter set Bit 1 On	0	10 = Parameter set 3 11 = Parameter set 4
		1	

6.4.3 Frequency inverter status machine

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

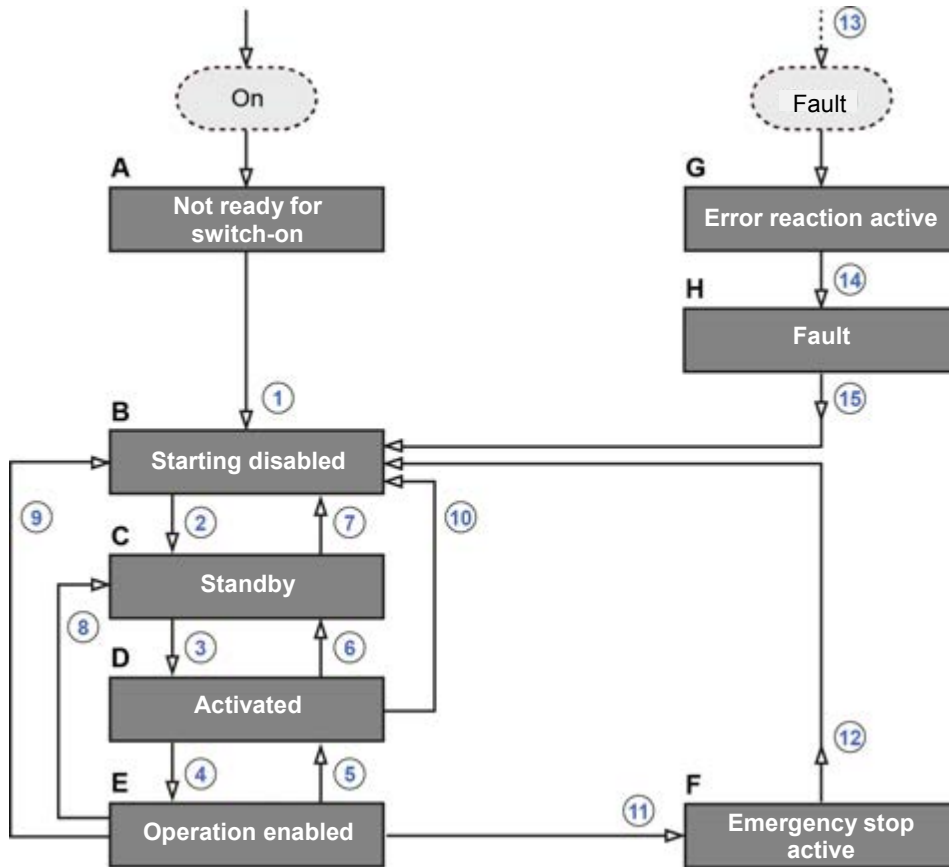


Figure 6: Frequency inverter status machine


Item	Meaning
A...H	Frequency inverter statuses(📖 following table)
1...15	Status transitions (📖 table below)


Frequency inverter statuses

Status		Description
A	Not on standby	Initial state after switching on the frequency inverter. As soon as the loading relay engages, the frequency inverter automatically changes to the status "Switch-on block".
B	Switch-on block	Second status after switching on the frequency inverter, which can only be exited with the control command "Shut-down". The charging relay is switched on.
C	Standby	In this status, initialisation of the frequency inverter is complete. The output voltage is blocked.
		<p>i Information</p> <p>During the initialisation process the response to a bus master telegram does not yet contain the response to the control command which has been issued. On the basis of the response from the bus participant, the control system must determine whether the control command has been executed.</p>
D	Activated	Frequency inverter ready for operation.
E	Operation enabled	The frequency inverter receives and processes setpoints.
F	Emergency stop active	Emergency stop function is being executed (the drive is stopped), the frequency inverter changes to the status "Switch-on block".
G	Error reaction active	If an error occurs, the frequency inverter changes to this status and all functions are blocked.
H	Fault	After processing of the response to the fault, the frequency inverter changes to this status, which can only be exited with the control command "Acknowledge fault".

Status transitions

Triggered status transition		Control command	Bit 7...0 of the control word ¹							
			7	6	5	4	3	2	1	0
1	From "Not ready for switch-on" to "Switch on block"	—	—							
	Automatic activation of the charging relay									
2	From "Switch-on block" to "Ready for switch-on"	Shut down	X	X	X	X	X	1	1	0
3	From "Ready for switch-on" to "Switched on"	Switch on	X	X	X	X	X	1	1	1
4	From "Switched on" to "Operation enabled"	Enable operation	X	1	1	1	1	1	1	1
	Output voltage is enabled									
5	From "Operation enabled" to "Switched on"	Disable operation	X	X	X	X	0	1	1	1
	Output voltage is disabled									
6	From "Switched on" to "Ready for switch-on"	Shut down	X	X	X	X	X	1	1	0
	Voltage enabled at "f = 0 Hz"									
7	From "Ready for switch-on" to "Switch-on block"	Disable voltage	X	X	X	X	X	X	0	X
		Emergency stop	X	X	X	X	X	0	1	X
8	From "Operation enabled" to "Ready for switch-on"	Shut down	X	X	X	X	X	1	1	0
9	From "Operation enabled" to "Switch on block"	Disable voltage	X	X	X	X	X	X	0	X
10	From "Switched on" to "Switch on block"	Disable voltage	X	X	X	X	X	X	0	X
		Emergency stop	X	X	X	X	X	0	1	X
11	From "Operation enabled" to "Emergency stop active"	Emergency stop	X	X	X	X	X	0	1	X
12	From "Emergency stop active" to "Switch on block"	Disable voltage	X	X	X	X	X	X	0	X
13	Automatically, after the occurrence of a fault from any status	—	—							
14	Automatically after completion of the response to a fault	—	—							
15	End fault	Acknowledge error	0	X	X	X	X	X	X	X
			→							
			1	X	X	X	X	X	X	X

X = The bit status (0 or 1) is not important for reaching the status. Please also note the list of control bits,  Section 6.4.1 "Control word".

¹ Complete list of control bits (Bit 0...15)  Section 6.4.1 "Control word".


Information

Control bit 10

Control bit 10 "Control data valid" must always be set to 1. Otherwise the process data will not be evaluated by the frequency inverter.

Decoded frequency inverter statuses

Status	Status bit ¹						
	6	5	4	3	2	1	0
Not ready for switch-on	0	X	X	0	0	0	0
Starting disabled	1	X	X	0	0	0	0
Ready for switch-on	0	1	1	0	0	0	1
Switched on	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

¹ Complete list of status bits (Bit 0...15)  Section 6.4.2 "Status word".

