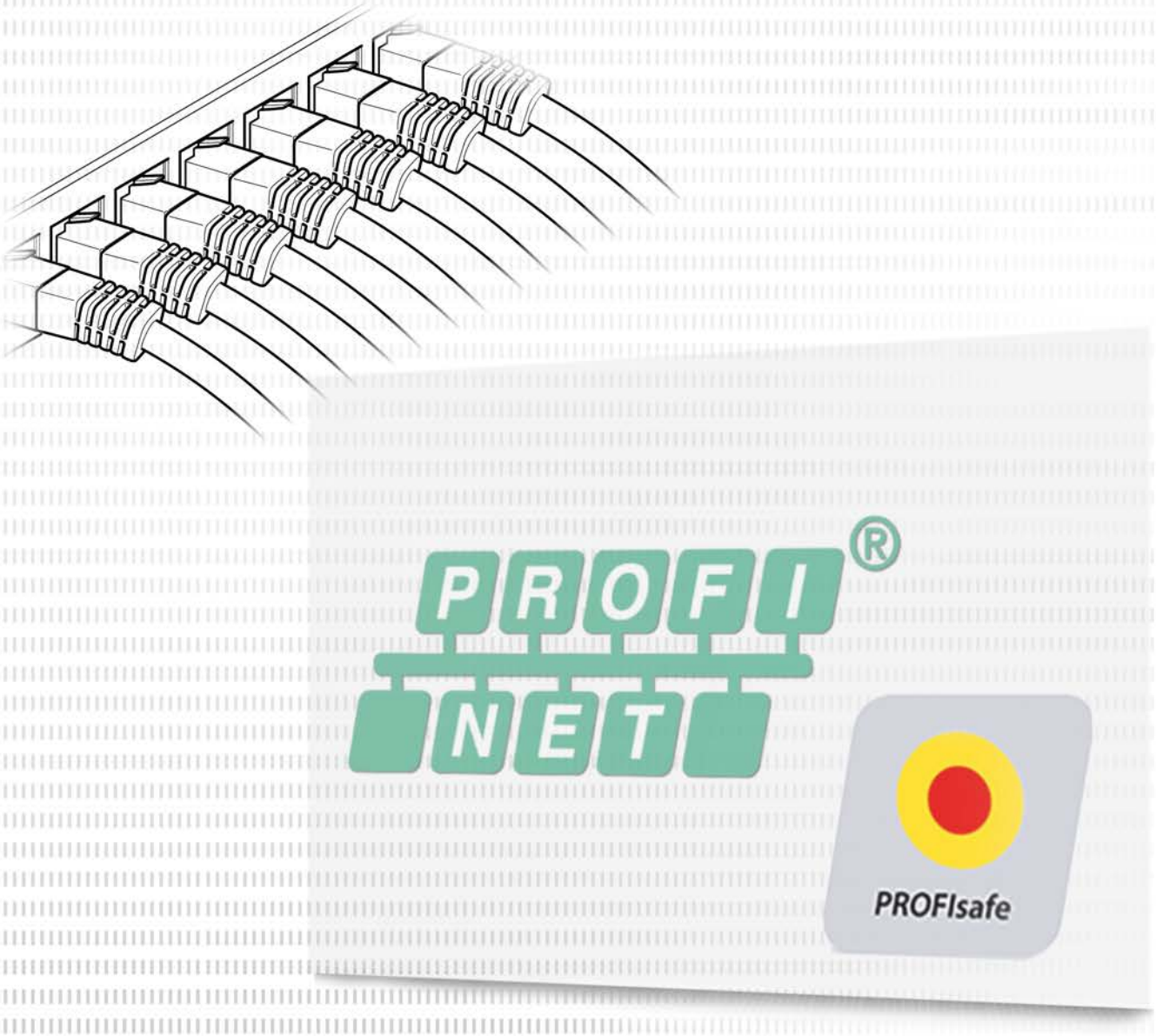


BU 2800 – en

PROFIsafe bus interface

Supplemental manual for frequency inverters

NORD DRIVESYSTEMS

Table of Contents

Table of Contents

1 Introduction 7
1.1 General 7
1.1.1 Documentation 7
1.1.2 Validity of documentation 7
1.1.3 Document history 7
1.1.4 Copyright notice 8
1.1.5 Publisher 8
1.1.6 About this manual 8
1.2 Other applicable documents 8
1.3 Presentation conventions 9
1.3.1 Warning information 9
1.3.2 Other information 9
1.3.3 Text markings 10
1.3.4 List of abbreviations 11
1.3.5 Further terminology 12

2 Safety 13
2.1 Intended use 13
2.2 Selection and qualification of personnel 13
2.2.1 Qualified personnel 13
2.2.2 Qualified electrician 14
2.3 Safety information 14
2.4 Exclusion of liability 14

3 PROFINET IO and PROFIsafe principles 15
3.1 Characteristics 15
3.1.1 PROFINET IO 15
3.1.2 PROFIsafe 17
3.2 Topology 19
3.2.1 Linear topology 19
3.2.2 Star topology 20
3.2.3 Ring topology 21
3.2.4 Tree topology 22
3.3 Bus protocol 23
3.3.1 PROFINET IO 23
3.3.2 PROFIsafe 28
3.4 Description of the function of the PROFIsafe bus interface 29
3.4.1 Schematic structure of the PROFIsafe bus interface 29
3.4.2 Safe inputs and outputs 30
3.4.2.1 Digital inputs 30
3.4.2.2 Digital outputs 31
3.4.2.3 Clock outputs 31
3.4.3 Examples / Implementation 32
3.4.4 Safety functions 33

4 NORD system bus 38
4.1 NORD system bus participants 40
4.1.1 Access to parameters and control options 41
4.1.2 Access via the NORD ParameterBox 41
4.1.3 Access via NORDCON software 42
4.2 Remote maintenance 43

5 Initial setup 44
5.1 Connecting the bus interface 44
5.2 Integration into the bus master 45
5.2.1 PROFINET IO controller 45
5.2.2 PROFIsafe F-Host 45
5.2.2.1 F-Parameters 45
5.2.2.2 Checksum check (CRC) 45
5.2.3 Installing the device description file 46
5.2.4 Format of process data 46
5.3 Addressing the bus interface 47

5.3.1 PROFINET IO field bus address 47
5.3.2 PROFIsafe - F-Address 48
5.4 Example: Commissioning the PROFIsafe bus module 49

6 Data transmission 51
6.1 Introduction 51
6.1.1 Process data 51
6.1.2 Parameter data 51
6.1.3 F-Data 51
6.2 Structure of application data 52
6.3 Transfer of process data 54
6.3.1 Control word 55
6.3.2 Status word 56
6.3.3 Frequency inverter status machine 57
6.3.4 Setpoints and actual values 61
6.3.5 Process data telegrams 63
6.4 Parameter data transmission 65
6.4.1 Structure of acyclic parameter data exchange (Records) 66
6.4.2 Data sets for acyclic parameter requests 67
6.4.3 Data record format 68
6.4.3.1 Parameter ID PKE 68
6.4.3.2 Parameter index IND 71
6.4.3.3 Parameter value PWE 71
6.4.4 Examples of data record transfer 72
6.4.4.1 Telegram structure for parameterisation via PPO1 or PPO2 74
6.5 F-Data transmission 75
6.5.1 F-Parameters 78
6.5.2 Structure of F-Input and F-Output data 79
6.6 Example of setpoint specification 81

7 Parameters 82
7.1 Parameter settings on the bus interface 82
7.1.1 NORD standard parameters 83
7.1.2 PROFINET IO standard parameters 87
7.1.3 NORD information parameters 90
7.1.4 PROFINET IO information parameters 95
7.1.5 PROFIsafe standard parameters 98
7.1.6 PROFIsafe information parameters 106
7.2 Parameter settings on the frequency inverter 109

8 Error monitoring and error messages 110
8.1 Bus operation monitoring function 110
8.2 Resetting error messages 112
8.3 Handling of errors in the bus interface 113
8.3.1 PROFINET IO 113
8.3.2 PROFIsafe 114
8.4 Error messages 115
8.4.1 PROFINET IO 115
8.4.2 PROFIsafe 116

