EN

BU 2400

PROFINET IO bus interface

Supplementary manual options for NORD - Frequency Inverters

NORD DRIVESYSTEMS

Table of Contents

List of illustrations

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1.1 General

1.1.1 Documentation

Name: BU 2400

Material number 6082402

Series: **Field bus system PROFINET® IO**

1.1.2 Document History

Issue	Order number	Software version	Remarks
BU 2400, October 2016	**6082402** / 4116	V 1.4 R4	• Combination of manuals BU 0590 EN, January 2012, Part number 607 5901 / 0312 and BU 0290 EN, October 2012, Part number 607 2901 / 4312 • Extensive revision
BU 2400, April 2017	**6082402** / 1617	V 1.4 R4	Various corrections, among others • section 3.3 "Bus protocol" corrected and supplemented • Parameter **P164**, **P174**

1.1.3 Copyright notice

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 PROFINET® IO 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.

PROFINET® IO 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
AR	Application Relation
Bus module	Bus module
CR	Communication Relation
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
GSDML	Generic Station Description Markup Language
IND	Index
IP	Internet protocol
I/O	Input, Output
IW	Actual value
PDO	Process Data Object
PKE	Parameter label
PKW	Parameter label value
PLC	Programmable Logic Control
PNU	Parameter number
PPO	Parameter/Process Data Object
PWE	Parameter value
PZD	Process data
RO	Read Only
Rx	Receive
SDO	Service Data Object
SPI	Serial Peripheral Interface
PLC	Programmable Logical Controller
STR	String value
STW	Control word
SW	Setpoint
TCP	Transmission Control Protocol
Tx	Transmit
U8 (U16, U32)	8 Bit (16 Bit, 32 Bit) unsigned
USS	Universal serial interface
XML	Extensible Markup Language
ZSW	Status word

2 Safety

2.1 Intended use

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

Bus interface	Frequency inverter
SK TU4-PNT	SK 180E and SK 200E series
SK TU4-PNT-C	
SK TU4-PNT-M12	
SK TU4-PNT-M12-C	
SK CU4-PNT	
SK CU4-PNT-C	
SK TU3-PNT	SK 500E series

PROFINET IO bus interfaces from Getriebebau NORD GmbH & Co. KG are used for communication by the frequency inverter with a PLC in a PROFINET IO 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 PROFINET IO basics

3.1 Characteristics

PROFINET IO is a real time Ethernet, based on the Ethernet standard IEEE 802.3. PROFINET IO is based on PROFIBUS DP and uses Switched-Ethernet technology as the physical communication medium for the rapid communication of I/O data and parameters. PROFINET IO is specified in the standards IEC 61158 and IEC 61784.

In contrast to the PROFIBUS Master-Slave method, PROFINET IO is a Provider-Consumer model, which supports communication relations (CR) between equal field bus participants. In addition to the cyclic exchange of process data, diagnostic data, parameters and alarms can be communicated by the PROFINET IO field bus system.

PROFIBUS® and PROFINET® are registered trademarks of PROFIBUS and PROFINET International (PI).

PROFINET IO bus participants are classified according to their tasks:

PROFINET IO bus participants	Description
IO Controller	Controller (PLC) Performs the master function for I/O data communication with bus participants and controls the process. As a provider, the IO controller sends the output data to the IO devices and as a consumer it processes the input data which is sent from the IO devices.
IO Device	Decentralised field bus device which is controlled by the I/O controller. As a provider, the IO device sends the input data to the IO controller and as a consumer it processes the output data which is sent from the IO controller.
IO Supervisor	Designation for the PROFINET IO tool (programming device, HMI or PC) for parameterisation and diagnosis of IO devices, which is only used temporarily for commissioning and diagnosis.

Addressing of PROFINET IO bus participants is carried out via:

- the unique MAC address of the device,
- the unique assigned device name and
- the unique assigned IP address.

For communication between the IO controller and an IO device a so-called "Application Relation" **AR** is established, with which the "Communication Relations" **CR** are specified.

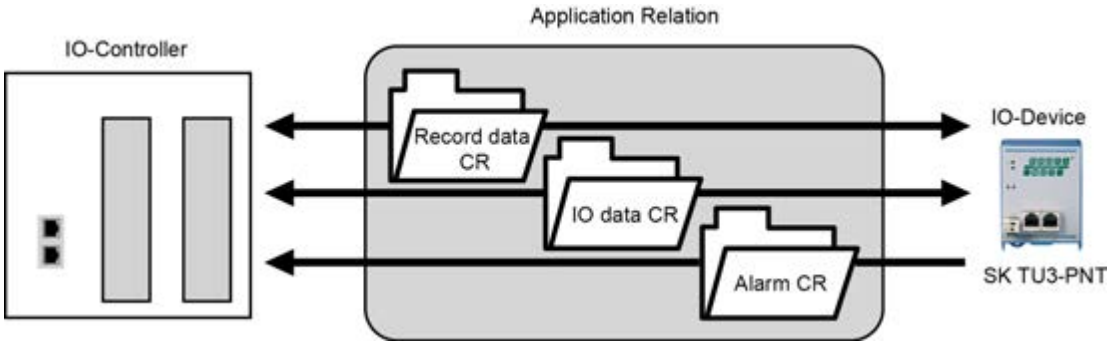


Figure 1: PROFINET IO communication via Application Relation AR

Communication Relation CR	Description
IO data CR	For cyclic communication of process data
Record data CR	For acyclic communication of parameter data
Alarm CR	For alarm messages in real time

Performance description

Standards	IEC 61158, IEC 61784
Possible number of bus participants	Practically unlimited, depending on the number of participants with which the IO controller can communicate.
Transfer rate	100 MBit (Switched Ethernet, Full Duplex)
Update interval	≤ 5 ms (exchange of process data between the bus interface and the frequency inverter)
Conformance Class	B, C
Transmission and reception cable	Auto Crossover, Auto Negotiation, Auto Polarity
Wiring	Standard Ethernet CAT 5 cable or better
Cable length	max. 100 m between 2 nodes,

3.2 Topology

PROFINET IO supports the following topologies:

3.2.1 Linear topology

Linear topology connects field bus participants which are equipped with integrated switches.

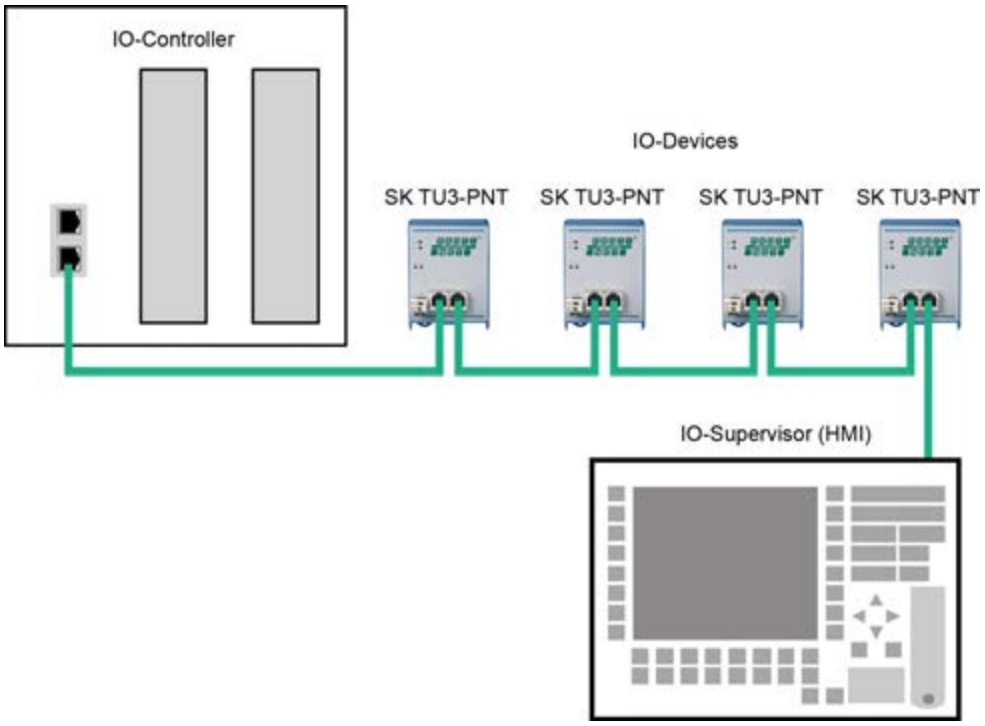


Figure 2: PROFINET IO linear topology (example)

Advantages: Requires little cable material, can be extended at the end of the line with little effort.

Disadvantages: If the line is interrupted (device failure or defective cable) the downstream field bus participants can no longer be accessed.

3.2.2 Star topology

The star topology requires a central switch (in the control cabinet).

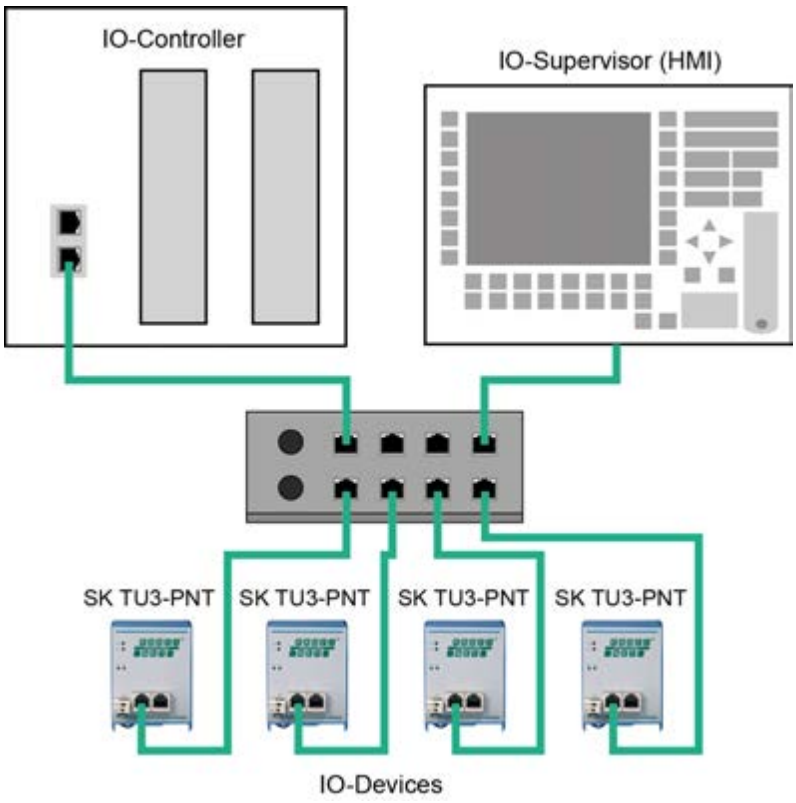


Figure 3: PROFINET IO star topology (example)

Advantages: A device failure has no effect on the other bus participants; can be extended with little effort, simple troubleshooting.