6.4.4 Setpoints and actual values

Setpoints (from the bus master to the frequency inverter) and actual values (from the frequency inverter to the bus master) are specified via the following parameters of the frequency inverter:

Direction of transmission	Process value	Parameter	
		Frequency inverter SK 2xxE	Frequency inverter SK 5xxE
To bus interface	Setpoint 1	P546, Array [-01]	P546
	Setpoint 2	P546, Array [-02]	P547
	Setpoint 3	P546, Array [-03]	P548
From bus interface	Actual value 1	P543, Array [-01]	P543
	Actual value 2	P543, Array [-02]	P544
	Actual value 3	P543, Array [-03]	P545

Setpoints and actual values are transmitted by three different methods:

Percentage transmission

The process value is transmitted as an integer with a value range of -32768 to 32767 (8000 hex to 7FFF hex). The value "16384" (4000 hex) corresponds to 100 %. The value "-16384" (C000 hex) corresponds to -100 %.

For frequencies, the 100% value corresponds to parameter **P105 Maximum frequency** of the frequency inverter. For current, the 100% value corresponds to parameter **P105 Torque current limit** of the frequency inverter.

Frequencies and currents result from the following formulae:

$$Frequency = \frac{Value^* \times P105}{16384} \quad Current = \frac{Value^* \times P112}{16384}$$

* 16 Bit- setpoint or actual value which is transferred via the bus.

Binary transmission

Inputs and outputs as well as digital input bits and bus output bits are evaluated bit-wise.

Transmission of positions (SK 2xxE and SK 530E and above)

In the frequency inverter, positions have a value range of -50000.00...50000.00 rotations. A rotation of the motor can be subdivided into a maximum of 1000 increments. The subdivision depends on the encoder which is used.

The 32 Bit value range is divided into a "Low" and a "High" word, so that two setpoints or actual values are required for the transmission.

Direction of transmission	SK 2xxE and SK 5xxE frequency inverters			
	1st word	2nd word	3rd word	4th word
To bus interface	Control word	32 Bit setpoint		Setpoint 3
From bus interface	Status word	Actual value 1	32 Bit actual value	

Only the "Low" word for the position can also be transferred. This results in a limited value range from 32,767 to -32,768 rotations. This value range can be extended with the ratio factor (**Parameter P607 speed ratio** and **P608 Reduction**), however this reduces the resolution accordingly.

6.5 Parameter data transmission

Transmission of parameter data is carried out acyclically. As with the process data, the parameter data are assigned via slots (see Section 3.3 "Bus protocol"). The following are transferred

- Higher level parameter data for the bus interface (slot assignment 1)
- Parameter data for the frequency inverter FI1... (slot assignment 2...)

Using the PKW area (see Section 6.2 "Structure of application data"), parameter processing can also be carried out in the cyclical data traffic. For this, the IO controller formulates an order and the inverter formulates the appropriate response to this. The PKW area is only used for the transfer of PPO types 1 and 2.

In principle, the PKW area consists of

- A **parameter identification**, in which the type of order (Write, Read etc.) and the relevant parameters are specified.
- An **Index (IND)**, with which the individual parameter sets or arrays are addressed,
- The **Parameter value (PWE)**, which contains the value which is to be read or written.

Field ¹		Data size	Explanation
PKE	Parameter label (Order label AK and parameter number PNU)	2 Byte	Parameter of the bus interface or the frequency inverter. The parameter number plus "1000". The order label is attached to the parameter number (upper nibble).
IND	Parameter index	2 Byte	Parameter sub-index
PWE	Parameter value	4 Byte	New setting value

¹ Description of the fields in the following sections.

A parameter order must be repeated until the inverter responds with the corresponding response telegram.



Information

Max. 100,000 permissible writing cycles

If parameter changes are made (order by the PROFIBUS DP-Master via the PKW channel), the maximum number of permissible writing cycles to the frequency inverter EEPROM (100,000 cycles) must not be exceeded. I.e. continuous cyclical writing must be prevented.

For certain applications it is sufficient if the values are only saved in the RAM of the frequency inverter. The corresponding setting can be made by selecting the appropriate AK or via the parameter **P560 Save in EEPROM**.

To ensure standardised device and access behaviour for the drive data, NORD bus interfaces and frequency inverters support the PROFIdrive profile.


6.5.1 Details of the PKW area

6.5.1.1 Parameter label PKE

The order or response and the associated parameters are encrypted in the parameter label PKE.

PKE																IND	PWE1	PWE2	
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				
AK				SPM	PNU														

The parameter label (PKE) is always a 16 bit value.

- PNU** Bits 0...10 contain the number of the required parameter or the number of the current parameter in the response telegram of the frequency inverter.
Parameter numbers  Manual for the relevant frequency inverter.
- SPM** Bit 11 is the toggle-bit for spontaneous messages. This function is **not** supported.
- AK** Bits 12...15 contain the order or response label.



Information

Parameter numbers

Getriebebau NORD GmbH & Co. KG parameter numbers P000...P999 must be converted into the numerical range 1000...1999, i.e. "1000" must be added to the parameter numbers for parameterisation.

Order label and response label AK

A total of 15 parameter orders can be transferred from the PROFIBUS DP-Master to frequency inverters and the bus interface.

- Parameter orders with order labels 0...10 can only be transferred to frequency inverters.
- Parameters orders with order labels 11...14 can be transferred to both frequency inverters as well as to the bus interface.

The right-hand column of the following table lists the corresponding label of a positive response The label of a positive response depends on the order label.

Meaning of order labels

Order label	Function	Response label (positive)
0	No order	0
1	Order parameter value	1 or 2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
4	Reserved	—
5	Reserved	—
6	Order parameter value (array)	4 or 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	—
11	Change parameter value (array, double word) without writing to the EEPROM	5
12	Change parameter value (array, double word) without writing to the EEPROM	4
13	Change parameter value (double word) without writing to the EEPROM	2
14	Change parameter value (word) without writing to the EEPROM	1

Meaning of response labels

Response label	Meaning
0	No response
1	Transfer parameter value (word)
2 ¹	Transfer parameter value (double word)
4	Transfer parameter value (array, word)
5 ¹	Transfer parameter value (array, double word)
6	Transfer the number of array elements
7	Order cannot be executed (with error number in PWE2)

¹ Only with PPO types PPO2 and PPO4

Information

Plausibility check

As long as an order has not been executed, the inverter sends the response for the previous order. Therefore the bus master must always check whether the received response matches the order which was sent. For the plausibility check, the value in the response label (AK), the received parameter number (PNU) with the corresponding Index (IND) as well as the current parameter value (PWE) can be used.