9 Appendix 127
9.1 Repair information 127
9.2 Service and commissioning information 127
9.3 Documents and software 128

List of illustrations

Figure 1: PROFINET IO communication via Application Relation AR 16
Figure 2: Safety data communication 17
Figure 3: Linear topology (example) 19
Figure 4: Star topology (example) 20
Figure 5: Ring topology (example) 21
Figure 6: Tree topology (example) 22
Figure 7: PROFINET IO telegram (communication within a sub-net) 23
Figure 8: PROFINET IO data cycle times 25
Figure 9: PROFIsafe telegrams 28
Figure 10: Bus interface – hardware 29
Figure 11: Monitoring of discrepancy time 30
Figure 12: Example of the structure of a NORD system bus 38
Figure 13: Remote maintenance via Internet (schematic diagram) 43
Figure 14: Structure of the application data area – Telegram traffic 52
Figure 15: Example – PROFINET IP / PROFIsafe device model for decentralised devices 54
Figure 16: Frequency inverter status machine 57
Figure 17: Sequence of acyclic PROFINET IO parameter data exchange 66
Figure 18: F-Data exchange 75
Figure 19: Examples of monitoring parameter settings – SK TU4 bus interface 111
Figure 20: Flashing code – Error example "5713" (Invalid host address) 116

1 Introduction

1.1 General

1.1.1 Documentation

Name: **BU 2800**

Material number **6022802**

Series: **Field bus system PROFIsafe**

1.1.2 Validity of documentation

The documentation is valid for the bus interfaces according to 🕮 Section 2.1 "Intended use". It describes the functionality and the operation of the bus interfaces, and contains notes on integration. The documentation is only valid in its latest version. The documentation's latest version can be found on the Getriebebau NORD GmbH Co. KG website (BU 2800).

1.1.3 Document history

Edition	Order number	Software version	Remarks
BU 2800, March 2018	**6022802**/ 1118	V 1.4 R0	First edition
BU 2800, April 2018	**6022802**/ 1618	V 1.4 R0	Minor corrections
BU 2800, July 2019	**6022802**/ 3019	PROFINET IO: V 2.0 R5 PROFIsafe: V 1.4 R0	• Minor corrections • Consideration of bus interface SK CU4-PNS
BU 2800, January 2021	**6022802**/ 0221	PROFINET IO: V 2.1 R0 PROFIsafe: V 1.5 R0	• Minor corrections • New parameters P806, P831 • New errors 5737, 5738 • Correction of safety integrity level (SIL) for SDI and SOS
BU 2800, August 2021	**6022802**/ 3421	PROFINET IO: V 2.1 R1 PROFIsafe: V 1.5 R0	• Revocation of SIL restrictions for SDI and SOS
BU 2800, November 2021	**6022802**/ 4821	PROFINET IO: V 2.1 R2 PROFIsafe: V 1.5 R0	• Function test (proof test) added • Various corrections

1.1.4 Copyright notice

1.1.5 Publisher

Getriebebau NORD GmbH & Co. KG

Getriebebau-Nord-Straße 1

22941 Bargteheide, Germany

http://www.nord.com/

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

Fax: +49 (0) 45 32 / 289-2253

1.1.6 About this manual

This manual is intended to assist you in the setup of bus interfaces PROFIsafe 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.

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 users are marked as follows:

DANGER

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

WARNING

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

CAUTION

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

NOTICE

This warning information warns of material damage.

1.3.2 Other information

Information

This information shows tips 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	1. 2.	Instructions whose sequence must be complied with are numbered sequentially.
Bullet points	•	Bullet points are marked with a dot.
Parameter	**P162**	Parameters are indicated by a “P” prefix, a three-digit number and bold lettering.
Arrays	[-01]	Arrays are indicated by square brackets.
Factory settings	{ 0.0 }	Factory settings are indicated by curly brackets.
Software descriptions	“**Cancel**”	Menus, fields, windows, buttons and tabs are indicated by quotation marks and bold lettering.

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	🕮 Chapter 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	Frequency inverter of SK 180E series
SK 2xxE	Frequency inverter of SK 200E series
SK 2x0E-FDS	Frequency inverter of SK 250E-FDS series
SK 3xxP	Frequency inverter of SK 300P series
SK 5xxE	Frequency inverter of SK 500E series
SK 5xxP	Frequency inverter of SK 500P series

1.3.4 List of abbreviations

Abbreviations used in this manual

Abbreviation	Meaning
AG	Absolute encoder
AK	Order label/response label
AR	Application Relation
BusBG	Bus module
CR	Communication Relation
CRC	Cyclic Redundancy Check, Checksum check
DIN	Digital Input
DIP	Dual In-line Package, Compact switch group
DO	Digital Output
EMC	Electromagnetic compatibility
I / O	Input/Output
F-Device	Failsafe Device, safety device ("F" stands for "functional safety")
F-Data	Safety data
F-Host	Failsafe Host, safety control
F-Parameter	Safety-relevant parameters (for identification, monitoring, etc.), which must be transferred from the IO controller/F-Host to the bus interface
FI	Frequency inverter
GSDML	Generic Station Description Markup Language
HMI	Human Machine Interface
IND	Index
IP	Internet protocol
I/O	Input, Output
i-Parameters	Individual safety parameters of the bus interface
IW	Actual value
OSSD	Output Signal Switching Device, Safety-relevant switch output
PDO	Process Data Object
PKE	Parameter label
PKW	Parameter label value
PNU	Parameter number
PPO	Parameter/Process Data Object
PWE	Parameter value
PZD	Process data
SDI	Safe Direction, drive monitoring which only allows the enabled direction
SDO	Service Data Object
SIL	Safety Integrity Level**,** safety requirement level (according to IEC 61508/IEC6151)
SLS	Safely Limited Speed, drive monitoring, which triggers an error response (e.g. STO, SS1 etc.) if the speed limit is exceeded
SOS	Safe Operation Stop, drive monitoring which triggers an error response (e.g. STO) if a defined position is departed from
SPI	Serial Peripheral Interface
PLC	Programmable Logical Controller
SS1	Safe Stop 1 (corresponds to Stop Category 1 according to EN 60204), the drive is brought to a standstill in a controlled manner and then STO is activated

Abbreviation	Meaning
SSM	Safe Speed Monitor, drive monitoring in which an error response is triggered by the safety controller if a minimum speed is undershot
SSR	Safe Speed Range, combination of SLS and SSM
STO	Safe Torque Off, corresponds to Stop Category 0 according to EN 60204), immediate interruption of the drive power supply, the drive is shut down in an uncontrolled manner
STW	Control word
SW	Setpoint
TCP	Transmission Control Protocol
USS	Universal serial interface
ZSW	Status word

1.3.5 Further terminology

Specific terminology used in this manual:

Term	Meaning
Re-integratable	After acknowledgement of a bus interface error, the bus interface must be re-integrated, i.e. re-connected to the system. Otherwise it cannot be used. For this, the controller must set the command "Acknowledgement for Reintegration" according to the PROFIsafe specification.

2 Safety

2.1 Intended use

PROFIsafe bus interfaces from Getriebebau NORD GmbH & Co. KG are interfaces for PROFINET IO and PROFIsafe field bus communication. They are used for the communication of the frequency inverters with a fail-safe PLC in an operator's PROFINET IO/PROFIsafe field bus system.

The PROFIsafe bus interfaces have been developed and configured for use with the following frequency inverters from Getriebebau NORD GmbH & Co. KG.

Bus interface	Frequency inverter	Assembly type
SK TU4-PNS	NORDAC *FLEX* (SK 200E) series	Wall mounting or direct mounting on the frequency inverter
SK TU4-PNS-C		
SK TU4-PNS-M12		
SK TU4-PNS-M12-C		
SK CU4-PNS	NORDAC *LINK* (SK 2x0E-FDS) series	Installation in the frequency inverter

Any other use of the bus interface, including its use with frequency inverters other than the above-mentioned ones, 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 NORD DRIVESYSTEM Group 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 1.2 "Other applicable documents".

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".

Before using a fail-safe device, a safety assessment according to the Machinery Directive is required.

For the bus interface as an individual component, functional safety is guaranteed here, but not for the entire machine/system. To achieve the required safety level of the entire machine/system, define the safety requirements and their technical and organisational implementation for the machine/system.