Disadvantages: Operation of the network is not possible in case of problems with the switch.

3.2.3 Ring topology

With a ring topology, one line is closed to form a ring for media redundancy.

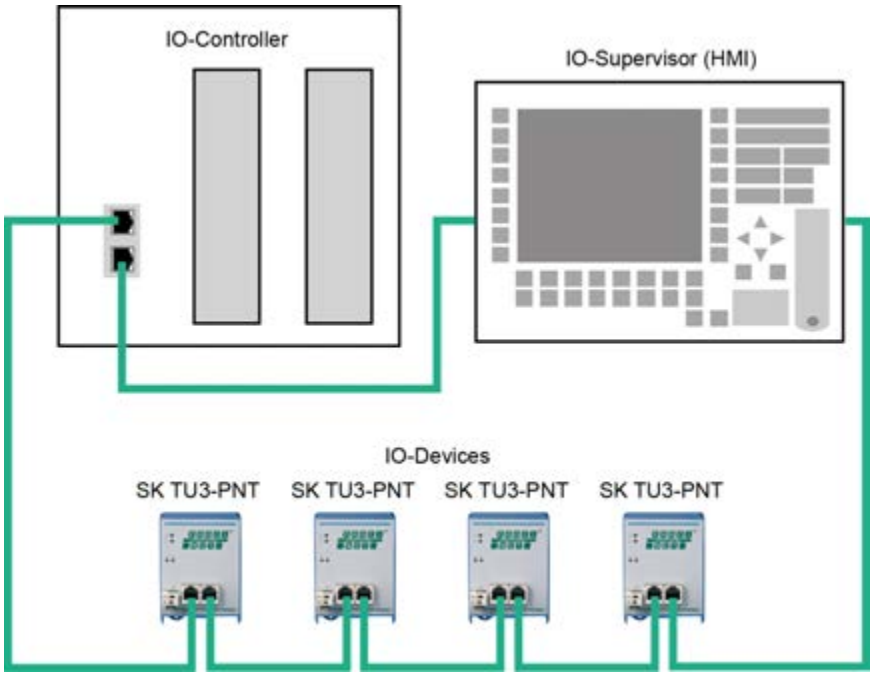


Figure 4: PROFINET IO ring topology (example)

Advantages: No external switch necessary Communication is maintained even in case of a defective cable

Requirement: Requires Media Redundancy Protocol (MRP).

3.2.4 Tree topology

Linear and star topologies can be mixed in a tree topology.

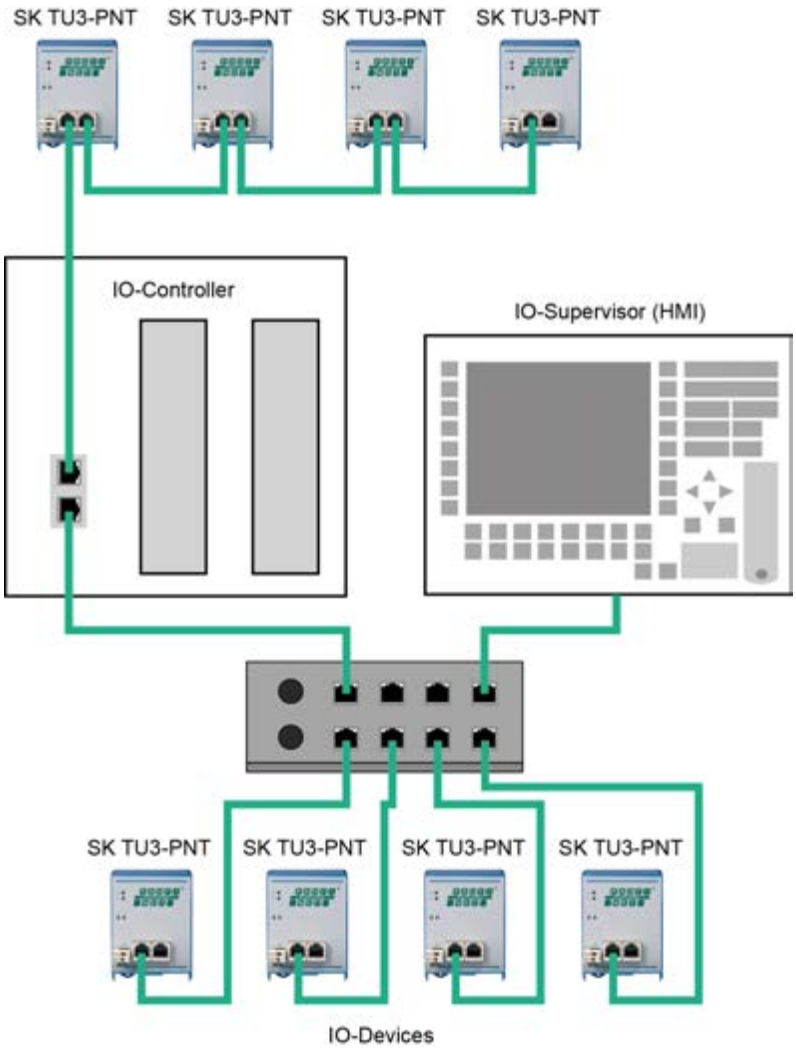


Figure 5: PROFINET IO tree topology (example)

3.3 Bus protocol

The PROFINET IO process data are embedded in standard Ethernet frames. For communication of process data, a PROFINET IO frame is identified with the label "8892h" and a frame ID in the type field "Ethertype".

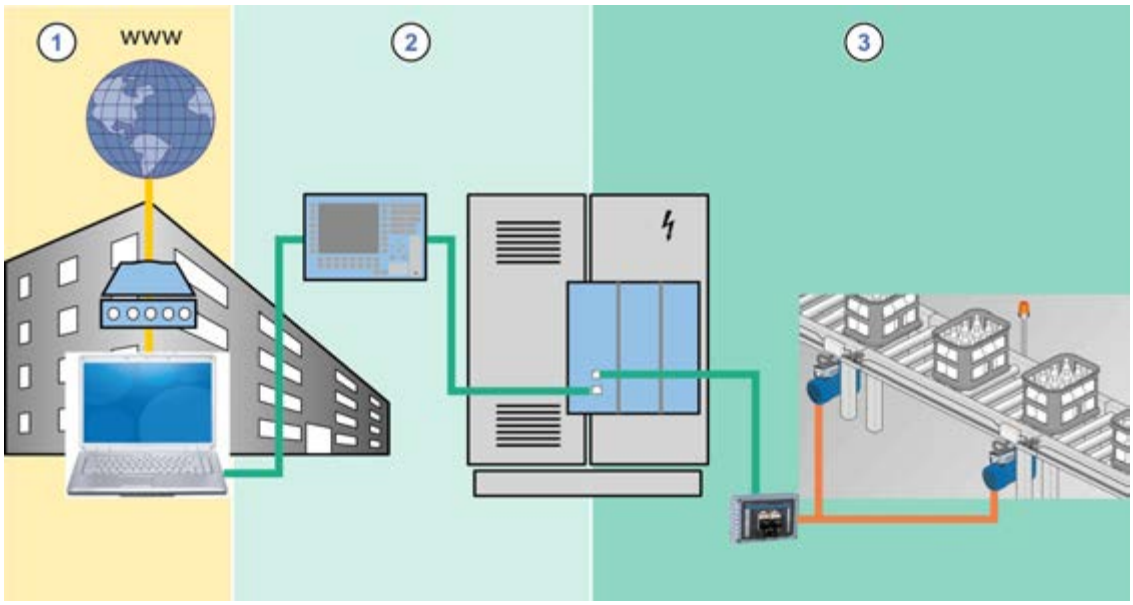
Figure 6: PROFINET IO telegram (communication within a sub-net)

	Designation	Description
Ethernet Header	**DA**	Destination Address = Destination address of the PROFINET IO frame
	SA	Source Address = Source address of the PROFINET IO frame
	VLAN Tag	Identifier for communicating the priority
	8892h	Ethertype identifier
PROFINET IO	**Frame ID**	Data identifier for cyclic or acyclic communication
	Status	Status information
Ethernet	**FCS**	Checksum of the PROFINET IO frame

PROFINET IO is subdivided into various performance classes, the so-called "Conformance Classes" CC-A, CC-B and CC-C.

Conformance Class	Description
CC-A	• Cyclic exchange of I/O data with real time characteristics • Acyclic data exchange for reading and writing of parameters and diagnostic data, including the function Identification & Maintenance I&M for reading out device information • Alarm function for signalling device and network faults in three levels (maintenance requirement, urgent maintenance requirement, diagnosis)
CC-B	• Cyclic exchange of I/O data with real time characteristics • Acyclic data exchange for reading and writing of parameters and diagnostic data, including the function Identification & Maintenance I&M for reading out device information • Alarm function for signalling device and network faults in three levels (maintenance requirement, urgent maintenance requirement, diagnosis) • Network diagnosis with the Simple Network Management Protocol (SNMP) • Topology detection with the Link Layer Discovery Protocol (LLDP)
CC-C	• Cyclic exchange of I/O data with the Isochronous Real Time Protocol • Acyclic data exchange for reading and writing of parameters and diagnostic data, including the function Identification & Maintenance I&M for reading out device information • Alarm function for signalling device and network faults in three levels (maintenance requirement, urgent maintenance requirement, diagnosis) • Network diagnosis with the Simple Network Management Protocol (SNMP) • Topology detection with the Link Layer Discovery Protocol (LLDP) • Reservation of bandwidth: Part of the available communication bandwidth of 100 MBit is exclusively reserved for real time tasks • Synchronisation of the application program clock to the bus cycle

The process data are communicated cyclically from the IO controller to the IO devices in real time and inversely from the IO devices into the process image of the IO controller. As the IO controller transfers the data without a request, when the system is started up, the IO devices are informed that they will receive current data in a particular bus cycle.



TCP/IP **RT** **RT, IRT** [1] **System bus**

[1] See **Information RT, IRT**

Figure 7: PROFINET IO data cycle times

Item	Description
1	Standard communication (IT services, TCP/IP)
2	Process automation
3	Motion Control (drive control)
TCP/IP	Internet protocol, cycle time less than 100 ms
RT	Real time protocol, cycle time less than 10 ms
IRT	Isochronous real time protocol, cycle time 0.25 ms…1.0 ms
System bus	NORD-specific bus system between the bus interface and frequency inverters, cycle time ≥ 1 ms

Information RT, IRT

The NORD PROFINET IO bus interfaces communicate exclusively via RT communication, while the Ethernet switches in the modules are IRT capable.