The label for a negative response is always the value "7" (order cannot be executed) for all order labels. In case of a negative response, an error message is also listed in the response from the frequency inverter in PWE2.

Meaning of error messages in parameter value PWE2

Error message	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
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
9	Description data not available or for acyclic access a READ command was triggered without a previous WRITE command
101	Addressed frequency inverter does not exist
102	
103	Addressed frequency inverter exists, but access blocked by another bus participant.
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

Information

Order and response labels

Both the order label and the response label are abbreviated as "AK" in the data telegram. Because of this, especially the response or order labels "AK1", "AK2" and "AK4" to "AK7" must be carefully interpreted.

6.5.1.2 Parameter index IND

The structure and function of the parameter index depends on the type of parameter to be transmitted.

PKE	IND																PWE1	PWE2
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
							P1...P4		No information (all "0")									
	Arrays 1...64						P1...P4											
	Sub-index																	

For **values which depend on the parameter set** the parameter set can be selected via Bit 8 and Bit 9 of the index (0 = Parameter set 1, 1 = Parameter set 2 etc.).

For **array parameters** the sub-index can be addressed via Bit 10 to Bit 15 (0 = Array element 1, 1 = Array element 2 etc.).

For **parameters which do not depend on the parameter set** Bit 8 to Bit 15 are used for the sub-index. In order for the sub-index to be effective, the corresponding order label (numbers 6, 7, 8 and 11 and 12) must be used.

Examples for address formation for array parameters which depend on parameter sets

Array element						Parameter set		No information							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	1	0	1	0	1	No information (all "0")							
5 (0001 01b)						2 (01b)									

Array element						Parameter set		No information							
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	1	0	1	0	1	1	1	No information (all "0")							
21 (0101 01b)						4 (11b)									

Structure of parameter and sub-index values  Manual for the relevant frequency inverter.

6.5.1.3 Parameter value PWE

According to the parameter, parameter values are transmitted as a word (16 Bit) or as a double word (32 Bit). For negative values, the High bytes must be filled up with "FFh"

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.

$$99.99_s = \frac{99.99 \times 1}{0.01} = 99.99 \times 100 = 9999$$

The value "9999" (270Fh) must be transferred.

6.6 Example telegrams

6.6.1 Switch-on block → Standby

After the frequency inverter is switched on, it is in the "switch-on block" state (Control Bit 0 = "0") and is to be set to the state "Standby" (Control Bit 0 = "1").

Transfer is carried out with PPO type PPO1; parameter set 1 is valid; only the PZD channel is depicted.

Procedure

1. Check the last status word (e.g. "0B70h").

Status word (status "switch-on block")				Telegram				
Bit	Value	Value _{hex}	Meaning	Word	5		6	
15	0	0	Parameter set Bit 1 = Off	Byte	8	9	10	11
14	0		Parameter set Bit 0 = Off	Type	ZSW		IW1	
13	0		Reserved	Value _{hex}	0B	70	00	00
12	0	B	Rotation left = Off					
11	1		Rotation right = On					
10	0		Reference value undershot					
9	1		Bus control					
8	1	7	Setpoint = actual value					
7	0		No warning					
6	1		Starting disabled					
5	1		No emergency stop					
4	1	0	Voltage enabled					
3	0		No error					
2	0		Operation disabled					
1	0		Not ready for operation					
0	0		Not on standby					

2. Generate control word ("047Eh").

To switch the frequency inverter to the "Standby" status, the following telegram must be sent:

Telegram				
Word	5		6	
Byte	8	9	10	11
Type	STW		SW1	
Value _{hex}	04	7E	00	00

i Information

Repeat sending of telegram

The control telegram must be repeated cyclically as the frequency inverter may not switch to the required status within the response time of a telegram.

3. Check the response telegram (status word **"0B31"**).

As soon as the frequency inverter is in "Standby" status, it sends a response telegram:

Telegram				
Word	5		6	
Byte	8	9	10	11
Type	ZSW		IW1	
Value _{hex}	0B	31	00	00

6.6.2 Enable with 50% setpoint

The frequency inverter is in "Standby" status (Control Bit 0 = "1") and is to be enabled in the right-hand direction with a setpoint of 50%.

Procedure

1. Check the last status word (ZSW "0B31h").

Telegram				
Word	5		6	
Byte	8	9	10	11
Type	ZSW		IW1	
Value _{hex}	0B	31	00	00

2. Generate the control word ("**047Eh**") and specify the setpoint (SW1 "2000h" = 50%).

To switch the frequency inverter to "Standby" status and set the setpoint, the following telegram must be sent:

Telegram				
Word	5		6	
Byte	8	9	10	11
Type	STW		SW1	
Value _{hex}	04	7E	20	00

3. The frequency inverter accelerates the motor in the ramp. As soon as the frequency inverter has reached the 50% setpoint, it sends a response telegram:

Telegram				
Word	5		6	
Byte	8	9	10	11
Type	ZSW		IW1	
Value _{hex}	0B	37	20	00

6.6.3 Parameter changes

When transferring parameter orders it must be considered that the frequency inverter does not respond to an order telegram immediately, but rather only after one or more communication cycles. The bus master must therefore repeat an order until it receives the corresponding response telegram.

Parameter orders must be transferred with the PPO type PPO1.

The parameter **P102 Acceleration time** (PNU = "66h") of a frequency inverter is to be set to the value "10 s" in parameter set 3. Only the PZD channel is depicted. As the acceleration time has an internal resolution of "0.01s", the parameter value "3E8h" (10 divided by 0.01 = 1000) must be transferred for 2 seconds.

Procedure

- Specify the order label (Change parameter value = 7),
- Select the parameter (P102 + 1000 = P1102 = "44Eh").
- Select parameter set 3 (IND = 02)
- Set the parameter value ("3E8h").

Telegram								
Word	1		2		3		4	
Byte	0	1	2	3	4	5	6	7
Type	PKE		IND		PWE		PWE	
Value _{hex}	74	4E	02	00	00	00	03	E8

- When the order has been fully implemented by the frequency inverter, it sends the response telegram:



Telegram								
Word	1		2		3		4	
Byte	3	4	5	6	7	8	9	10
Type	PKE		IND		PWE		PWE	
Value _{hex}	44	4E	02	00	00	00	03	E8

7 Parameters

The bus interface and frequency inverter parameters are communicated as words (16 Bit/Word). Exceptions to this are position values (POSITION), which are communicated as double words (32 Bit).

For field bus operation, several parameters must be set on the bus interface and the frequency inverter.

The parameters can be set with

- An external control or ParameterBox ( Manual [BU 0040](#)),
- NORD CON software ( Manual [BU 0000](#)) or
- The operator's PLC project.