2.4 Exclusion of liability

This technical documentation is for users who wish to use fail safe modules from Getriebebau NORD GmbH & Co. KG. It is solely for information purposes and is only intended for qualified and adequately trained specialist personnel (🕮 Section 2.2 "Selection and qualification of personnel"). The information provides assistance on the subject of safety technology and was compiled and produced in good faith. No claim is made with regard to the completeness of this documentation, in particular for the listing of directives and standards. The technical and schematic diagrams do not constitute binding solutions or application suggestions for the particular application. The illustrated application examples only relate to modules from Getriebebau NORD GmbH & Co. KG. It is the sole responsibility of the user to check and comply with all laws, directives and standards which are relevant for the particular application, design, manufacture and operation of the products. Users act independently at their own responsibility. Getriebebau NORD GmbH & Co. KG accepts no liability or warranties for solutions which are planned by the user.

3 PROFINET IO and PROFIsafe principles

3.1 Characteristics

3.1.1 PROFINET IO

PROFINET IO is a protocol for communication with peripherals 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 via 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:

Name	PROFINET IO bus participant	Task
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	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	Programming device, HMI or PC	PROFINET IO tool 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.

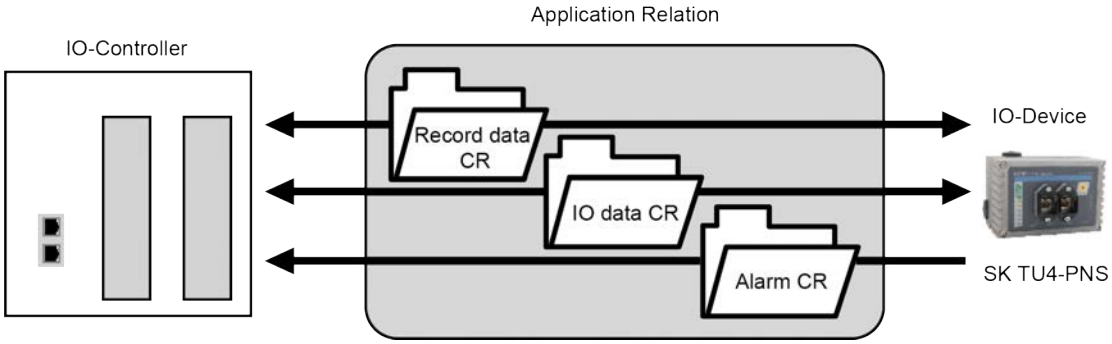


Figure 1: PROFINET IO communication via Application Relation AR

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 used IO controller can communicate.
Transfer rate	100 MBit (Switched Ethernet, Full Duplex)
Update interval	≥ 5 ms (exchange of process data with the frequency inverter)
Conformance class	B, C
Transmission and reception cable	Auto Crossover, Auto Negotiation, Auto Polarity
Wiring	Standard Ethernet cable CAT 5 or better
Cable length	Max. 100 m between two nodes

Information — **Hardware information**

Details of the bus interface (technical data and information for assembly and installation) can be found in the documents for the relevant bus interface(🕮 Section 9.3 "Documents and software").

3.1.2 PROFIsafe

PROFIsafe is an additional safety level on the field bus application layer (PROFINET IO or PROFIBUS) for the reliable transmission of safety-relevant data, in which communication faults are detected and remedied, and safety functions are only triggered if the corresponding faults occur.

PROFIsafe safety data is transferred in the application data of the standard communication (PROFINET IO), independent of the PROFINET IO transmission channel, which is designated as the “Black Channel” below the safety layer.

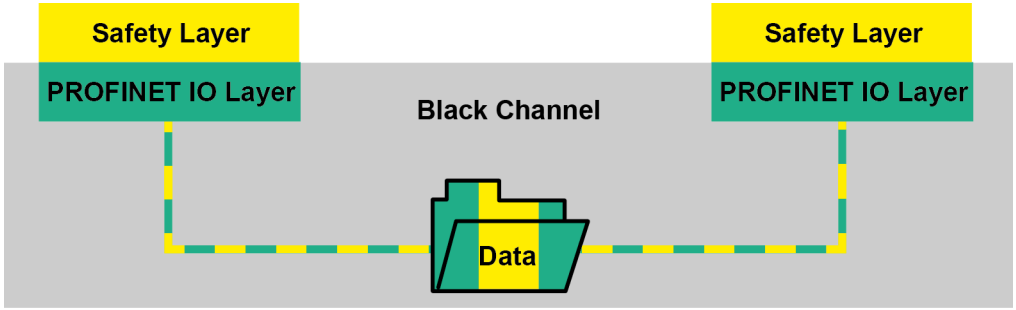


Figure 2: Safety data communication

PROFIsafe can be used for safety applications up to SIL 3 (safety integrity level 3 according to IEC 62061) and is published in Standard IEC 61508.

Performance Level ISO 13849-1	Probability of a hazardous failure per hour	Safety integrity level IEC 62061
a	10^{-4}…10^{-5}	—
b	10^{-5}…3 x 10^{-6}	SIL 1
c	3 x 10^{-6}…10^{-6}	SIL 1
d	10^{-6}…10^{-7}	SIL 2
e	10^{-7}…10^{-8}	SIL 3

In addition to the device requirements of PROFINET IO, PROFIsafe requires the use of a safety controller (F-Host) which ensures the execution of the safety function. The field devices which are used (F-Devices) must support the safety functions.

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

Performance description

Standards	IEC 61508, EN ISO 13849-1
Safety integrity level	Depending on the operating mode. See the details according to the additional documentation for the relevant bus interface. (📖 Section 9.3 "Documents and software")
Performance level	
Processor	Redundant dual-processor system
Voltage supply	From a safely isolated mains unit
Safe digital inputs	2x, with self-test function, two-channel operation, configurable
Safe digital outputs	3x, with diagnostic function (OSSD), two-channel operation, configurable
Safe clock outputs	2x, short circuit-proof, detection of short circuits to the supply voltage, detection of earth faults, time-shifted pulsing of both outputs
Safety functions	SLS, SSR, SDI-P, SDI-N, SOS, SSM
Activation and response time	Adjustable
Encoder	Input for Sin/Cos encoders
Safety communication	Monitoring of process data, sequential numbering of PROFIsafe telegrams (24-bit counter) and checksum test (CRC), watchdog monitoring

Information — **Hardware information**

Details of the bus interface (technical data and information for assembly and installation) can be found in the documents for the relevant bus interface(📖 Section 9.3 "Documents and software").

3.2 Topology

The following topologies will be supported:

3.2.1 Linear topology

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

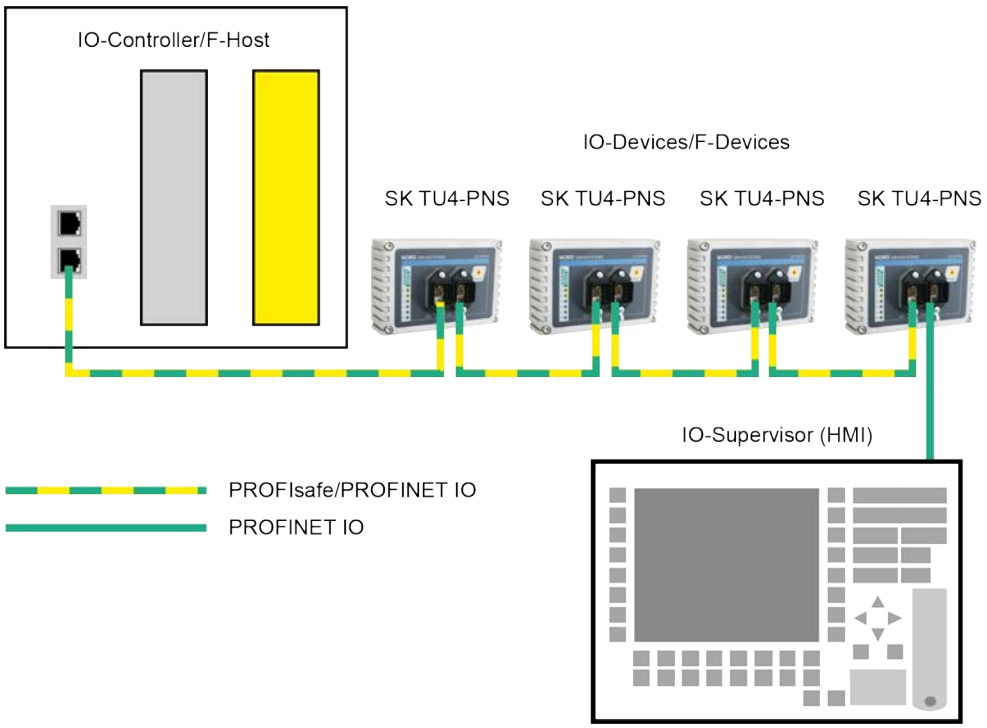


Figure 3: Linear topology (example)

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 bus participants can no longer be accessed.