PROFINET IO real time communication is divided into the following classes:

RT class	Description
RT_CLASS_1	Unsynchronised real time communication within a sub-network (identical to network ID) Unsynchronised RT communication is the normal form of PROFINET IO data communication and is implemented in all IO field devices. Industrial standard switches can be used in this RT class. Suitable for typical cycle times of 10 ms.
RT_CLASS_2 (IRT Flex)	RT_CLASS_2 frames can be communicated either synchronised or unsynchronised. With synchronised communication the start of a bus cycle is defined for all participants. This defines precisely when a field device may transmit. This is always the start of the bus cycle (clock synchronisation) for all field devices involved in RT_CLASS_2 communication. Combination with RT_Class_1 is possible.
RT_CLASS_3 (IRT or IRT Top)	Synchronised communication within a sub-net. Transmission of process data takes place in a sequence which is specified by the system engineering. This optimised data communication requires considerable planning effort, special hardware and the use of real time switches. Suitable for cycle times of 0.25 ms…1 ms.
RT_CLASS_UDP	Unsynchronised data exchange of UDP data packages between different sub-nets. Suitable for the communication of PROFINET IO data which are not time-critical. This RT communication (Transport Protocol TCP/UDP-ID) can be implemented with all standard network components (e.g. Internet, company Intranet, etc.) Data cycles of 5 ms with 100 Mbit/s can be achieved in Full Duplex mode.

Performance description of NORD-PROFINET bus interfaces 📖 Section 3.1 "Characteristics".

Details of communication sequence

PROFINET IO works on the basis of real time communication (RT). IT is therefore possible to configure the bus system so that in addition to RT communication, isochronous real time communication (IRT) is possible, which is especially important for time-sensitive procedures such as for Motion Control applications. With a corresponding configuration of an IO controller, communication in PROFINET IO operates in two phases, the IRT phase and the open phase.

The IRT phase is exclusively reserved for IRT frames. In the course of planning, the user precisely specifies the sequence in which the participants transmit. Communication between the participants is carried out synchronously. Any accumulating RT frames or UDP/IP frames are temporarily saved in the switches without processing In this way, the IRT frames can be transferred to the IO controller without waiting times. The resulting telegraph run time for the IRT frames ultimately depends on the number of switches which are integrated into the communication line and their throughput times.

In the open phase, which is defined by the IO controller, the temporarily stored RT or UDP/IP frames are transferred. However, a destination port can only receive one frame at a time from the switch. Further frames which are intended for this destination port are temporarily saved in the switch. Depending on the structure or the setup of the communication line, there may be a delay in the exchange of information during the open phase.

This means that with isochronous real time communication (IRT) the run times for messages between the devices and the IO controller are always identical; in contrast, for real time communication (RT) they depend on the bus load and are therefore different in each cycle. The difference between RT and IRT communication therefore does not lie in the performance of the individual components, but rather in the limitations due to the extension of the communication line.

SK CU4-PNT, SK TU4-PNT and SK TU3-PNT PROFINET IO bus interfaces as well as SK TU4 PNS PROFIsafe bus interfaces are each equipped with an integrated switch with two ports for setting up a

linear topology. The integrated switches support synchronised RT_Class_3 communication, however the bus interfaces only use RT_Class_1 communication.

Therefore, IRT field devices which are physically arranged behind a NORD PROFINET IO bus interface can also participate in IRT communication.

The PROFINET IO bus interface participates in the standard RT communication. The smallest interval which can be set, in which data from the bus interface are transmitted without synchronisation to the IO controller, and in which this data can be received is 1 ms.

Communication between the bus interface and the relevant NORD drive components is via the NORD system bus. The required communication time is added to the run time for PROFINET IO communication.

The specific values for the update interval for process data, parameter reading and writing access can be obtained from the data sheets (TIs) for the relevant bus interfaces.

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.

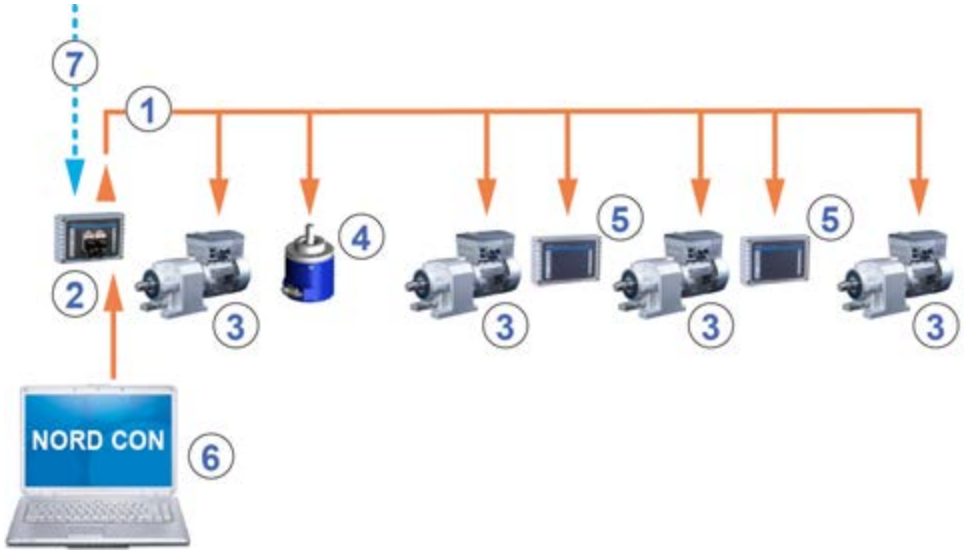


Figure 8: Example of the structure of a NORD system bus

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	8	8
Input/output extensions	8	8	—	16
CANopen encoder	4	4	8	8
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:

Absolute encoder address = 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.

4.3 Remote maintenance

NORD bus interfaces are designed for remote maintenance via the field bus system. Devices which are connected to the bus interface and the NORD system bus (frequency inverters, I/O extensions) from Getriebebau NORD GmbH & Co. KG can also be accessed via LAN or Internet for maintenance purposes.

The data transfer is carried out with encryption via a secure connection.

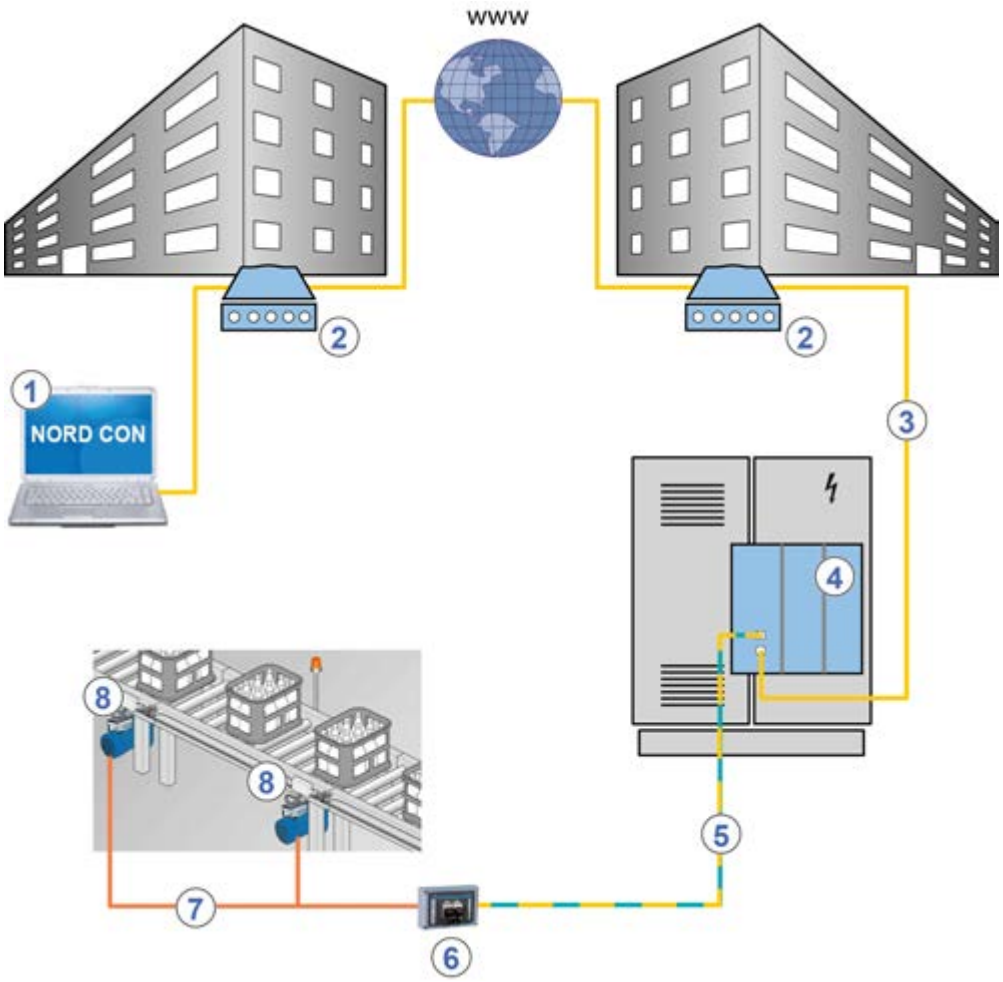


Figure 9: Remote maintenance via Internet (schematic diagram)

Item	Description
1	NORD CON software
2	Modem
3	LAN
4	Field bus gateway or bus master (PLC)
5	Field bus
6	Bus interface
7	NORD system bus
8	NORD- frequency inverter

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 PROFINET IO 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 "Integration into the bus master"). 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 PROFINET IO field bus is described in the corresponding technical information:

Bus interface	Frequency inverter	Documentation
SK TU3-PNT	SK 5xxE series	Technical Information/Data Sheet TI 275900190
SK TU4-PNT	SK 1x0E and SK 2xxE series	Technical Information/Data Sheet TI 275281115
SK TU4-PNT-M12		Technical Information/Data Sheet TI 275281122
SK TU4-PNT-C		Technical Information/Data Sheet TI 275281165
SK TU4-PNT-M12-C		Technical Information/Data Sheet TI 275281172
SK CU4-PNT		Technical Information/Data Sheet TI 275271015
SK CU4-PNT-C		Technical Information/Data Sheet TI 275271515

5.2 Integration into the bus master

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

For integration of NORD frequency inverters into the Siemens AG SIMATIC Manager, Getriebebau NORD GmbH & Co. KG provides standard S7 modules, which can be used for both PROFINET IO as well as for PROFIBUS 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 IO controller (bus master) during the bus scan. The current device description file which is required for configuration of the PROFINET IO bus interface can be downloaded under the link

NORDAC_Options.