7.1 Parameter setting on the bus interface

The parameters of the bus interface are divided into NORD-specific standard parameters and field-bus specific information parameters:

Parameter No.	Description
P15x	NORD standard parameter (can be set and saved)
P16x	PROFIBUS DP standard parameter (can be set and saved)
P17x	NORD information parameter (display)
P18x	PROFIBUS DP information parameter (display)

- Bus interface SK TU3-PBR does not have its own parameters. It is set via the parameters of the connected frequency inverter.
- The NORD standard parameters **P151**, **P153** and **P154** and the PROFIBUS DP standard parameter **P160** must be set on the bus interfaces K CU4-PBR and SK TU4-PBR.

A detailed description of the bus interface parameters can be found in the following sections.

7.1.1 NORD standard parameters


The basic settings of the bus interface can be made via NORD standard parameters.

P150	Set relay																																												
Setting range	0...4																																												
Factory setting	{ 0 }																																												
Bus interface	SK CU4-PBR, SK TU4-PBR																																												
Description	The setting of this parameter determines the switching state of each digital output.																																												
Setting values	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> <th>Comments</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Via bus</td> <td>All digital outputs are controlled via the system bus. The functions are defined in the frequency inverter (P480).</td> </tr> <tr> <td>1</td> <td>Outputs Off</td> <td>All digital outputs are set to "Low" (0 V)</td> </tr> <tr> <td>2</td> <td>Output 1 On (DO1)</td> <td>Digital output DO1 is set to "High" (active), digital output DO2 is set to "Low" (0 V).</td> </tr> <tr> <td>3</td> <td>Output 2 On (DO2)</td> <td>Digital output DO2 is set to "High" (active), digital output DO1 is set to "Low" (0 V).</td> </tr> <tr> <td>4</td> <td>Outputs 1 and 2 ON</td> <td>All digital outputs are set to "High" (active)</td> </tr> </tbody> </table>	Value	Meaning	Comments	0	Via bus	All digital outputs are controlled via the system bus. The functions are defined in the frequency inverter (P480).	1	Outputs Off	All digital outputs are set to "Low" (0 V)	2	Output 1 On (DO1)	Digital output DO1 is set to "High" (active), digital output DO2 is set to "Low" (0 V).	3	Output 2 On (DO2)	Digital output DO2 is set to "High" (active), digital output DO1 is set to "Low" (0 V).	4	Outputs 1 and 2 ON	All digital outputs are set to "High" (active)																										
Value	Meaning	Comments																																											
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4	Outputs 1 and 2 ON	All digital outputs are set to "High" (active)																																											
P151	Timeout for external bus																																												
Setting range	0...32767 ms																																												
Factory setting	{ 0 }																																												
Bus interface	SK CU4-PBR, SK TU4-PBR																																												
Description	Monitoring function of the bus interface After receipt of a valid telegram, the next telegram must arrive within the set time. Otherwise the bus interface or the connected frequency inverter reports an error (E010/10.3 "Time Out") and switches off. See also parameter P513 Telegram timeout time for the frequency inverter.																																												
Setting values	-1 = Monitoring Off 0 = Control word monitoring Off, PROFIBUS monitoring active																																												
Note	The following table shows an overview of the responses of the device to typical user errors in combination with certain monitoring parameter settings:																																												
	<table border="1"> <thead> <tr> <th rowspan="2">Action</th> <th colspan="2">Setting value</th> <th rowspan="2">SK xU4-PBR error</th> </tr> <tr> <th>P151</th> <th>P513</th> </tr> </thead> <tbody> <tr> <td>Invalid control word set (e.g. PLC to Stop)</td> <td>-1</td> <td>-0.1</td> <td>Frequency inverter continues operation</td> </tr> <tr> <td>Connection to PROFIBUS DP Master lost</td> <td>-1</td> <td>-0.1</td> <td>Frequency inverter continues operation</td> </tr> <tr> <td>Bus connection interrupted</td> <td>-1</td> <td>-0.1</td> <td>Frequency inverter continues operation</td> </tr> <tr> <td>Invalid control word set (e.g. PLC to Stop)</td> <td>0 sec</td> <td>0 sec</td> <td>Frequency inverter continues operation</td> </tr> <tr> <td>Connection to PROFIBUS DP Master lost</td> <td>0 sec</td> <td>0 sec</td> <td>Error E10.2*</td> </tr> <tr> <td>Bus connection interrupted</td> <td>0 sec</td> <td>0 sec</td> <td>Error E10.8*</td> </tr> <tr> <td>Invalid control word set (e.g. PLC to Stop)</td> <td>1 sec</td> <td>1 sec</td> <td>Error E10.3*</td> </tr> <tr> <td>Connection to PROFIBUS DP Master lost</td> <td>1 sec</td> <td>1 sec</td> <td>Error E10.2*</td> </tr> <tr> <td>Bus connection interrupted</td> <td>1 sec</td> <td>1 sec</td> <td>Error E10.8*</td> </tr> </tbody> </table>	Action	Setting value		SK xU4-PBR error	P151	P513	Invalid control word set (e.g. PLC to Stop)	-1	-0.1	Frequency inverter continues operation	Connection to PROFIBUS DP Master lost	-1	-0.1	Frequency inverter continues operation	Bus connection interrupted	-1	-0.1	Frequency inverter continues operation	Invalid control word set (e.g. PLC to Stop)	0 sec	0 sec	Frequency inverter continues operation	Connection to PROFIBUS DP Master lost	0 sec	0 sec	Error E10.2*	Bus connection interrupted	0 sec	0 sec	Error E10.8*	Invalid control word set (e.g. PLC to Stop)	1 sec	1 sec	Error E10.3*	Connection to PROFIBUS DP Master lost	1 sec	1 sec	Error E10.2*	Bus connection interrupted	1 sec	1 sec	Error E10.8*		
Action	Setting value		SK xU4-PBR error																																										
	P151	P513																																											
Invalid control word set (e.g. PLC to Stop)	-1	-0.1	Frequency inverter continues operation																																										
Connection to PROFIBUS DP Master lost	-1	-0.1	Frequency inverter continues operation																																										
Bus connection interrupted	-1	-0.1	Frequency inverter continues operation																																										
Invalid control word set (e.g. PLC to Stop)	0 sec	0 sec	Frequency inverter continues operation																																										
Connection to PROFIBUS DP Master lost	0 sec	0 sec	Error E10.2*																																										
Bus connection interrupted	0 sec	0 sec	Error E10.8*																																										
Invalid control word set (e.g. PLC to Stop)	1 sec	1 sec	Error E10.3*																																										
Connection to PROFIBUS DP Master lost	1 sec	1 sec	Error E10.2*																																										
Bus connection interrupted	1 sec	1 sec	Error E10.8*																																										
	* Error E10.2 = PROFIBU Watchdog Error E10.3 = Bus Timeout (P151/P513) Error E10.8 = Communication error																																												