3.2.2 Star topology

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

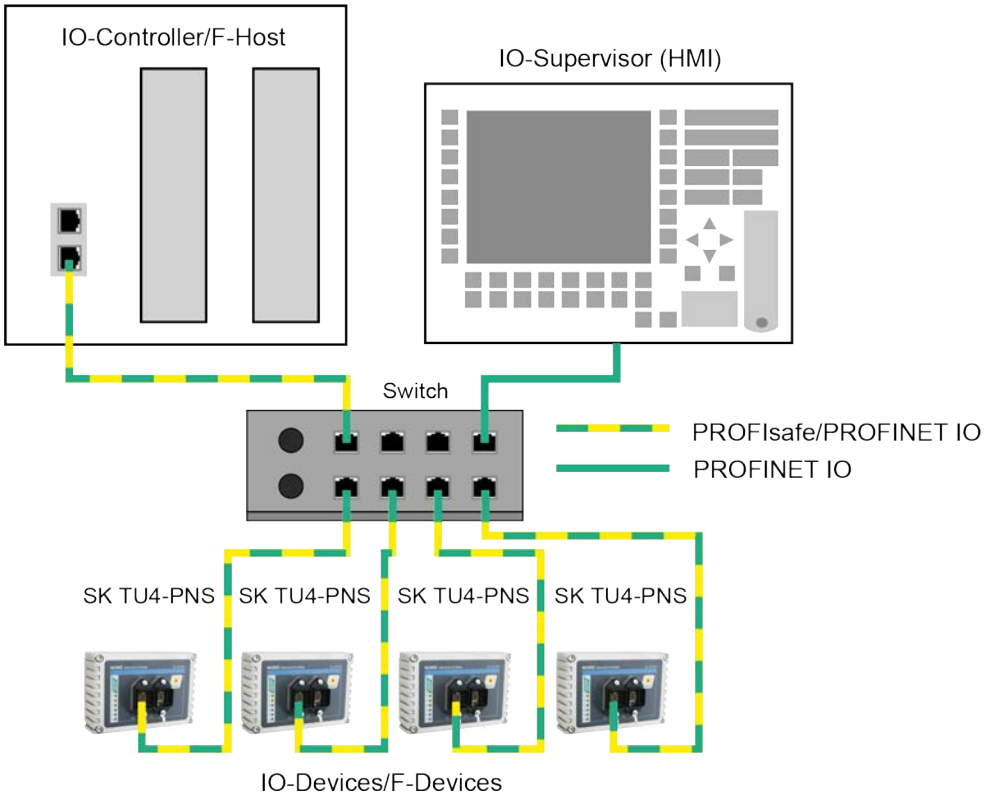


Figure 4: Star topology (example)

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.

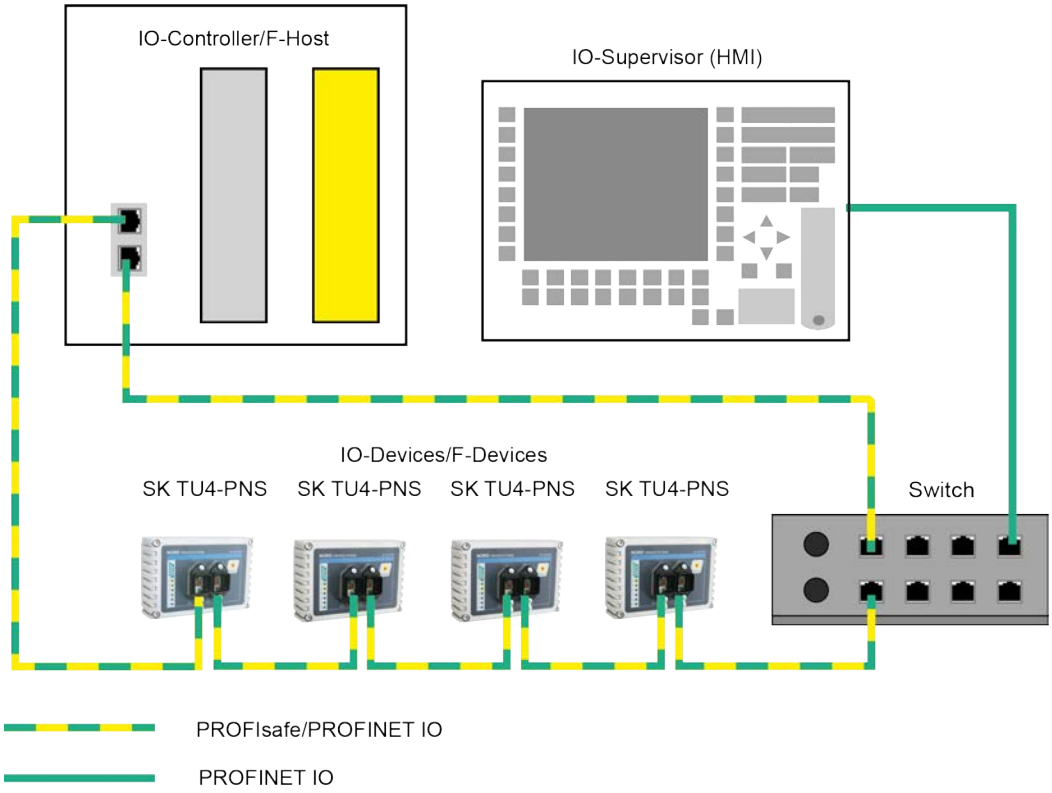


Figure 5: Ring topology (example)

Advantages: 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.