The file (e.g. "GSDML-V2.2-NORD DRIVESYSTEMS-xUxPNT-20150603.xml") contains a description of the device characteristics of the bus interface and its parameters, as well as the parameters of the connected frequency inverters.

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

At present two device description versions are available:

File	Remarks
GSDML-**V2.2**-NORD DRIVESYSTEMS-xUxPNT-20150603.xml	For Simatic Step 7 V5.4 software systems:
	SP3 (does not support the IRT protocol)
	SP4 (supports the IRT protocol)
	SP5 (full support)
GSDML-**V2.25**-NORD DRIVESYSTEMS-xUxPNT-20150603.xml	For Simatic Step 7 software systems from V5.5 and above:

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 IO controller in 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 PROFINET IO field bus system
- Specify the characteristics of the bus interface (device name, device number, IP address)

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 6.3 "Transfer of process data".

5.2.4 PROFINET IO field bus address

In order for the bus interface and the connected frequency inverters to be detected by the IO controller, an IP address and a device name must be assigned to the bus interface. The settings must be made in both the operator's PROFINET IO configuration software as well as in the NORD CON software.

The following bus interface parameters must be set in the NORD CON software::

- **P160 IP address**
- **P161 IP sub-net mask**
- **P162 device name**
- **P164 IP gateway** (if the gateway function is configured)

Requirement

- The PROFINET IO field bus system has been installed and commissioned according to the manufacturer's instructions.
- The NORD CON computer is equipped with a serial interface (🕮 Technical Information/Data Sheet).

Procedure

1. Assign a device name, an IP address and a sub-net mask and if necessary activate the gateway function in the PROFINET IO configuration software for the bus master of the bus interface.

2. In the tree directory of the NORD CON software, open the entry for the bus interface with a double click, call up the standard parameter **P160 IP address**, enter the IP address and save this with "**ENTER**".

Information

If the IP address of the bus interface has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. Parameter **P160** is then set to zero. In this case, the currently set IP address can be obtained via parameter **P185**.

If the IP address which is entered does not conform with the IP sub-net mask which is entered in parameter **P161** the IP sub-net mask is corrected automatically.

3. Call up the standard parameter **P161 IP sub-net mask**, enter the IP address and save this with "**ENTER**".

Information

If the IP sub-net mask has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. Parameter **P161** is then set to zero. In this case, the currently set IP sub-net mask can be obtained via parameter **P186**.

The IP sub-net mask is only saved after a value is entered in Array [-04].

If the IP sub-net mask does not conform with the IP address which is entered in **P160** the entry is not saved.

4. Call up the standard parameter **P162 device name**, enter the device name and save this with "**ENTER**".

Information

In order for the bus interface to be detected when the IO controller is started up, the device name which is entered here must conform with the device name which is assigned in the PLC project.

Observe the following conventions when entering the device name:

- The device name may have a maximum of 127 characters. Lower case letters a...z, numbers 0...9, hyphens /-" and fullstops "." are permissible.
- A character string between two hyphens or two full stops may only have an maximum length of 63 characters.
- The device name must not contain any special characters (umlauts, brackets, slashes and underscores etc.) or spaces.
- The device name must not begin or end with a hyphen.
- The device name must not begin or end with a number.
- The device name must not have the format "n.n.n.n" or start with the character sequence "port-nnn" (n = 0…9).

5. Call up the standard parameter **P164 IP gateway**, enter the IP address for the gateway function and save this with "**ENTER**".

Information

If the IP address for the gateway function has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. This parameter is then set to zero. In this case, the currently set IP address can be obtained via parameter **P187**.

5.3 Example: Commissioning the PROFINET IO bus module

The following example contains an overview of the necessary steps for commissioning the bus interface in a PROFINET IO 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-PNT	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	Set the parameters for system bus communication.	Set the following parameters on each frequency inverter:
			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 world
			P546, [-01] 1 (setpoint frequency)
			P546, [-02] 23 (setpoint frequency incl.Low word)
			P546, [-03] 24 (setpoint frequency incl. High world
PROFINET IO field bus	6	Set up the bus interface for field bus communication.	🕮 Sections 5.1 "Connecting the bus interface" to 5.2 "Integration into the bus master"
			Set the following parameters on the bus interface (🕮 Section 7.1.1 "NORD standard parameters"):
			P151 200 ms (Timeout external bus)
NORD system bus	7	Set the parameters for system bus monitoring.	Set the following parameters on each frequency inverter (🕮 BU 0200)
			P120, [-01] 1 (Auto) or 2 (monitoring active immediately)
	8	Check the system bus communication.	Check the display of the following information parameters on all frequency inverters (🕮 BU 0200):
			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"
			Check the display of the following bus interface information parameters (🕮 Section 7.1.3 "NORD information parameters"):
			P173 "Module status"
PROFINET IO field bus	9	Check the field bus communication.	Check the display of the following bus interface information parameters (🕮 Section 7.1.3 "NORD information parameters"):
			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 5 setpoints, as well as the status word and up to 5 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 6.3.5 "Process data telegrams".

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 acyclically without priority.
- If PPO types 1 and 2 are used (📖 Section 6.3.5 "Process data telegrams") the parameters can be transferred cyclically.

📖 Section 6.4 "Parameter data transmission".

6.2 Structure of reference data

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

- PKW area = **P**arameter **L**abel **V**alue (parameter level)
- PZD area = **P**ro**c**ess**D**ata (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 or 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 from the IO controller is transferred to the IO device. In the response telegram, the application data is transferred from the IO device to the IO controller.

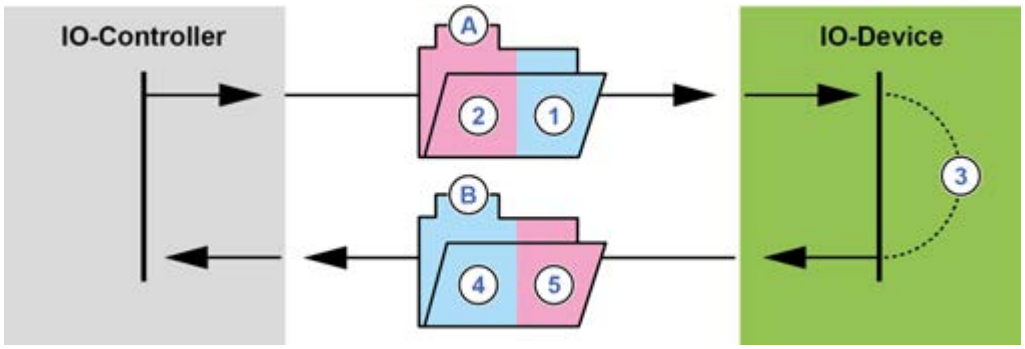


Figure 10: Structure of the application data area – Telegram traffic

Item	Meaning
A	Order telegram
1	Parameter order
2	Control word and setpoints
3	Processing
W	Response telegram
4	Parameter response
5	Status word and actual values

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 IO controller 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 IO controller to the IO device. NORD frequency inverters can process PPO types 1, 2, 3, 4 and 6.

Structure of PPO types:

	PKW				PZD					
	PKE	IND	PWE	PWE	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
					STW	SW1	SW2	SW3	WAF 4	WAF 5
					ZSW	IW1	IW2	IW3	IW4	IW5
	1st word	2nd word	3rd word	4th word	5th word	6th word	7th word	8th word		
PPO 1	x	x	x	x	x	x				
PPO 2	x	x	x	x	x	x	x	x		
					1st word	2nd word	3rd word	4th word	5th word	6th word
PPO 3					x	x				
PPO 4					x	x	x	x		
PPO 6					x	x	x	x	x	x

For detailed information see 🕮 Section 6.3.5 "Process data telegrams".

6.3 Transfer of process data

The control word (STW) and up to 5 Setpoints (SW) are transferred from the IO controller to the frequency inverter and the status word (ZSW) and up to 5 actual values (IW) are transferred from the frequency inverter to the IO controller as process data.

Addressing of the process data is performed with a slot/index combination. The slots and indices of NORD bus interfaces and frequency inverters are read by the IO controller from the device description file (🕮 Section 5.2 "Integration into the bus master").

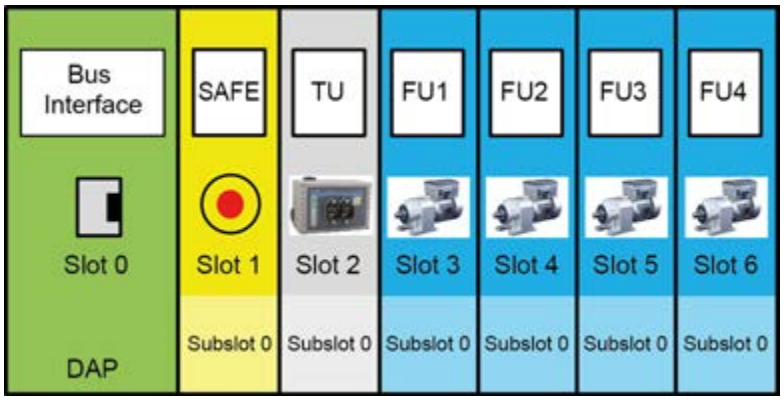


Figure 11: Example – PROFINET IP device model for decentralised devices

Designation	Description
DAP	Device Access Point, access point for communication with the Ethernet interface
SAFE	Only for PROFIsafe field bus systems (decentralised devices SK 1x0E, SK 2xxE)
TU	Bus interface
FI1…FI4	Frequency inverters 1…4 (SK 1x0E, SK 2xxE decentralised inverters)
FI1…FI8	Frequency inverters 1…8 (SK 5xxE central inverters)

The length and structure of the process data are determined by the PPO types which the IO controller reads out from the device description file. The PPO types must be assigned to the slots for the bus participants during the configuration of the IO controller (PLC project). The PPO types are defined in the PROFIBUS profile.

6.3.1 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.	
102	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 01 = Parameter set 2 10 = Parameter set 3 11 = Parameter set 4	—
		1		
15	Parameter set Bit 1 On	0		
		1		

[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

6.3.2 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 10 = Parameter set 3 11 = Parameter set 4
		1	
15	Parameter set Bit 1 On	0	
		1	

6.3.3 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.