P152	Factory setting		
Setting range	0...1		
Factory setting	{ 0 }		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Reset the present parameter settings of the bus interface to the factory setting.		
Setting values	Value	Meaning	Comments
	0	No change	The present parameter setting are not changed.
	1	Load factory setting	All bus interface parameters are reset to the factory settings. After this, the setting of parameter P152 automatically changes back to { 0 }.
P153	Min. system bus cycle		
Setting range	0...250 ms		
Arrays	[-01] = TxSDO Inhibit Time [-02] = TxPDO Inhibit Time		
Factory setting	{ [-01] = 10 } { [-02] = 5 }		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Set the pause time for the system bus in order to reduce the bus load.		
P154	TB-IO access		
Setting range	0...5		
Arrays	[-01] = Access to inputs [-02] = Access to outputs		
Factory setting	{ [-01] = 0 } { [-02] = 0 }		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Assign reading and writing rights of each connected frequency inverter to 2 inputs and 2 outputs of the bus interface. This is carried out via the following frequency inverter parameters:		
	Input 1	Evaluation via P480 Funct. BusIO In Bits , Array [-11]	
	Input 2	Evaluation via P480 Funct. BusIO In Bits , Array [-12]	
	Output 1	Evaluation via P481 Funct. BusIO Out Bits , Array [-09]	
	Output 2	Evaluation via P481 Funct. BusIO Out Bits , Array [-10]	
Setting values	Value	Meaning	Comments
	0	No access	No influence by the frequency inverter.
	1	Broadcast (inputs)	All connected frequency inverters read the inputs (Array [-02] = No function).
	2	FI 1	Frequency inverter 1 reads and writes to the inputs and outputs.
	3	FI 2	Frequency inverter 2 reads and writes to the inputs and outputs.
	4	FI 3	Frequency inverter 3 reads and writes to the inputs and outputs.
5	FI 4	Frequency inverter 4 reads and writes to the inputs and outputs.	


7.1.2 PROFIBUS DP standard parameters

Field-bus specific settings of the bus interface can be made via the PROFIBUS DP standard parameters.

P160	Profibus address
Setting range	3...125
Factory setting	{ 126 }
Bus interface	SK CU4-PBR, SK TU4-PBR
Description	Setting the bus interface PROFIBUS-DP address After setting, restart the bus interface (switch the power supply off and on again) so that the parameter setting is read in.
Note	<ul style="list-style-type: none"> • If the PROFIBUS address is set via this parameter, DIP switches "3"...."8" of the bus interface ( Technical Information/Data Sheet) must be in the "OFF" position. Otherwise the setting of this parameter will be ignored and the PROFIBUS address will be read from the setting of the DIP switches. • PROFIBUS addresses "0"..."2" and "126" are reserved for special PROFIBUS-DP services.

7.1.3 NORD information parameters

NORD information parameters are used to display current and archived error messages, as well as current operating states.

P170	Actual error		
Display range	0/9999		
Arrays	[-01] = Actual error in bus interface [-02] = Last error in bus interface		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Display of the actual error present. For a list of possible error messages please refer to  Section 8.3 "Error messages".		
Note	The error message is reset when the supply voltage is switched off.		
P171	Software version		
Display range	0.0...9999.9		
Arrays	[-01] = Software version [-02] = Software revision [-03] = Special version		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Display of the software version and revision number of the bus interface. Array [-03] shows possible special versions (0 = standard version).		
P172	Configuration level		
Display range	0...		
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Display of the bus interface identifier.		
Display values	Value	Meaning	
	0	CU4 (internal)	Bus interfaceSK CU4-PBR
	1	TU4 (external)	Bus interfaceSK TU4-PBR

P173	Module status
Display range	0...FFFFh
Bus interface	SK CU4-PBR, SK TU4-PBR
Description	Displays the operating state of the bus interface.

Display values	Bit	Meaning																
	0	Bus status "Preoperational" (PROFIBUS DP initialisation)																
	1	Bus status "Operational" (Data exchange mode)																
	2	Timeout Node guarding (Watchdog, PROFIBUS DP Master)																
	3	Timeout (time set in parameters P151/P513)																
	4	Bus interface system error																
	5	PROFIBUS DP Watchdog active																
	6	System bus "Warning"																
	7	System bus "Bus OFF"																
	8	FI 1 status	Status for frequency inverter Bit 8...Bit 15: <table border="1"> <thead> <tr> <th>Bit "High"</th> <th>Bit "Low"</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>Frequency inverter "offline"</td> </tr> <tr> <td>0</td> <td>1</td> <td>Unknown frequency inverter</td> </tr> <tr> <td>1</td> <td>0</td> <td>Frequency inverter "online"</td> </tr> <tr> <td>1</td> <td>1</td> <td>Frequency inverter lost or switched off</td> </tr> </tbody> </table>	Bit "High"	Bit "Low"	Meaning	0	0	Frequency inverter "offline"	0	1	Unknown frequency inverter	1	0	Frequency inverter "online"	1	1	Frequency inverter lost or switched off
	Bit "High"	Bit "Low"		Meaning														
	0	0		Frequency inverter "offline"														
	0	1		Unknown frequency inverter														
	1	0		Frequency inverter "online"														
	1	1		Frequency inverter lost or switched off														
	9																	
10	FI 2 status																	
11																		
12	FI 3 status																	
13																		
14	FI 4 status																	
15																		

P174	Digital input status
Display range	0...255 (00000000...11111111b)
Bus interface	SK CU4-PBR, SK TU4-PBR
Description	Display of the actual switching status of the digital bus interface inputs.

Display values	Bit	Meaning
	0	Input 1 (DIN1) of the bus interface
	1	Input 2 (DIN2) of the bus interface
	2	Input 3 (DIN3) of the bus interface ¹
	3	Input 4 (DIN4) of the bus interface ¹

¹ Only bus interface , SK TU4-PBR

P175	Relay status
Display range	0...3 (00...11b)
Bus interface	SK CU4-PBR, SK TU4-PBR
Description	Display of the actual switching status of the relay outputs of the bus interface.