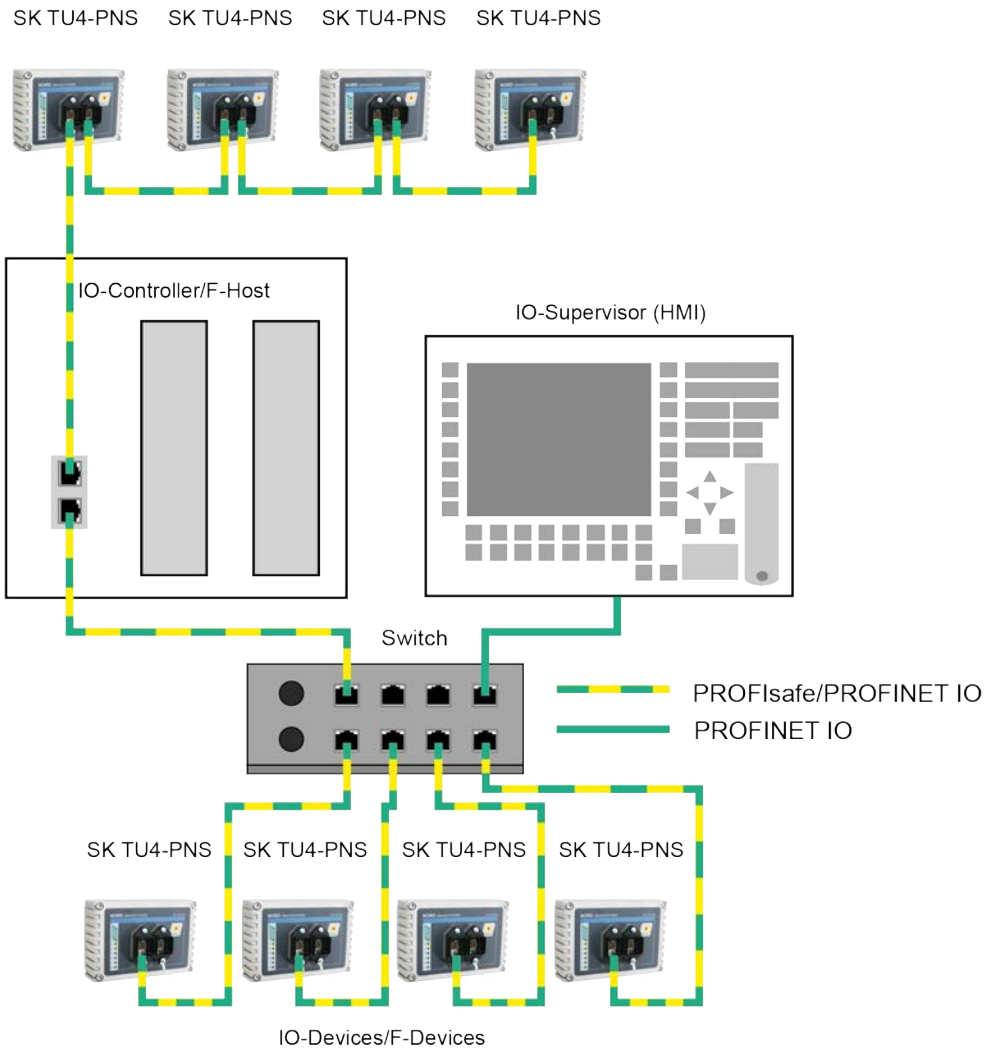


Figure 6: Tree topology (example)

3.3 Bus protocol

3.3.1 PROFINET IO

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".

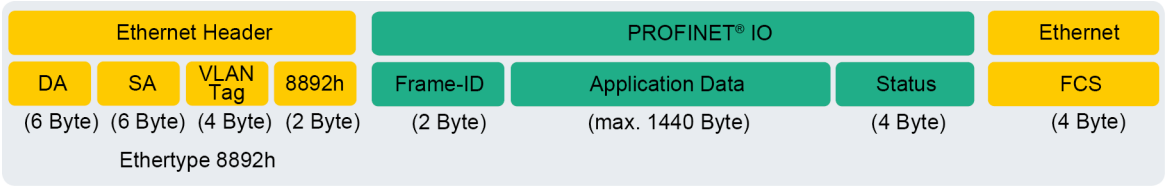


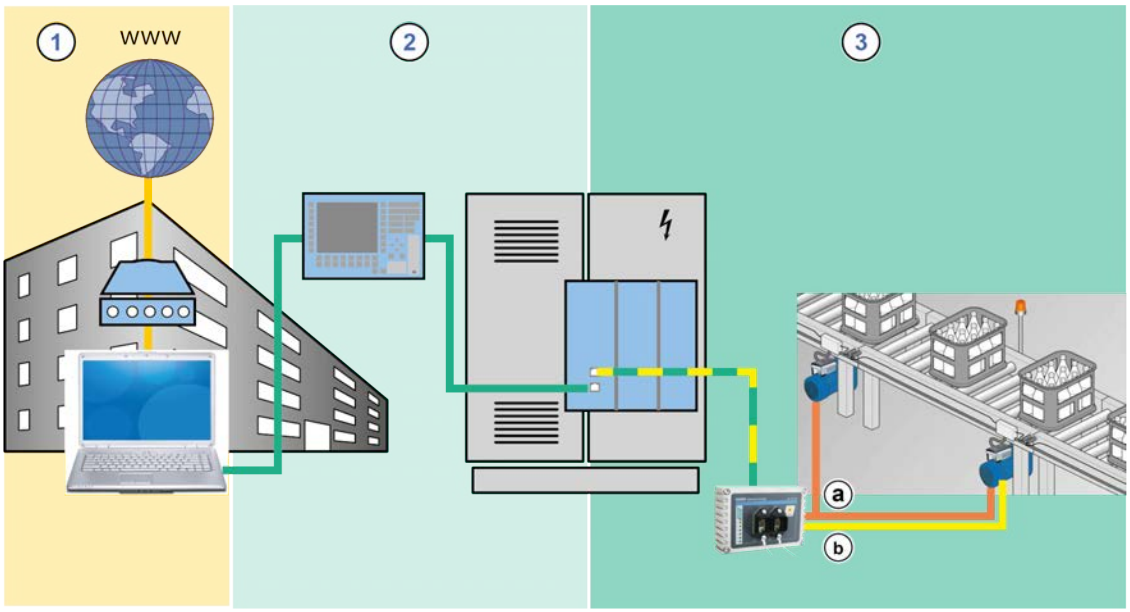
Figure 7: PROFINET IO telegram (communication within a sub-net)

	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

Process data is transferred – cyclically and in real-time – from the IO controller to the IO devices, and vice versa from the IO devices to the process map of the IO controller. As the IO controller transfers the data without a request, the IO devices are informed during system start-up that they are receiving current data in a certain bus cycle.



TCP/IP **RT** **RT, IRT** [1] **(a) System bus** **(b) Safe function**

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

Figure 8: PROFINET IO data cycle times

Item	Description
1	Standard communication (IT services, TCP/IP)
2	Process automation
3	Motion 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 ≥ 5 ms
Safe function	Safe connection between PROFIsafe bus interface and frequency inverter or encoder

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.

3.3.2 PROFIsafe

A PROFIsafe telegram which is to be transmitted is included in the PROFINET IO application data. Either up to 12 bytes of the input and output data are used – in which case a CRC of 3 bytes is used – or 13 to 123 bytes of the input and output data are used – in which case a 4-byte CRC is used. Getriebebau NORD GmbH & Co. KG uses 4 byte input and output data and therefore uses the 3-byte CRC.

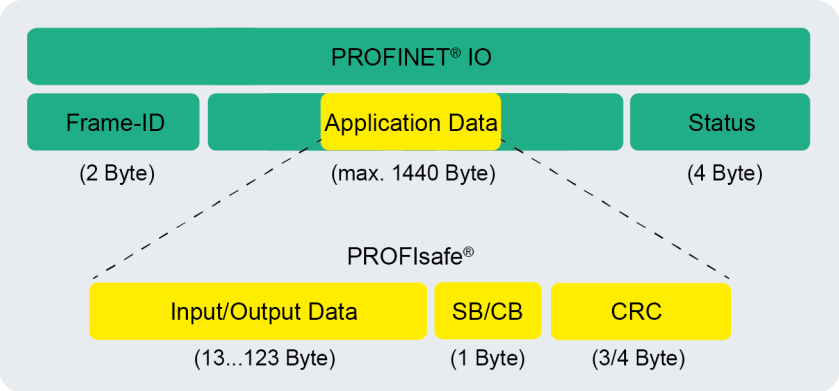


Figure 9: PROFIsafe telegrams

The data frame is supplemented with a control byte (CB = Control Byte) or a status byte (SB = Status Byte). The data package is secured with a checksum (CRC).

Detailed information 🕮 Section 6 "Data transmission".

3.4 Description of the function of the PROFIsafe bus interface

The PROFIsafe bus interface monitors the safe compliance with the limit values and provides safe inputs and outputs. If a limit value is exceeded or undershot, the bus interface switches to a safe state. The voltage is disconnected from the outputs, input information is reset and transmitted to the higher-level PROFIsafe controller (F-Host).