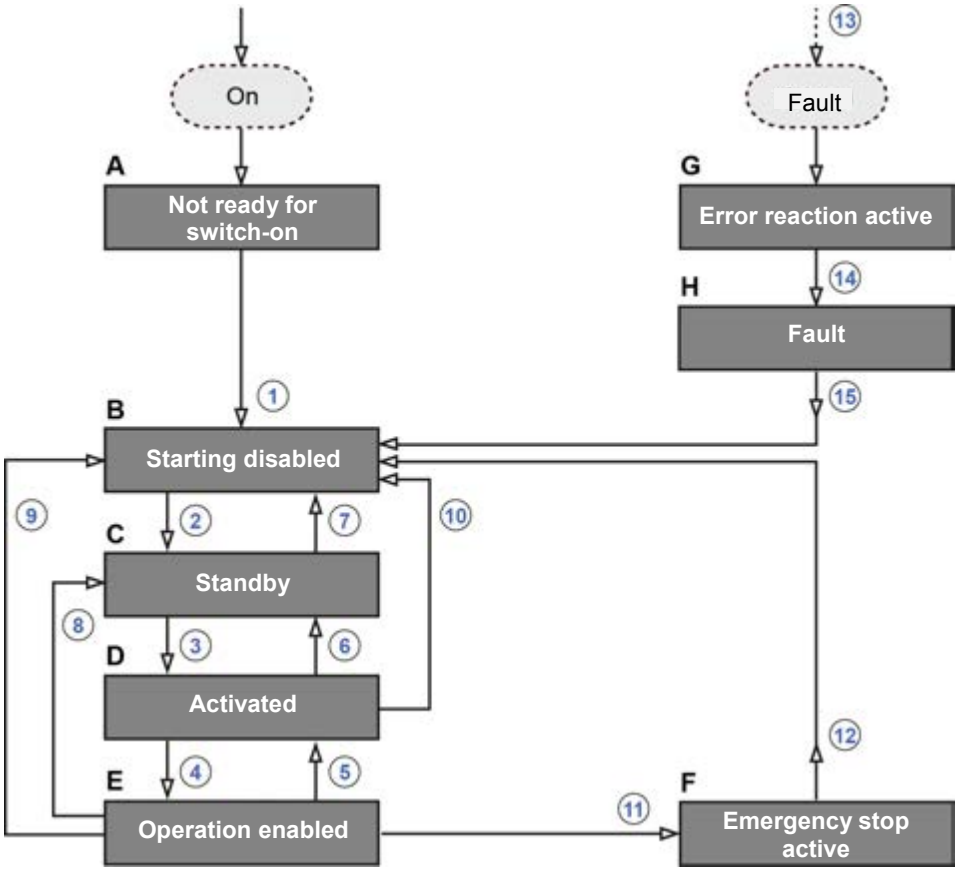


Figure 12: Frequency inverter status machine

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. **Information** 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.
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 6.3.1 "Control word".

[1] Complete list of control bits (Bit 0…15) 🕮 Section 6.3.1 "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 6.3.2 "Status word".

6.3.4 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	Parameters		
		SK 1x0E, SK 2xxE frequency inverters	SK 500E…SK 535E frequency inverters	SK 54xE frequency inverters
To bus interface	Setpoint 1	**P546, Array [-01]**	**P546**	**P546, Array [-01]**
	Setpoint 2	**P546, Array [-02]**	**P547**	**P546, Array [-02]**
	Setpoint 3	**P546, Array [-03]**	**P548**	**P546, Array [-03]**
	Setpoint 4	—	—	**P546, Array [-04]**
	Setpoint 5	—	—	**P546, Array [-05]**
From bus interface	Actual value 1	**P543, Array [-01]**	**P543**	**P543, Array [-01]**
	Actual value 2	**P543, Array [-02]**	**P544**	**P543, Array [-02]**
	Actual value 3	**P543, Array [-03]**	**P545**	**P543, Array [-03]**
	Actual value 4	—	—	**P543, Array [-04]**
	Actual value 5	—	—	**P543, Array [-05]**

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 **P112 Torque current limit** of the frequency inverter.

Frequencies and currents result from the following formulae:

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

* 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 1x0E, 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	**Transmitted data**					
	SK 1x0E, SK 2xxE, SK 5xxE frequency inverters				**Only frequency inverters SK 540E…SK 545E**	
	1st word	**2nd word**	**3rd word**	**4th word**	**5th word**	**6th word**
To bus interface	Control word	32 Bit setpoint		Setpoint 3	Setpoint 4	Setpoint 5
From bus interface	Status word	Actual value 1	32 Bit actual value		Actual value 4	Actual value 5

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.

6.3.5 Process data telegrams

Getriebebau NORD GmbH & Co. KG uses the PPO types PPO3, PPO4 and PPO6 as process data telegrams for cyclic communication of process data.

PPO3

Direction of transmission	Transmitted data (4 Byte)	
	SK 1x0E, SK 2xxE, SK 5xxE, SK 54xE frequency inverters	
	1st word	2nd word
To bus interface	Control word	Setpoint 1
From bus interface	Status word	Actual value 1

PPO4

Direction of transmission	Transmitted data (8 Byte)			
	SK 1x0E, SK 2xxE, SK 5xxE, SK 54xE frequency inverters			
	1st word	2nd word	3rd word	4th word
To bus interface	Control word	Setpoint 1	Setpoint 2	Setpoint 3
From bus interface	Status word	Actual value 1	Actual value 2	Actual value 3

PPO6

Direction of transmission	Transmitted data (12 Byte)					
	SK 1x0E, SK 2xxE, SK 5xxE frequency inverters				Only SK 540E…SK 545E frequency inverters	
	1st word	2nd word	3rd word	4th word	5th word	6th word
To bus interface	Control word	Setpoint 1	Setpoint 2	Setpoint 3	Setpoint 4	Setpoint 5
From bus interface	Status word	Actual value 1	Actual value 2	Actual value 3	Actual value 4	Actual value 5

Getriebebau NORD GmbH & Co. KG uses the PPO types PPO1 and PPO2 for the cyclic exchange of process and parameter data.

PPO1

Direction of transmission	Transmitted data (12 Byte)					
	SK 1x0E, SK 2xxE, SK 5xxE, SK 54xE frequency inverters					
	1st word	2nd word	3rd word	4th word	5th word	6th word
To bus interface	AK and PNU	IND	PWE HI	PWE LO	Control word	Setpoint 1
From bus interface	AK and PNU	IND	PWE HI	PWE LO	Status word	Actual value 1

AK Order label
IND Parameter index
PNU Parameter number
PWE Parameter value

(📖 Section 6.4 "Parameter data transmission")

PPO2

Direction of transmission	Transmitted data (16 Byte)							
	SK 1x0E, SK 2xxE, SK 5xxE, SK 54xE frequency inverters							
	1st word	2nd word	3rd word	4th word	5th word	6th word	7th word	8th word
To bus interface	AK and PNU	IND	PWE HI	PWE LO	STW	Setpoint 1	Setpoint 2	Setpoint 3
From bus interface	AK and PNU	IND	PWE HI	PWE LO	ZSW	Actual value 1	Actual value 2	Actual value 3

AK Order label
IND Parameter index
PNU Parameter number
PWE Parameter value

(📖 Section 6.4 "Parameter data transmission")

6.4 Parameter data transmission

Transmission of parameter data is carried out acyclically. As with the process data, the parameter data are assigned via slots (🕮 Section 6.3 "Transfer of process data"). The following are transferred

- • Higher level parameter data for the bus interface (slot assignment 2)
- • Parameter data for the frequency inverter FI1… (slot assignment 3…)

Using the PKW area (🕮 Section 6.3 "Transfer of process 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 or 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 IO-Controller 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**.

6.4.1 Structure of acyclic parameter data exchange (Records)

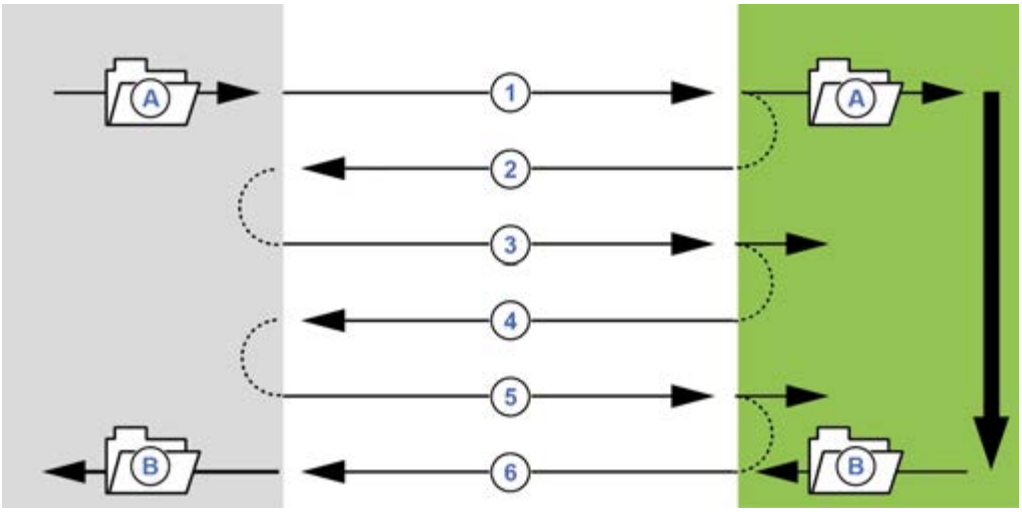


Figure 13: Sequence of acyclic PROFINET IO parameter data exchange

Item	Meaning	Comments
A	Parameter order	
W	Parameter response	
1	Write Request (with data, Slot 3…10)	By means of a "Write Request" the data record is transferred to the IO device (bus interface) as a parameter order.
2	Write Response (without data, Slot 3…10)	With "Write Response" the IO controller receives confirmation of the receipt of the message.
3	Read Request (without data, Slot 3…10)	With a "Read Request" the IO controller orders a response from an IO device.
4	Read Response (–) (without data, Slot 3…10)	The IO device responds with a "Read Response (–)", if processing is not yet complete.
5	Read Request (without data, Slot 3…10)	With a "Read Request" the IO controller orders a response from an IO device.
6	Read Response (+) (with data, Slot 3…10)	After processing the parameter order, the IO device responds with "Read Response (+)". The parameter order is complete.

During the communication of parameter orders, the positive response from the IO device to the IO controller can be delayed by one or more communication cycles. The IO controller must therefore repeat the order until the corresponding response is received from the IO device.

6.4.2 Data records for acyclic parameter orders

Parameter orders are transferred as data records. The data records are generally transferred to the bus interface (Slot 2). The number of the data record determines the recipient of the parameter order:

Data record 100	Order to the bus interface (Parameter P150…P199)
Data record 101	Order to frequency inverter 1 (Parameter P000…P149 and P200…P999)
Data record 102	Order to frequency inverter 2 (Parameter P000…P149 and P200…P999)
…	
Data record 108	Order to frequency inverter 8 (Parameter P000…P149 and P200…P999)

The structure of these data records is described in Section 6.4 "Parameter data transmission" ("PKW area").