Display values	Bit	Meaning
	0	Output 1 (DO1) of the bus interface
	1	Output 2 (DO2) of the bus interface

P176	Process data Bus In		
Display range	-32768...32767		
Arrays	[-01] = Bus module outputs		
	[-02] = Control word	[-03]...[-05] = Setpoint 1...3	to F11
	[-06] = Control word	[-07]...[-09] = Setpoint 1...3	to F12
	[-10] = Control word	[-11]...[-13] = Setpoint 1...3	to F13
	[-14] = Control word	[-15]...[-17] = Setpoint 1...3	to F14
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Display of data received from the PROFIBUS DP-Master.		
P177	Process data Bus Out		
Display range	-32768...32767		
Arrays	[-01] = Bus module inputs		
	[-02] = Status word	[-03]...[-05] = Actual value 1...3	from F11
	[-06] = Status word	[-07]...[-09] = Actual value 1...3	from F12
	[-10] = Status word	[-11]...[-13] = Actual value 1...3	from F13
	[-14] = Status word	[-15]...[-17] = Actual value 1...3	from F14
Bus interface	SK CU4-PBR, SK TU4-PBR		
Description	Display of the data sent from the bus interface to the PROFIBUS DP-Master.		

7.1.4 PROFIBUS DP information parameters

PROFIBUS DP information parameters are used to display statuses and settings which are specific to the field bus.

P180	Actual Profibus address																													
Display range	3...125																													
Bus interface	SK CU4-PBR, SK TU4-PBR																													
Description	Displays the PROFIBUS DP address which is actually set																													
P181	Profibus baud rate																													
Display range	0...15																													
Bus interface	SK CU4-PBR, SK TU4-PBR																													
Description	Display of the currently set baud rate for PROFIBUS DP data traffic.																													
Note	The baud rate which is specified by the PROFIBUS DP master is automatically detected by the bus interface.																													
Display values	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>12 MBit/s</td> </tr> <tr> <td>1</td> <td>6 MBit/s</td> </tr> <tr> <td>2</td> <td>3 MBit/s</td> </tr> <tr> <td>3</td> <td>1.5 MBit/s</td> </tr> <tr> <td>4</td> <td>500 kBit/s</td> </tr> <tr> <td>5</td> <td>187.5 kBit/s</td> </tr> </tbody> </table>	Value	Meaning	0	12 MBit/s	1	6 MBit/s	2	3 MBit/s	3	1.5 MBit/s	4	500 kBit/s	5	187.5 kBit/s	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>6</td> <td>93.75 kBit/s</td> </tr> <tr> <td>7</td> <td>45.45 kBit/s</td> </tr> <tr> <td>8</td> <td>19.2 kBit/s</td> </tr> <tr> <td>9</td> <td>9.6 kBit/s</td> </tr> <tr> <td>10...14</td> <td>Reserved</td> </tr> <tr> <td>15</td> <td>After reset and during a baud rate scan</td> </tr> </tbody> </table>	Value	Meaning	6	93.75 kBit/s	7	45.45 kBit/s	8	19.2 kBit/s	9	9.6 kBit/s	10...14	Reserved	15	After reset and during a baud rate scan
Value	Meaning																													
0	12 MBit/s																													
1	6 MBit/s																													
2	3 MBit/s																													
3	1.5 MBit/s																													
4	500 kBit/s																													
5	187.5 kBit/s																													
Value	Meaning																													
6	93.75 kBit/s																													
7	45.45 kBit/s																													
8	19.2 kBit/s																													
9	9.6 kBit/s																													
10...14	Reserved																													
15	After reset and during a baud rate scan																													
P182	PPO Type																													
Display range	0...255																													
Arrays	[-01] = Bus interface	[-02]...[-05] = Frequency inverter F11...4																												
Bus interface	SK CU4-PBR, SK TU4-PBR																													
Description	Display of the currently assigned PPO type																													
Note	The PPO type is assigned via the PROFIBUS DP configuration software.																													
Display values	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No participant configured</td> </tr> <tr> <td>48</td> <td>Bus interface</td> </tr> <tr> <td>245</td> <td>PPO1</td> </tr> <tr> <td>247</td> <td>PPO2</td> </tr> <tr> <td>241</td> <td>PPO3</td> </tr> <tr> <td>243</td> <td>PPO4</td> </tr> </tbody> </table>		Value	Meaning	0	No participant configured	48	Bus interface	245	PPO1	247	PPO2	241	PPO3	243	PPO4														
Value	Meaning																													
0	No participant configured																													
48	Bus interface																													
245	PPO1																													
247	PPO2																													
241	PPO3																													
243	PPO4																													

7.2 Parameter settings on the frequency inverter

After connection and addressing of the bus interface, the additional parameters of the frequency inverter must be set as listed below. The additional parameters of the frequency inverter are used to set the bus interface, the pulse frequency and acknowledgement of errors.

A detailed description of the parameters can be found in the relevant manual for the frequency inverter.

Additional parameters

The following table contains a list of additional parameters which are relevant for the bus interface.

No.	Parameter name	Recommended setting			Comments
		SK CU4/SK TU4	SK TU3		
		SK 1x0E, SK 2xxE	SK 500E–SK 535E	SK 54xE	
P507	PPO Type	—	○ ¹	○ ¹	
P508	Profibus address	—	○ ¹	○ ¹	
P509	Source Control Word	"3" = System bus	"4" = PROFIBUS	"4" = PROFIBUS	SK 511E frequency inverters and above: Communication with the bus interface via the system bus is possible with setting "6" = CANopen.
P510	Setpoint source	"0" = Auto	"0" = Auto	"0" = Auto	If P509 is set to "3", "4" or "6"
P513	Telegram timeout	—	○ ¹	○ ¹	
P514	CAN bus baud rate	"5" = 250 kBaud	"5" = 250 kBaud	"5" = 250 kBaud	The parameter setting is not relevant if P509 is set to "4"
P515	CAN address (Array [-01])	32, 34, 36 or 38	32, 34, 36 or 38*	32, 34, 36 or 38*	System bus address (The parameter setting is not relevant if P509 is set to "4")
P543	Actual bus value Arrays [-01]...[-03]	○ ²	○ ²	○ ²	Refer to the relevant frequency inverter operating manual
P543	Actual bus value 1	—	○ ²	—	
P544	Actual bus value 2	—	○ ²	—	
P545	Actual bus value 3	—	○ ²	—	
P546	Function Bus setpoint Arrays [-01]...[-03]	○ ²	—	○ ²	Refer to the relevant frequency inverter operating manual
P546	Function Bus setpoint 1	—	○ ²	—	
P547	Function Bus setpoint 2	—	○ ²	—	
P548	Function Bus setpoint 3	—	○ ²	—	

* Only necessary if **P509** is set to "6" (= CANopen), i.e. for communication with a bus interface via system bus.

○¹ Depending on the application: Change the settings according to the requirements of the application.

○² Depending on the function: Setting according to the required function(s) is necessary.