3.4.1 Schematic structure of the PROFIsafe bus interface

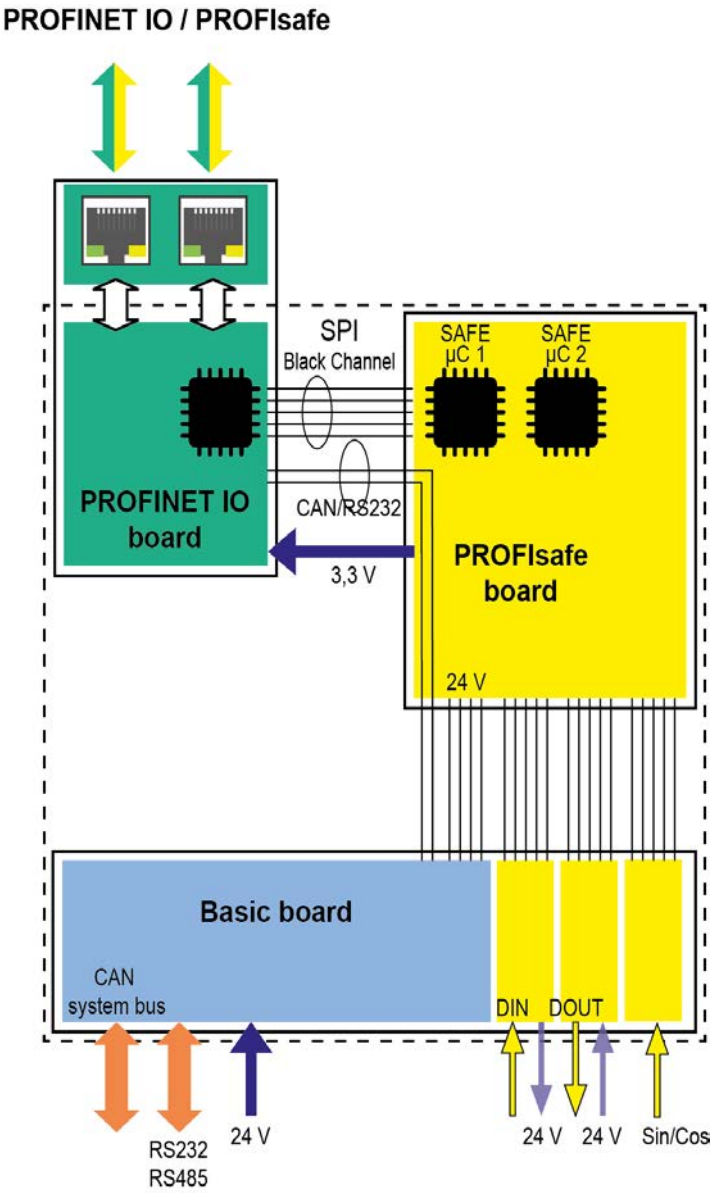


Figure 10: Bus interface – hardware

Communication between the PROFINET IO and the PROFIsafe PCB is via the SPI interface. The safety-relevant data telegrams are transmitted to one of the two SAFE micro-controllers (µC 1 or µC 2) via the so-called "Black Channel". The two micro-controllers are synchronised via the second free SPI channel.

3.4.2 Safe inputs and outputs

3.4.2.1 Digital inputs

The bus interface has two safe single-channel digital inputs, which are combined to form a two-channel input (parameter **P800 I/O operating mode**) The input circuit is reverse polarity protected and is redundantly structured with self-monitoring. The cycle pattern is recognised and monitored (parameter **P806 cycletime monitoring**).

Two channel operation is monitored with an adjustable discrepancy time (parameter **P803 Discrepancy time**)

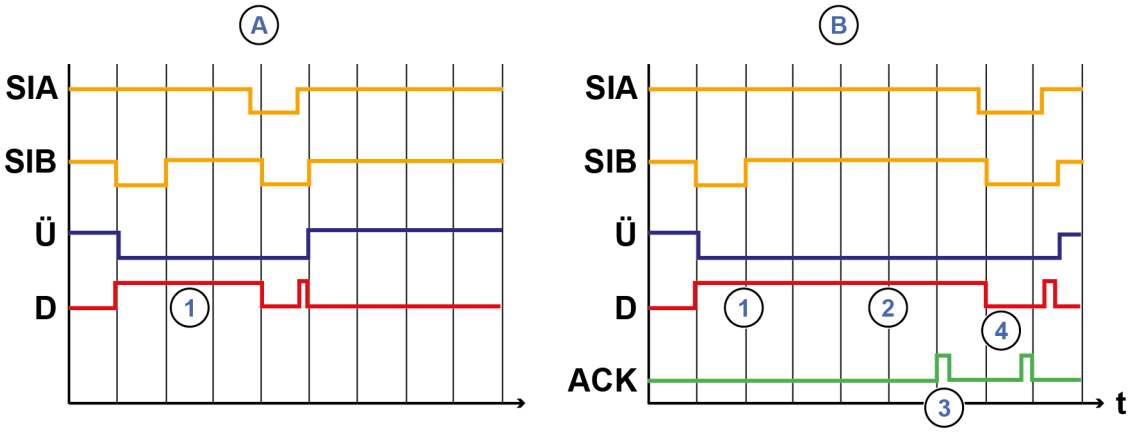


Figure 11: Monitoring of discrepancy time

Item	Meaning
A	Error-free input signals
B	Incorrect input signals
SIA	Safe input, Channel A
SIB	Safe input, Channel B
R	Internal evaluation of safe input
D	Discrepancy monitoring
ACK	Error acknowledgement
1	Discrepancy monitoring enabled
2	Set discrepancy time exceeded
3	Error acknowledgement not permissible
4	Error acknowledgement permissible

3.4.2.2 Digital outputs

The bus interface is equipped with three safe digital outputs (max. output current 0.3 A each):

- Periodic testing of outputs with switch-off test (test pulses).
- The two single-channel outputs SO1 and SO2 can be combined to form a two-channel output (parameter **P800 I/O operating mode**).
- “P” switching output circuit (i.e. the GND line is not switched).

Function test on the single-channel output (proof test)

WARNING

No automatic test if the single-channel output is switched off

If the single-channel output is switched off, it cannot be tested automatically.

- If the user cannot make sure that the output has been switched on within the test interval, take measures to detect faults on the output.

When using the bus interface and an output in permanently switched-off state, it must be checked if the output is working properly.

This proof test includes the following actions:

1. Switch on the single-channel output within the test interval (see table below).
2. The internal diagnosis of the activated output is enabled and allows for the detection of faults.
   – If no fault is detected, the proof test was successful.
   – If an error occurs during the function test, the module must be replaced.

   WARNING! If an error occurs during the function test, the module may no longer be able to be switched off.

Test interval according to DIN EN 61800-5-2

Safety integrity level	Performance level	Test interval
SIL 2	PL d / Category 3	1 time per year
SIL 3	PL e / Category 3	1 time every 3 months
SIL 3	PL e / Category 4	Daily

Information

If the user can make sure that the output has been switched on within the test interval, no proof test is required.

3.4.2.3 Clock outputs

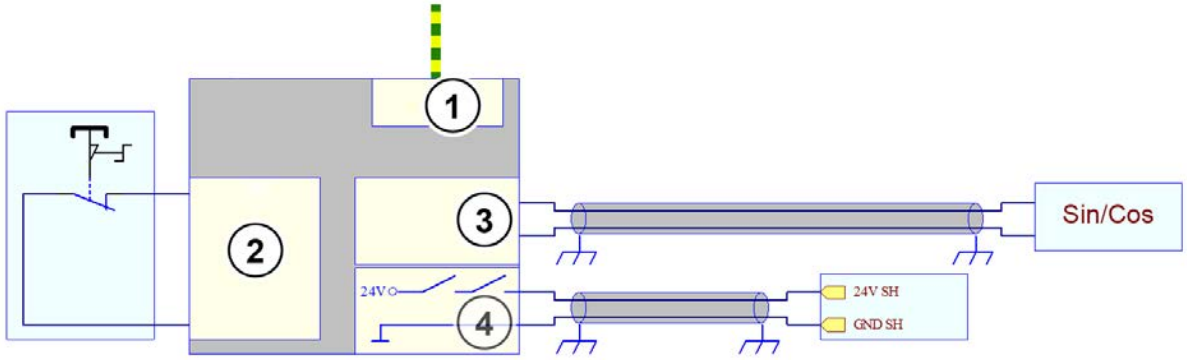
The bus interface is equipped with two clock outputs, which are used for monitoring connected devices (e.g. passive sensors such as EMERGENCY STOP switches) using the safe inputs. The clock outputs are short circuit-proof. In order to detect cross short-circuits, the clock outputs are pulsed with a time shift. Short circuits to the supply voltage and earthing faults are detected. Parameter P806 can be used to assign the clock outputs to a safe input. The pulse pattern is checked for plausibility.

3.4.3 Examples / Implementation

The following example illustrates a solution for connecting the PROFIsafe interface to a frequency inverter.