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.

6.4.3 Data record format

6.4.3.1 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 IO-Controller 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	Transfer parameter value (double word)
4	Transfer parameter value (array, word)
5	Transfer parameter value (array, double word)
6	Transfer the number of array elements
7	**Order cannot be executed (with error number in PWE2)**

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 present
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.

6.4.3.2 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								
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.

6.4.3.3 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.

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

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

6.4.4 Examples of data record transfer

6.4.4.1 Reading of parameter P170 actual error, Index 0 (actual error)

Data record 100 is used.

Example telegram

Field	Data size	Byte	Date		Explanation
Order label AK	1 Byte (upper Nibble)	2	1h		Order parameter value (read)
and Parameter value PWE	1 Byte (lower Nibble)			492h	Parameter number P170 (170+1000) = 492h
			1492h		
Parameter index	2 Byte	3	00h		Parameter sub-index
		4	00h		
Parameter value	4 Byte	5	00h		Setting value not set with read order
		6	00h		
		7	00h		
		8	00h		

Example code (SIMATIC STEP 7 V5.5)		Explanation
CALL	„WRREC“, DB53	→ Write Request
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnosis address
INDEX	:=100	→ Data record 100
LEN	:=8	→ Length: 8 Byte
DONE	:=#bEnd	
BUSY	:=#bBusy	
ERROR	:=#bError	
STATUS	:=wStatus	
RECORD	:=P#DB10.DBX0.0 BYTE 8	→ Data: 14h,92h, 00h,00h, 00h,00h, 00h,00h
CALL	“RDREC”, DB52	→ Read Response
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnosis address
INDEX	:=100	→ Data record 100
MLEN	:=8	
VALID	:=…	
BUSY	:=…	
ERROR	:=…	
STATUS	:=…	
LEN	:=…	
RECORD	:=P#DB10.DBX12.0 BYTE 8	→ Response: 14h,92h, 00h,00h, 00h,00h, 03h,FCh
Read value: P170 = 1020 (03FCh)		

6.4.4.2 Writing of parameter P102 acceleration time, Index 1

Data record 101 is used.

Example telegram

Field	Data size	Byte	Date		Explanation
Order label AK	1 Byte (upper Nibble)	2	2h		Order parameter value (read)
and Parameter value PWE	1 Byte (lower Nibble)			44Eh	Parameter number P102 (102+1000) = 44Eh
			244Eh		
Parameter index	2 Byte	3	01h		Parameter sub-index
		4	00h		
Parameter value	4 Byte	5	00h		The time "2.5 s" (250 = FAh) is to be set.
		6	00h		
		7	00h		
		8	FAh		

Example code (SIMATIC STEP 7 V5.5)		Explanation
CALL	„WRREC“, DB53	→ Write Request
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnosis address
INDEX	:=101	→ Data record 101
LEN	:=8	→ Length: 8 Byte
DONE	:=#bEnd	
BUSY	:=#bBusy	
ERROR	:=#bError	
STATUS	:=wStatus	
RECORD	:=P#DB10.DBX0.0 BYTE 8	→ Data: 24h, 4Eh, 01h, 00h, 00h, 00h, 00h, FAh
CALL	“RDREC”, DB52	→ Read Response
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Reference
INDEX	:=101	→ Data record 101
MLEN	:=8	
VALID	:=…	
BUSY	:=…	
ERROR	:=…	
STATUS	:=…	
LEN	:=…	
RECORD	:=P#DB10.DBX12.0 BYTE 8	→ Response: 14h, 4Eh, 01h, 00h, 00h, 00h, 00h, 00h

6.4.4.3 Telegram structure for parameterisation via PPO1 or PPO2

The parameter **P102 acceleration time** is to be set to the value "10 s" in parameter set 3 (only the PKW channel is considered). As the acceleration time has an internal resolution of "0.01 s" in the FI, the parameter value "1000" ("3E8h") must be transferred.

Procedure

1. Specify the order label (CAK 7 = "Change parameter value (Array, Word)").
2. Select parameter (P102 = P66h).
3. Select parameter set 3 (IND = 02)
4. Set parameter value (1000 = 3E8h).
5. Check response telegram (positive for array word 4)

Order telegram from IO controller

Word	1		2		3		4	
Byte	0	1	2	3	4	5	6	7
Designation	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	70h	66h	02h	00h	00h	00h	03h	E8h

Response telegram from frequency inverter (after complete processing of the order)

Word	1		2		3		4	
Byte	3	4	5	6	7	8	9	10
Designation	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	40h	66h	02h	00h	00h	00h	03h	E8h

6.5 Example of setpoint specification

The following example shows the specification of a setpoint for switching a frequency inverter on and off. The frequency inverter is operated with a setpoint (setpoint frequency) and responds with an actual value (actual frequency). The maximum frequency is set to 50 Hz.

Parameter settings on the frequency inverter

Parameter No.	Parameter name	Setting value
P105	Maximum frequency	50 Hz
P543	Actual bus value 1	1 (= Actual frequency)
P546	Function Bus setpoint 1	1 (= Setpoint frequency)

Example

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

7 Parameters

The bus interface and frequency inverter parameters are communicated as words (16 Bit/Word). Exceptions to this are position values (POSICON), 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	PROFINET IO standard parameter (can be set and saved)
P17x	NORD information parameter (display)
P18x	PROFINET IO information parameter (display)

No NORD standard parameters need to be set at the SK TU3-PNT bus interface, since the settings are made via frequency inverter parameters.

The NORD standard parameters **P151**, **P153** und **P154** must be set on the bus interfaces SK CU4-PNT and SK TU4-PNT.

Depending on the use and configuration, the PROFINET IO standard parameters **P160** to **P162** and **P164** must be set.

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 TU4-PNT**
Description	The setting of this parameter determines the switching state of each digital output.

Setting values

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)

P151	**Timeout for external bus**
Setting range	0…32767 ms
Factory setting	{ 0 }
Bus interface	**SK CU4-PNT, SK TU4-PNT**
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, PROFINET 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:

Action	Setting value		SK xUx-PNT error
	P151	P513	
Invalid control word set (e.g. PLC to Stop)	-1	-0.1	Frequency inverter continues operation
Connection to PROFINET IO controller lost	-1	-0.1	Frequency inverter continues operation
Ethernet cable 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 PROFINET IO controller lost	0 sec	0 sec	Error E10.2*
Ethernet cable interrupted	0 sec	0 sec	Error E10.5*
Invalid control word set (e.g. PLC to Stop)	1 sec	1 sec	Error E10.3*
Connection to PROFINET IO controller lost	1 sec	1 sec	Error E10.2*
Ethernet cable interrupted	1 sec	1 sec	Error E10.5*

* Error E10.2 = PROFINET Watchdog
Error E10.3 = Bus Timeout (P151/P513)
Error E10.8 = No Ethernet connection

P152	Factory setting
Setting range	0…1
Factory setting	{ 0 }
Bus interface	**SK TU3-PNT, SK CU4-PNT, SK TU4-PNT**
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-PNT, SK TU4-PNT**
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-PNT, SK TU4-PNT**	
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 PROFINET IO standard parameters

Field-bus specific settings of the bus interface can be made via the PROFINET IO standard parameters.

P160	**IP address**			
Setting range	0…255			
Arrays	[-01] = IP-High (NET-ID)		[-03] = IP (NET-ID)	
	[-02] = IP (NET-ID)		[-04] = IP Lo (Host)	
Factory setting	{ [-01] = 192 }	{ [-02] = 168 }	{ [-03] = 20 }	{ [-04] = 200 }
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT			
Description	Set the IP address for the bus interface, consisting of 4 bytes.			
Note	If the IP address of the bus interface has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. This parameter is then set to "0". In this case, the currently set IP address can be obtained via parameter **P185**. If the IP address which is entered does not conform with the IP sub-net mask which is entered in parameter **P161** the IP sub-net mask is corrected automatically. If the IP address is changed (e.g. with NORD CON software), this is only saved after a value is entered in Array [-04].			

P161	**IP sub-net mask**			
Setting range	0…255			
Arrays	[-01] = IP Sub 1	[-02] = IP Sub 2	[-03] = IP Sub 3	[-04] = IP Sub 4
Factory setting	{ [-01] = 255 }	{ [-02] = 255 }	{ [-03] = 255 }	{ [-04] = 0 }
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT			
Description	Set the IP sub-net mask for the bus interface, consisting of 4 bytes.			
Note	If the IP sub-net mask has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. This parameter is then set to "0". In this case, the currently set IP sub-net mask can be obtained via parameter **P186**. If the IP sub-net mask is changed (e.g. with NORD CON software), this is only saved after a value is entered in Array [-04]. If the IP sub-net mask does not conform with the IP address which is entered in **P160** the entry is not saved.			

P162	Device name
Setting range	45…122 (ASCII)
Factory setting	{ 0 }
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT
Description	Enter the device name for the bus interface in the PROFINET IO bus system.
Note	In order for the bus interface to be detected when the IO controller is started up, the device name which is entered here must conform with the device name which is assigned in the PLC project. Observe the following conventions when entering the device name: • The device name may have a maximum of 127 characters. Lower case letters a...z, numbers 0...9, hyphens /-" and fullstops "." are permissible. • A character string between two hyphens or two full stops may only have an maximum length of 63 characters. • The device name must not contain any special characters (umlauts, brackets, slashes and underscores etc.) or spaces. • The device name must not begin or end with a hyphen. • The device name must not begin or end with a number. • The device name must not have the format "n.n.n.n" or start with the character sequence "port-nnn" (n = 0…9).

P163	Testing the alarm	
Setting range	0…255	
Arrays	[-01] = Slot 0 (DAP – reserved)	
	[-02] = Slot 1 (reserved)	
	[-03] = Slot 2 (bus interface)	
	[-04]…[-07] = Slot 3…6 (FI1…4)	[-08]…[-11] = Slot 7…10 (FI5…8)[1]
Factory setting	{ [-01]…[-11] = 0 }	
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT	
Description	Enter the error number to trigger a diagnostic alarm on one of the slots (e.g. during commissioning).	
Note	When the entry is saved, an alarm is triggered on the relevant slot. Set the value back to "0" to reset the alarm.	
Example	Trigger alarm with error 5.0 on Slot 3:	
	P163 Array [-04]	→ ChannelErrorType = 0x100+50=0x132

1 Only SK TU3 bus interface:

P164	IP Gateway			
Setting range	0…255			
Arrays	[-01] = IP High (NET-ID)		[-03] = IP (NET-ID)	
	[-02] = IP (NET-ID)		[-04] = IP Lo (Host)	
Factory setting	{ [-01] = 0 }	{ [-02] = 0 }	{ [-03] = 0 }	{ [-04] = 0 }
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT			
Description	Set the IP address for the gateway function, consisting of 4 bytes.			
Note	If the IP address for the gateway function has been configured in the PLC project, this is automatically assigned to the bus interface when the IO controller is started up. This parameter is then set to "0". In this case, the currently set IP address can be obtained via parameter **P187**. If the IP address is changed (e.g. with NORD CON software), this is only saved after a value is entered in Array [-04].			