Information parameters

Information parameters are used to display current and archived error messages, as well as current operating states and settings.

The following table contains a list of information parameters which are relevant for the bus interface.

No.	Parameter name	SK TU3	SK CU4	SK TU4																				
P700	Current error	Array [-01]																						
	Current warning	Array [-02]																						
	Reason for switch-on block	Array [-03]																						
P701	Last fault																							
P740	Process data Bus In	No display if P509 is set to "0"																						
P741	Process data Bus Out																							
P744	Configuration																							
P745	Module version		—																					
P746	Module status	Possible values: <table border="1" data-bbox="539 846 1062 1160"> <thead> <tr> <th>Bit</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Bus interface ready</td> </tr> <tr> <td>1</td> <td>Bus interface is connected to the DP master</td> </tr> <tr> <td>2</td> <td>Initialisation active</td> </tr> <tr> <td>3</td> <td>Reserved</td> </tr> <tr> <td>4</td> <td>Bus interface error</td> </tr> <tr> <td>5</td> <td>Timeout error</td> </tr> <tr> <td>6</td> <td>Reserved</td> </tr> <tr> <td>7</td> <td>Reserved</td> </tr> <tr> <td>8...15</td> <td>Bus interface ID (PROFIBUS = 06h)</td> </tr> </tbody> </table>		Bit	Meaning	0	Bus interface ready	1	Bus interface is connected to the DP master	2	Initialisation active	3	Reserved	4	Bus interface error	5	Timeout error	6	Reserved	7	Reserved	8...15	Bus interface ID (PROFIBUS = 06h)	—
Bit	Meaning																							
0	Bus interface ready																							
1	Bus interface is connected to the DP master																							
2	Initialisation active																							
3	Reserved																							
4	Bus interface error																							
5	Timeout error																							
6	Reserved																							
7	Reserved																							
8...15	Bus interface ID (PROFIBUS = 06h)																							
P748	CANopen status	Displays the system bus status																						

8 Error monitoring and error messages

Bus interfaces and frequency inverters are equipped with monitoring functions and generate error messages in case of deviations from the normal operating state.

8.1 Bus operation monitoring function

Independent of the specific bus watchdogs, comprehensive monitoring functions are integrated into Getriebbau NORD GmbH & Co. KG frequency inverters and bus interfaces. With the aid of this "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").

Monitoring of communication at the field bus level is primarily carried out via the bus interface. Field bus communication faults are registered in the bus interface. If an error at field bus level causes an error in the frequency inverter, the frequency inverter also displays a corresponding error. The frequency inverter itself does not monitor communication on the field bus level.

Monitoring of communication on the NORD system bus level (between the frequency inverter and the bus interface) is carried out by the frequency inverter. An error in the system bus communication is registered in both the bus interface and the frequency inverter and results in specific error messages.

Function	Parameter						
	Bus interface	SK CU4 and SK TU4 via NORD system bus			SK TU3 ¹⁾	SK TU3 via CANopen/NORD system bus ²⁾	
		Frequency inverters	SK 1x0E SK 2xxE	SK 511E ... SK 535E	SK 54xE ³⁾	SK 5xxE	SK 511E ... SK 535E
Field bus timeout		P151	P151	P151	P513	P513	P513
Optional monitoring (system bus timeout)		P120	P513	P120	— ⁴⁾	P513	P120
Bus interface error display		P170 (P700)	P170 (P700)	P170 (P700)	P170 ²⁾ P700	P170 P700	P170 P700
Error display for frequency inverter and communication errors between the frequency inverter and the bus interface.		P700	P700	P700	P700	P700	P700

- 1) Only for communication between the SK TU3 bus interface and the frequency inverter on which the bus interface is mounted.
- 2) Only for Ethernet-based bus interfaces
- 3) Connection for CANopen (Parameter **P509**)
- 4) Monitoring is automatic and cannot be set.

Information

Parameter P513

The setting ("0.1" = No error) of parameter **P513 Telegram timeout time** ensures that the frequency inverter ignores all communication errors on both the field bus and the system bus level. The frequency inverter maintains its operating status.

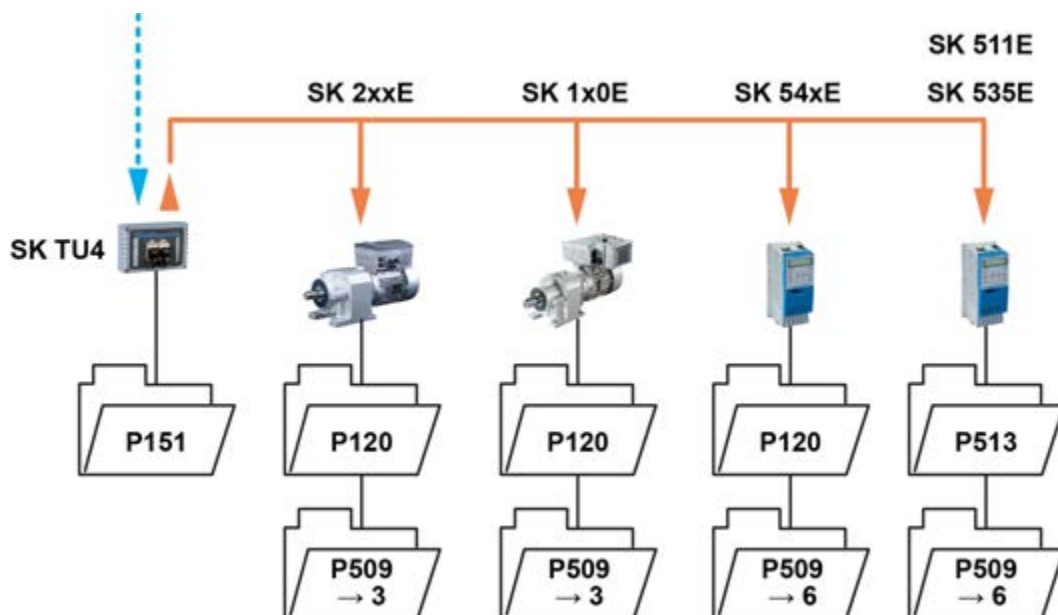


Figure 7: Examples of monitoring parameter settings – SK TU4 bus interface

Setting values for parameter **P509 Control word source**:

3 = System bus

6 = CANopen

8.1.1 Response monitoring by the PROFIBUS DP master

Response monitoring is a monitoring function controlled by the PROFIBUS DP master, which must be activated during system configuration (📖 Section 5.2 "Integration into the bus master") with a software tool for PROFIBUS DP- field bus systems (e.g. "Simatic Step 7" from Siemens AG).