Safe input (single channel) / Safe output (single channel) / Sin/Cos encoder function

Emergency stop button	PROFIsafe bus interface	Shielded cables [1]	Frequency inverter [2]	Safe encoder
			Use of Safe Pulse Block	



1) Shielded cables to exclude faults as per DIN EN ISO 13849-2

2) See supplementary manual on functional safety of the frequency inverter:
BU0230 (NORDAC *FLEX* (SK 2xxE series))
BU0235 (NORDAC *LINK* (SK 2x0E-FDS series))

1	PROFIsafe cable connection
2	Input circuit with cross-circuit detection Example: Clock 1 on SI1: Single-channel input with cycle evaluation
3	Safe encoder connection
4	Safety output Example: SO3: Single-channel output

Information

Note on wiring a single-channel output (SIL 3)

With an exclusion of faults according to ISO 13849-2 (2013) and/or IEC 60204-1, and with a proof test performed by the customer (see 🕮 Section 3.4.2.2 "Digital outputs"), a single-channel output can be upgraded to SIL CL 3, PL e.

3.4.4 Safety functions

Information

Fail-safe encoder

The safety functions described below require the mandatory use of a fail-safe encoder.

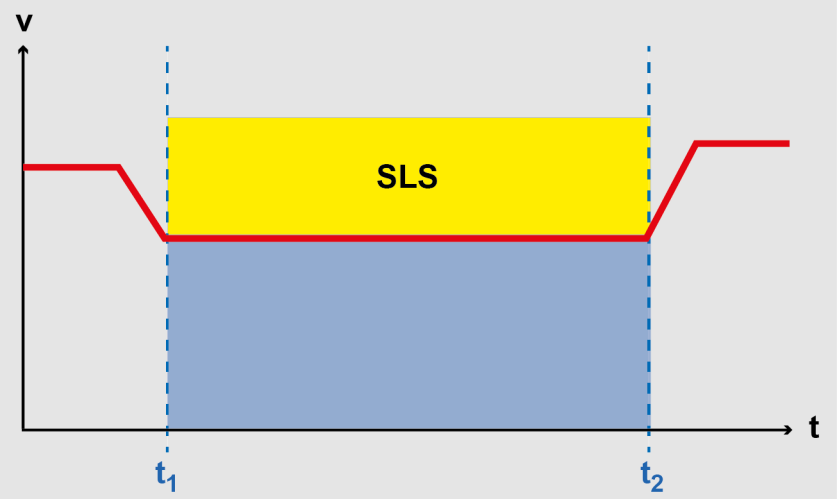
Information

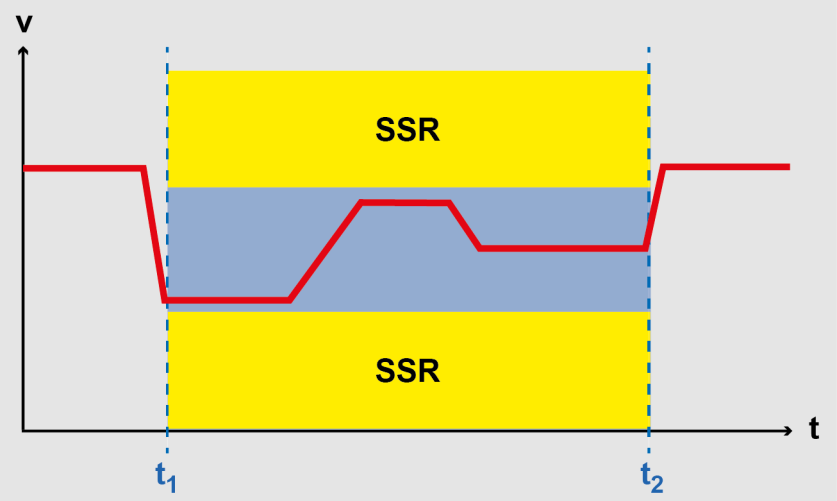
Use of safety functions

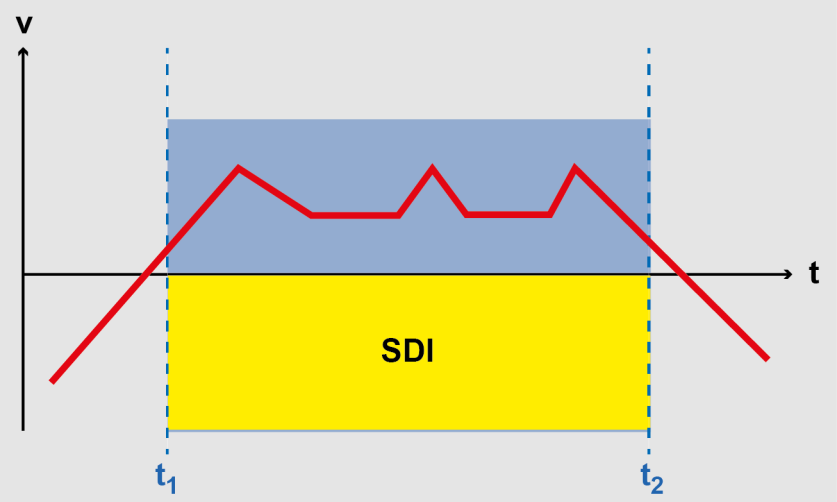
In order to be able to use the safety function SLS, SSR, SDI and SOS, they must also be enabled by the safety PLC via the F data. If a safety function is enabled without having been switched on accordingly, an error is triggered

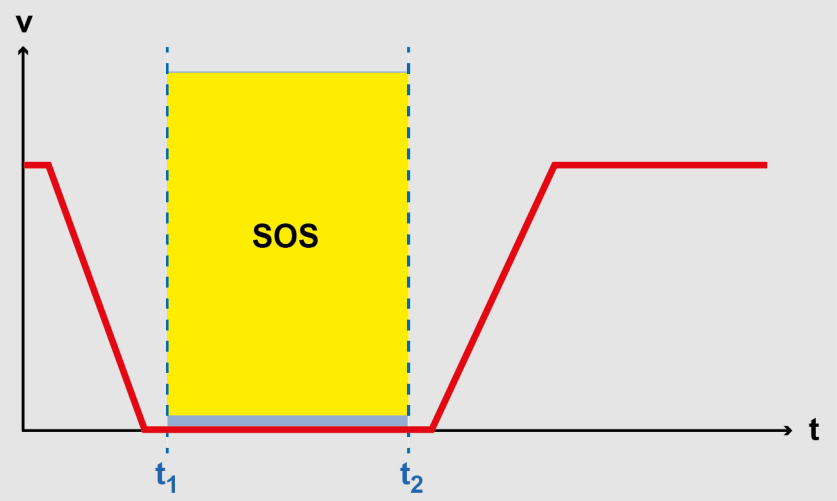
The bus interface supports the following safety functions (drive safety functions according to EN IEC 61800-5-2:2007). Selection and setting of the safety functions is made with the parameters **P820**…**P824** (📖 Section 7.1.5 "PROFIsafe standard parameters")

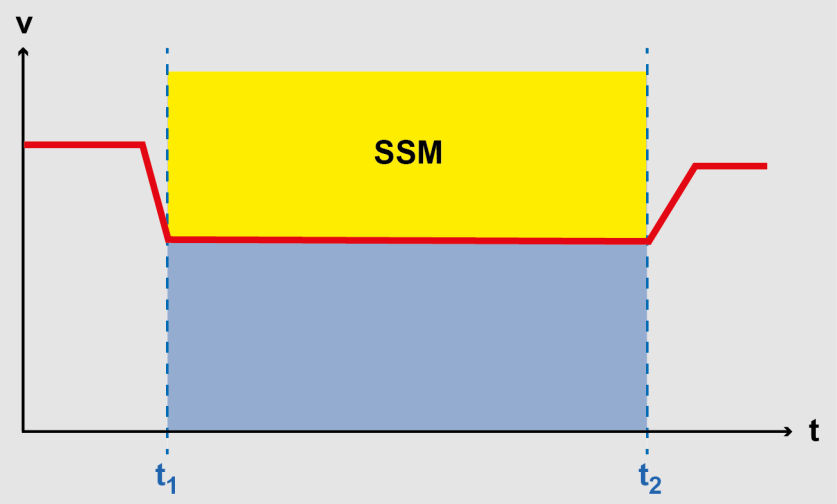
For specialists, the English names are normally used for identification, even in the German-speaking area.