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 TU3-PNT, SK CU4-PNT, SK TU4-PNT**
Description	Display of the actual error present. For a list of possible error messages please refer to 🕮 Section 8 "Error monitoring and 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 TU3-PNT, SK CU4-PNT, SK TU4-PNT**
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 TU3-PNT, SK CU4-PNT, SK TU4-PNT**
Description	Display of the bus interface identifier.

Display values

Value	Meaning	
0	CU4 (internal)	Bus interfaceSK CU4-PNT
1	TU4 (external)	Bus interfaceSK TU4-PNT
2	TU3 (Techn. Unit)	Bus interfaceSK TU3-PNT
3	TU3 (Techn. Unit)+DIP	Bus interface SK TU3-PNT with DIP switch

P173	Module status
Display range	0…FFFFh
Arrays*	[-01]…[-02]
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT
Description	Displays the operating status of the bus interface.

Display values

Bit	Meaning (Array [-01]*)	Meaning Array [-02]*
0	Initialisation	FI 1 status
1	Application Relation established	
2	Ethernet connection	FI 2 status
3	Timeout (P151/P513)	
4	Status error code	FI3 status
5	Status error code	
6	Status error code	FI4 status
7	System bus Error / Warning	
8	FI1 status	FI5 status*
9		
10	FI 2 status	FI6 status*
11		
12	FI 3 status	FI7 status*
13		
14	FI 4 status	FI8 status*
15		

FI status

Frequency inverter status, Array [-01] Bit 8…Bit 15, or Array [-02] Bit 0 … Bit 15:

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

Status error codes

Status error code	Bit 6	Bit 5	Bit 4	Meaning
FU_FAULT-101	0	0	X	
FU_FAULT_102	0	X	0	PROFINET timeout
FU_FAULT_103	0	X	X	Process data (STW) timeout
FU_FAULT_104	X	0	0	CAN hardware error
FU_FAULT_105	X	0	X	Ethernet No Link
FU_FAULT_106	X	X	0	IO Hardware error
FU_FAULT_107	X	X	X	Safe hardware error
Example: Bit 4 = 0, Bit 5 = 1, Bit 6 = 0 → PROFINET timeout (E10.2)				

* Only bus interface SK TU3-PNT

P174	Digital input status
Display range	0…255 (00000000…11111111b)
Bus interface	**SK CU4-PNT, SK TU4-PNT**
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[2]
4	Input 5 (DIN5) of the bus interface[2]
5	Input 6 (DIN6) of the bus interface[2]
6	Input 7 (DIN7) of the bus interface[2]
7	Input 8 (DIN8) of the bus interface[2]

[1] SK CU4: Indication of excess temperature of the bus interface
Bit 2 = Low (0) → Bus interface switched off, or "Overtemperature" error is active
Bit 2 = High (1) → Bus interface in operation, **no** "Overtemperature" error

[2] Only bus interface SK TU4-PNT

P175	Relay status
Display range	0…3 (00…11b)
Bus interface	**SK TU4-PNT**
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[1]			
	[-02] =	Control word	[-03]…[-07] =	Setpoint 1…5	to FI1
	[-08] =	Control word	[-09]…[-13] =	Setpoint 1…5	to FI2
	[-14] =	Control word	[-15]…[-19] =	Setpoint 1…5	to FI3
	[-20] =	Control word	[-21]…[-25] =	Setpoint 1…5	to FI4
	[-26] =	Control word	[-27]…[-31] =	Setpoint 1…5	to FI5[2]
	[-32] =	Control word	[-33]…[-37] =	Setpoint 1…5	to FI6[2]
	[-38] =	Control word	[-39]…[-43] =	Setpoint 1…5	to FI7[2]
	[-44] =	Control word	[-45]…[-49] =	Setpoint 1…5	to FI8[2]
	[1] Only bus interface , SK CU4-PNT, SK TU4-PNT [2] Only bus interface , SK TU3-PNT				
Bus interface	**SK TU3-PNT, SK CU4-PNT, SK TU4-PNT**				
Description	Display of data received from the IO-Controller.				
Note	Setpoints 4 and 5 are only possible with SK 54xE frequency inverters.				

P177	Process data Bus Out				
Display range	-32768…32767				
Arrays	[-01] =	Bus module inputs[1]			
	[-02] =	Status word	[-03]…[-07] =	Actual value 1…5	from FI1
	[-08] =	Status word	[-09]…[-13] =	Actual value 1…5	from FI2
	[-14] =	Status word	[-15]…[-19] =	Actual value 1…5	from FI3
	[-20] =	Status word	[-21]…[-25] =	Actual value 1…5	from FI4
	[-26] =	Status word	[-27]…[-31] =	Actual value 1…5	from FI5[2]
	[-32] =	Status word	[-33]…[-37] =	Actual value 1…5	from FI6[2]
	[-38] =	Status word	[-39]…[-43] =	Actual value 1…5	from FI7[2]
	[-44] =	Status word	[-45]…[-49] =	Actual value 1…5	from FI8[2]
	[1] Only bus interface , SK CU4-PNT, SK TU4-PNT [2] Only bus interface , SK TU3-PNT				
Bus interface	**SK TU3-PNT, SK CU4-PNT, SK TU4-PNT**				
Description	Display of the data sent from the bus interface to the IO-Controller.				
Note	Actual values 4 and 5 are only possible with SK 54xE frequency inverters.				

P178	Internal temperature	
Display range	0…2	
Bus interface	**SK CU4-PNT**	
Description	Display of the internal temperature in the associated frequency inverter.	
Display values	**Value**	**Meaning**
	0	No error
	1	Overtemperature warning
	2	Overtemperature error

7.1.4 PROFINET IO information parameters

PROFINET IO information parameters are used to display statuses and settings which are specific to the field bus.

P180	PPO Type	
Display range	0…7	
Arrays	[-01] = Slot 0 (DAP)	
	[-02] = Slot 1 (SAFE)	
	[-03] = Slot 2 (bus interface)	
	[-04]…[-07] = Slot 3…6 (FI1…4)	[-08]…[-11] = Slot 7…10 (FI5…8)[1]
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT	
Description	Display of the currently assigned PPO type	
Note	The PPO type is assigned via the PROFINET IO configuration software.	

Display values

Value	Meaning	
0	Empty slot	
1	Reserved slot	
2	DIG-IO	Process data for bus interface
3	PPO3	Process data for frequency inverter
4	PPO4	Process data for frequency inverter
5	PPO6	Process data for frequency inverter
6	PPO1	Process/parameter data for frequency inverter
7	PPO2	Process/parameter data for frequency inverter

1 Only bus interface SK TU3-PNT

P181	MAC address
Display range	0…255
Arrays	[-01]…[-03] = PROFINET identifier [-04]…[-06] =Manufacturer identifier (Getriebebau NORD GmbH & Co. KG)
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT
Description	Display of the unique MAC address of the bus interface.

P185	Present IP address
Display range	0…255
Arrays	[-01]…[-04]
Bus interface	**SK TU3-PNT, SK CU4-PNT, SK TU4-PNT**
Description	Display of the currently set bus interface IP address.
Note	The IP address which is displayed here may deviate from the IP address which is set in parameter **P160** (in case of addressing by the IO controller).

P186	Present IP subnet mask
Display range	0…255
Arrays	[-01]…[-04]
Bus interface	**SK TU3-PNT, SK CU4-PNT, SK TU4-PNT**
Description	Display of the currently set bus interface sub-net mask.
Note	The sub-net mask which is displayed here may deviate from the sub-net mask which is set in parameter **P161** (in case of addressing by the IO controller).

P187	Present IP Gateway
Display range	0…255
Arrays	[-01]…[-04]
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT
Description	Display of the currently set IP address (parameter **P164**) for the gateway function of the bus interface.

P190	DIP switch status	
Display range	0…8191	
Bus interface	SK TU3-PNT, SK CU4-PNT, SK TU4-PNT	
Description	Display of the current settings of DIP switches 2…12 on the bus interface. DIP switch configuration 🕮 Technical Information/Data Sheet for the bus interface.	
Note	DIP switch 1 :	used as the termination resistor for the NORD system bus and is depicted as "0".
	DIP switches 10...12:	used to set the access rights for remote maintenance (NORD CON software via TCP/UDP):
	DIP 10 =	TCP/UDP Write access to parameter
	DIP 11 =	TCP/UDP control possible
	DIP 12 =	TCP/UDP encryption active

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	
P509	Source Control Word	"3" = System bus	"8" = Ethernet TU	"8" = Ethernet TU	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", "6" or "8"
P513	Telegram timeout	—	O[1]	O[1]	
P514	CAN bus baud rate	"5" = 250 kBaud	"5" = 250 kBaud	"5" = 250 kBaud	
P515	CAN address (Array [-01])	32, 34, 36 or 38	32, 34, 36 oder 38*	32, 34, 36 oder 38*	System bus address
P543	Actual bus value Arrays [-01]…[-03]	O[2]	O[2]	O[2]	Refer to the relevant frequency inverter operating manual
	Actual bus value Arrays [-04]…[-05]	—	—	O[2]	
P543	Actual bus value 1	—	O[2]	—	
P544	Actual bus value 2	—	O[2]	—	
P545	Actual bus value 3	—	O[2]	—	
P546	Function Bus setpoint Arrays [-01]…[-03]	O[2]	—	O[2]	Refer to the relevant frequency inverter operating manual
	Function Bus setpoint Arrays [-04]…[-05]	—	—	O[2]	
P546	Function Bus setpoint 1	—	O[2]	—	
P547	Function Bus setpoint 2	—	O[2]	—	
P548	Function Bus setpoint 3	—	O[2]	—	

* Only necessary if more than one frequency inverter is connected to bus interface SK TU3-PNT.

O[1] Depending on the application: Change the settings according to the requirements of the application.

O[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.