If response monitoring is activated, the PROFIBUS DP master transfers a calculated time interval to the bus interface (DP slave). If there is no communication during this interval, the bus interface changes from data exchange mode to a safe state, in which all outputs are switched to "0". The frequency inverters which are connected to the bus interface are set to error status (Error E010/10.2).

Usually, the monitoring time is calculated automatically for the entire PROFIBUS DP field bus system by the software tool. The value corresponds to the longest cycle time and is between 10 ms and 650 sec.

i Information

Deactivating response monitoring

If response monitoring is deactivated, the outputs of the affected DP slave are not set to a safe state if an error occurs. Response monitoring should therefore only be deactivated for test purposes during commissioning.

8.2 Resetting error messages

There are several methods for resetting (acknowledging) an error message.

On the frequency inverter:

- Switch the mains voltage off and on again, or
- Actuate the programmed digital input with parameter **P420 Digital inputs** (Setting 12 = Acknowledge error), or
- Switch off "Enable" on the frequency inverter (if no digital input is parameterised to the function "Acknowledge errors"), or
- By carrying out a bus acknowledgement, or
- Automatic error acknowledgement by activating parameter **P506 Auto. error acknowledgement**.

On the bus interface

The error message (via information parameter **P170**, [-01]) is automatically reset if the error is no longer active. Otherwise:

- Switch the voltage supply to the bus interface off and on again, or
- Acknowledge the error via the field bus.

i Information

Archiving error messages

A field bus communication error (display via parameter **P170**) is only displayed as long as it is active. After the error has been remedied, the message is deleted and is archived as the last error message in parameter **P170**, Array [-02]. If the mains supply is interrupted before the error is remedied, the message is lost, i.e. it is not archived.

i Information

Error display in the SimpleBox

A field bus communication error is displayed in the operating display of the SimpleBox SK CSX-3H by display of the error group number "E1000". The bus interface parameter **P170**, Array [-01] must be selected to determine the actual error.

8.3 Error messages

Error messages from the bus interface can be read out via parameter **P170** of the bus interface (Array [-01] = Actual error, Array [-02] = Previous error).

Error	Meaning	Comments
100.0	EEPROM error	EMC fault, bus interface defective
101.0	System bus 24 V missing	No 24 V voltage on bus, connections not correct
102.0	Bus timeout P151	By means of timeout supervision parameter P151/P513
103.0	System bus Off	No 24 V voltage on bus, connections not correct
500.0	PROFIBUS ASIC error	No communication with ASIC
501.0	PROFIBUS address incorrect	Address outside permissible range (3...125)
502.0	PROFIBUS Timeout	Telegram transfer error

Error messages which occur in relation to the bus interface are depicted as follows in the error memory of the frequency inverter (Parameter **P700** and **P701**).

Error (E010)	Meaning	Comments
10.0	Connection error	<ul style="list-style-type: none"> Contact to bus interface lost
10.2	PROFIBUS telegram failure	<ul style="list-style-type: none"> Telegram transfer error. <ul style="list-style-type: none"> Check the connections and links, program sequence and Bus Master.
10.3	Timeout by P151/P513	<ul style="list-style-type: none"> Telegram transfer error. <ul style="list-style-type: none"> Check watchdog time (P151). Check the connections and links and the program sequence in the Bus Master. The enable bit is missing in the control word.
10.4	External bus interface initialisation error	<ul style="list-style-type: none"> Unable to communicate with the bus interface. <ul style="list-style-type: none"> Check parameter P746 setting. Check the bus interface power supply. Check the connections and links.
10.8	External bus interface communication error	<p><i>Only SK TUx-PBR bus interfaces:</i></p> <ul style="list-style-type: none"> Connection between bus interface and frequency inverter interrupted.
10.9	Missing bus interface	<p><i>Only bus interfaces SK CU4-PBR and SK TU4-PBR:</i></p> <ul style="list-style-type: none"> Connection between bus interface and frequency inverter interrupted (see setting of parameter P120).

9 Appendix

9.1 Repair information

In order to keep repair times as short as possible, please state the reasons for the return of the device and at least one contact partner in case of queries.

In case of repairs, please send the device to the following address:

NORD Electronic DRIVESYSTEMS GmbH

Tjüchkampstraße 37
26606 Aurich, Germany



Information

Third party accessories

Before returning a bus interface and/or a frequency inverter, please remove any external accessories such as mains cables, potentiometers, external displays, etc., which were not supplied by Getriebebau NORD GmbH & Co. KG. No liability can be accepted by Getriebebau NORD GmbH & Co. KG for devices which are returned with third party accessories.



Information

Accompanying document

Please use the filled-in accompanying document for returns, You can find this on our homepage www.nord.com or directly under the link [Warenbegleitschein](#).

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG

Tel.: +49 (0) 45 32 / 289-2515

Fax: +49 (0) 45 32 / 289-2555

9.2 Service and commissioning information

In case of problems, e.g. during commissioning, please contact our Service department:

☎ +49 4532 289-2125

Our Service department is available 24/7 and can help you best if you have the following information about the device (e.g. frequency inverter) and its accessories (e.g. bus interface) to hand:

- Type designation,
- Serial number,
- Firmware version

9.3 Documents and software

Documents and software can be downloaded from our website www.nord.com.

Other applicable documents and further information

Documentation	Contents
TI 275271000	Technical Information/Data Sheet for bus interface SK CU4-PBR (for IP55 devices)
TI 275271500	Technical Information/Data Sheet for bus interface SK CU4-PBR-C (for IP66 devices)
TI 275900100	Technical Information/Data Sheet for bus interface SK TU4-PBR (for IP55 devices)
TI 275281150	Technical Information/Data Sheet for bus interface SK TU4-PBR-C (for IP66 devices)
TI 275281200	Technical Information/Data Sheet for bus interface SK TU4-PBR-M12 (for IP55 devices with M12 round plug connectors)
TI 275281250	Technical Information/Data Sheet for bus interface SK TU4-PBR-M12- (for IP66 devices with M12 round plug connectors)
TI 275900030	Technical Information/Data Sheet for bus interface SK TU3-PBR (for IP20 devices)
TI 275900160	Technical Information/Data Sheet for bus interface SK TU3-PBR-24V (with external power supply, for IP20 devices)
BU 0200	Manual for SK 2xxE frequency inverters
BU 0500	Manual for frequency inverters SK 500E to SK 535E
BU 0505	Manual for SK 54xE frequency inverters
BU 0000	Manual for use of NORD CON software
BU 0040	Manual for use of NORD parameterisation units

Software

Software	Description
GSD file	Device description file for PROFIBUS DP configuration software
NORD CON	Parametrisation and diagnostic software

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