<table>
<tr><th>No.</th><th>Parameter name</th><th>SK TU3</th><th>SK CU4</th><th>SK TU4</th></tr>
<tr><td>P700</td><td>Current error</td><td colspan="3">Array [-01]</td></tr>
<tr><td></td><td>Current warning</td><td colspan="3">Array [-02]</td></tr>
<tr><td></td><td>Reason for switch-on block</td><td colspan="3">Array [-03]</td></tr>
<tr><td>P701</td><td>Last fault</td><td colspan="3"></td></tr>
<tr><td>P740</td><td>Process data Bus In</td><td colspan="3">No display if P509 is set to "0"</td></tr>
<tr><td>P741</td><td>Process data Bus Out</td><td colspan="3"></td></tr>
<tr><td>P744</td><td>Configuration</td><td colspan="3"></td></tr>
<tr><td>P745</td><td>Module version</td><td colspan="2"></td><td>—</td></tr>
<tr><td>P746</td><td>Module status</td><td colspan="2">Possible values:
<table>
<tr><th>Bit</th><th>Meaning</th></tr>
<tr><td>0</td><td>Initialisation (waiting for Application Relation AR)</td></tr>
<tr><td>1</td><td>Application Relation AR established</td></tr>
<tr><td>2</td><td>Reserved</td></tr>
<tr><td>3</td><td>Timeout (P151/P513)</td></tr>
<tr><td>4</td><td>Error 1</td></tr>
<tr><td>5</td><td>Error 2</td></tr>
<tr><td>6</td><td>Error 3</td></tr>
<tr><td>7</td><td>System bus Error / Warning</td></tr>
<tr><td>8…15</td><td>FI1…FI4 status</td></tr>
</table>
Table of errors:
<table>
<tr><th colspan="3">Error</th><th>Meaning</th></tr>
<tr><th>3</th><th>2</th><th>1</th><th></th></tr>
<tr><td>0</td><td>0</td><td>X</td><td>No error</td></tr>
<tr><td>0</td><td>X</td><td>0</td><td>PN timeout</td></tr>
<tr><td>0</td><td>X</td><td>X</td><td>Process data (STW) timeout</td></tr>
<tr><td>X</td><td>0</td><td>0</td><td>CAN hardware error</td></tr>
<tr><td>X</td><td>0</td><td>X</td><td>Ethernet No Link</td></tr>
<tr><td>X</td><td>X</td><td>0</td><td>IO Hardware error</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>Safe hardware error</td></tr>
</table></td><td>—</td></tr>
<tr><td>P748</td><td>CANopen status</td><td colspan="3">Displays the system bus status</td></tr>
</table>

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 Getriebebau 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**	**SK 54xE**
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 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.

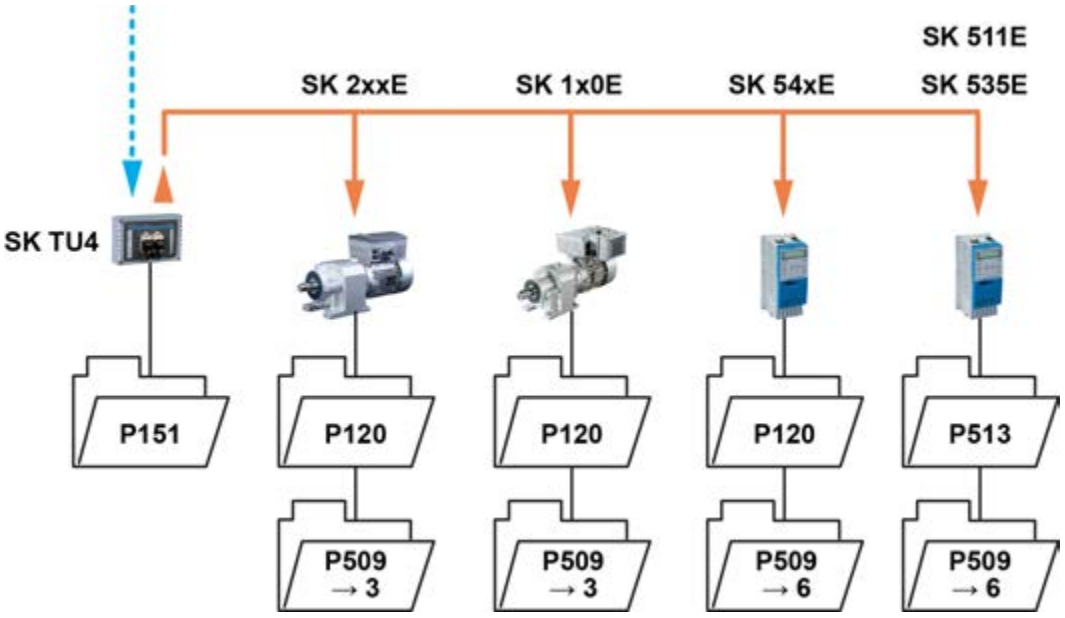


Figure 14: Examples of monitoring parameter settings – SK TU4 bus interface

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

3 = System bus

6 = CANopen

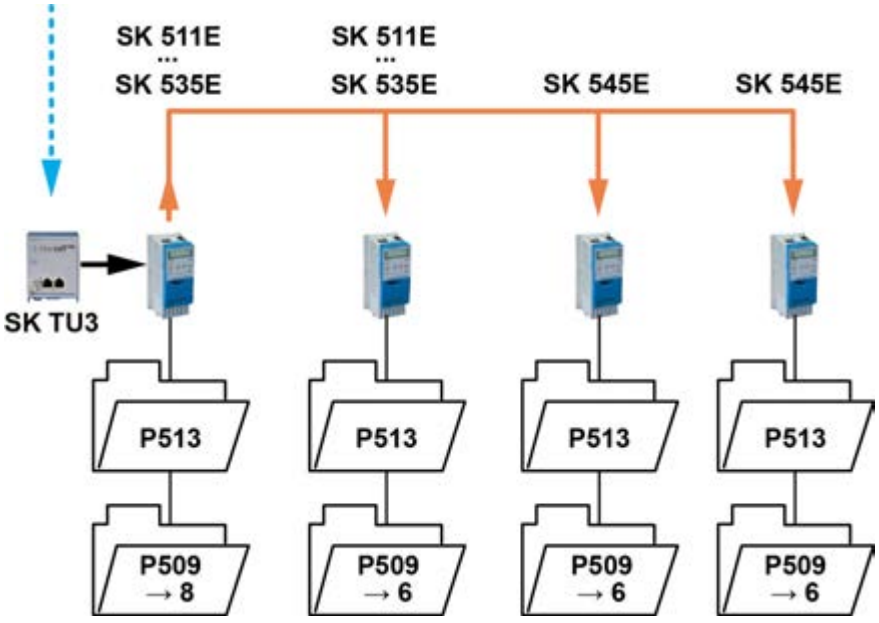


Figure 15: Examples of monitoring parameter settings – SK TU3 bus interface

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

8 = Ethernet TU

6 = CANopen

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.

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.

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 Handling of errors in the bus interface

If an error occurs in the frequency inverters which are connected to the NORD system bus, or in the bus interface, the bus interface sends a diagnostic alarm as "incoming event" to the IO controller. The error value is coded as follows:

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

Example:

Error E10.3 "Timeout by P151/P513" occurs during operation (**P700**, Index 1 = 103). The bus interface sends a diagnostic alarm with the value "359" (= 100h + 103 = 256 + 103 = 359) to the IO controller.

Format	Error number	Alarm code	Alarm number
Decimal	10.3 = 103	256	103 + 256 = 359
Hexadecimal	67h	100h	167h

If an error has been remedied or acknowledged, a diagnostic alarm is sent as a "outgoing event", which resets the error in the IO controller.

Information **Loss of a connected frequency inverter**

If the connection is lost between the bus interface and one of the frequency inverters which are connected to the NORD system bus, an alarm with the error number"1000" is sent to the diagnostic buffer of the IO controller (256 + 1000 = 1256). This error is not saved in P170, but rather is only used for information in case the shut-down of the connected frequency inverter is a part of the application.

Error messages which are generated by the frequency inverter are transferred from the bus module to the field bus level. They do not result in an error of the bus module.

8.4 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
104.0	Overtemp. Module	Only SK CU4-PNT bus interface (see **E10.7**)
550.0	General configuration error	No Ethernet connection (see **E10.5**)
550.1	IO hardware error	Error on IO interfaces (see **E10.4**)
550.2	CAN hardware error	EMC fault (see **E10.6**)
550.3	SAFE hardware error	Error in the safety module
550.4	FI lost	Connection to system bus participant (FI) lost
550.5	AR lost	PROFINET telegram failure, connection to the IO controller lost (see **E10.2**)
564.0	MAC address error	MAC address defective

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	• Contact to bus interface lost
10.2	PROFINET telegram failure	• Check physical bus connections • Check the status of the PROFINET IO controller
10.3	Timeout through **P151**	• System bus monitoring has triggered. – Check time setting parameter **P151** • Telegram transfer is faulty. – Reception of cyclic telegrams • Check physical bus connections
10.4	Hardware error, IOs	• An error has occurred in the IO hardware – Remedy EMC fault – Restart the bus interface
10.5	General PROFINET configuration error	• No Ethernet detected at the port This error only occurs if there had previously been a connection to another IO device or switch
10.6	System bus hardware error	• Remedy EMC fault
10.7	CU4 temperature too high	*Only SK CU4-PNT bus interface:* • Excess bus interface temperature
10.8	Timeout connection error	• Connection between bus interface and frequency inverter interrupted due to timeout.
10.9	Module missing **P120**	*Bus interfaces SK CU4-PNT and SK TU4-PNT only:* • The module entered in parameter **P120** is not available.

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 275271015	Technical Information/Data Sheet for bus interface **SK CU4-PNT** (for IP55 devices)
TI 275271515	Technical Information/Data Sheet for bus interface **SK CU4-PNT-C** (for IP66 devices)
TI 275281115	Technical Information/Data Sheet for bus interface **SK TU4-PNT** (for IP55 devices)
TI 275281165	Technical Information/Data Sheet for bus interface **SK TU4-PNT-C** (for IP66 devices)
TI 275281122	Technical Information/Data Sheet for bus interface **SK TU4-PNT-M12** (for IP55 devices with M12 round plug connectors)
TI 275281172	Technical Information/Data Sheet for bus interface **SK TU4-PNT-M12-C** (for IP66 devices with M12 round plug connectors)
TI 275900190	Technical Information/Data Sheet for bus interface **SK TU3-PNT** (for IP20 devices)
BU 0180	Manual for **SK 1x0E** frequency inverters
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
GSDML file	Device description file for PROFINET IO configuration software
NORD CON	Parametrisation and diagnostic software

Key word index

NORD DRIVESYSTEMS Group

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