SLS	**Safely Limited Speed**
Description	The bus interface monitors compliance with the set limited speed of the drive. If the speed limit is exceeded, an appropriate error response is triggered (triggering of the safety function). Up to four different speed ranges to be monitored can be defined (SLS-0, SLS-1, SLS-2, SLS-3).
Function	The speed value is monitored.
	
Error response	If the speed exceeds the set speed limit, an error message is transmitted to the control via the F-Data (safety data). If passivation of the module is set as the error response (parameter **P801 Error response**), the bus interface goes into the safe condition. The bus interface can be re-integrated when 10 seconds have elapsed after the triggering of the error.
Parameters	**P820 Safety function**, **P821 Activation time**, **P822 Reaction time**, **P823 Speed limit**

SSR	Safe Speed Range
Description	The bus interface monitors compliance with the set limited speed range of the drive. If the speed limit is exceeded or undershot an appropriate error response is triggered (triggering of the safety function).
Function	The value of the speed is monitored.
	
Error response	If the speed exceeds or undershoots the speed range which is set, an error message is transmitted to the controller via the F-Data (safety data). If passivation of the module is set as the fault response (parameter **P801 Fault response**) the bus interface goes into the fail safe condition. When 10 seconds have elapsed after the triggering of the fault, the bus interface can be re-integrated.
Parameters	**P820 Safety function**, **P821 Activation time**, **P822 Response time**, **P823 Speed limit**

SDI-P, SDI-N	Safe Direction, positive, negative (safe direction of movement)
Description	The bus interface monitors compliance with the set direction of movement. If an incorrect direction is detected, an appropriate error response is triggered (triggering of the safety function).
Function	The direction of movement is monitored.
	
Error response	If an incorrect direction of movement is detected, an error message is transmitted to the controller via the F-Data (safety data). If passivation of the module is set as the fault response (parameter **P801 Fault response**) the bus interface goes into the fail safe condition. The bus interface can be re-integrated when 10 seconds have elapsed after the triggering of the fault.
Parameters	**P820 Safety function**, **P821 Activation time**, **P822 Response time, P824 Max. position error**
Note	With parameter **P824 Max. position error** a permissible position deviation can be set for this safety function.

SOS	Safe Operating Stop
Description	The bus interface monitors compliance with a position within a defined range. If the range is exceeded, an appropriate error response is triggered (triggering of the safety function).
Function	The position is monitored.
	
Error response	If the set position range is exceeded, an error message is transmitted to the controller via the F-Data (safety data). If passivation of the module is set as the fault response (parameter **P801 Fault response**) the bus interface goes into the fail safe condition. The bus interface can be re-integrated when 10 seconds have elapsed after the triggering of the fault.
Parameters	**P820 Safety function**, **P821 Activation time**, **P824 Max. Position error**

SSM	Safe Speed Monitor
Description	The bus interface monitors compliance with the minimum speed. If the speed limit is exceeded, an appropriate error response is triggered. The higher-level control is responsible for triggering the safety function.
Function	The speed value is monitored.
	
Error response	If the set speed limit is exceeded, an identifier is transmitted to the control via the F-Data (safety data). Even if passivation of the module is set as the error response (parameter **P801 Error response**), the bus interface does **NOT** go into the safe condition.
Parameters	**P822 Reaction time**, **P823 Speed limit**
Note	The safety function **SSM** is permanently enabled.

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.

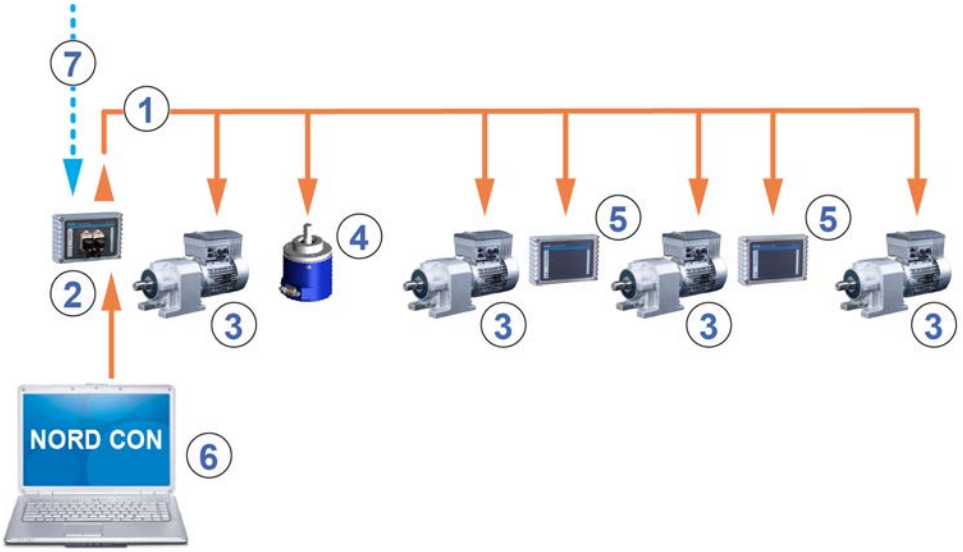


Figure 12: Example of the structure of a NORD system bus

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

Information

Fail-safe communication

There is **no** fail-safe communication via the system bus. Fail-safe communication is carried out exclusively via the corresponding IOs (safe inputs/safe outputs).

Due to the maximum permissible current capacity of the safe outputs of the bus interface, just one safe input (STO) of a frequency inverter can be controlled by each safe output.

From this, the following application options result for **SK TU4-PNS-**… fail-safe bus interfaces:

- Control of the safe input (STO) of a frequency inverter by a safe output (SO1 or SO2 or SO3) of the bus interface. Thus, up to 3 frequency inverters can be safely controlled by a bus interface.
- Evaluation of a safe encoder for safe speed monitoring by the bus interface and control of the safe input (STO) of a frequency inverter by a safe output (SO1 or SO2 or SO3) of the bus interface. Thus, up to 3 frequency inverters can be safely controlled by a bus interface.
- Evaluation of a safe encoder for speed control by the frequency inverter and for safe speed monitoring by the bus interface. Thus, just one frequency inverter can be safely controlled by a bus interface.

The following deviations apply to the **SK CU4-PNS** fail-safe bus interface compared to **SK TU4-PNS-**…:

- The safe output SO3 is directly used for the control of the safe input (STO) of the frequency inverter in which the module is installed. Thus, only the safe outputs SO1 and SO2 are available for the control of up to two more frequency inverters.

4.1 NORD system bus participants

Possible number of bus nodes on one system bus:

	Decentralised frequency inverter
	SK 2xxE (-FDS)
Frequency inverter	4
Input/output extensions	8
CANopen encoder	4
Bus interface	1
NORDCON computer	1

All participants on the NORD system bus must be assigned a unique address (CAN ID). The bus interface's address is set at the factory and cannot be changed. Connected IO extensions must be assigned to the frequency inverters (📖 Technical information/data sheet for the respective IO extension). Depending on the device, the addresses of the frequency inverters and the connected absolute encoder are set via parameter **P515 CAN bus address** or via DIP switches.

If absolute encoders are used, they 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	FI1	AE1	FI2	AE2	…
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 bus baud rate**). This also applies to any absolute encoders which are connected.

4.1.1 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.

4.1.2 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).

  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.

4.1.3 Access via NORDCON software

Access via the NORDCON software (🕮 Manual BU 0000) can be obtained by several methods:

- Connection of the NORDCON computer to a frequency inverter for **point-to-point USS bus communication**. The NORDCON software only communicates with the frequency inverter to which it is connected.
- Connection of the NORDCON 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 NORDCON computer to a bus interface or frequency inverter for **system bus communication (CANopen)** with a maximum of 32 participants (31 devices plus NORDCON). This requires an installed system bus:
  - Wired,
  - Termination resistors set,
  - System bus participants addressed, USS addresses set to the factory setting ("0"). If the NORDCON 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 NORDCON software is connected acts as a gateway.

4.2 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.

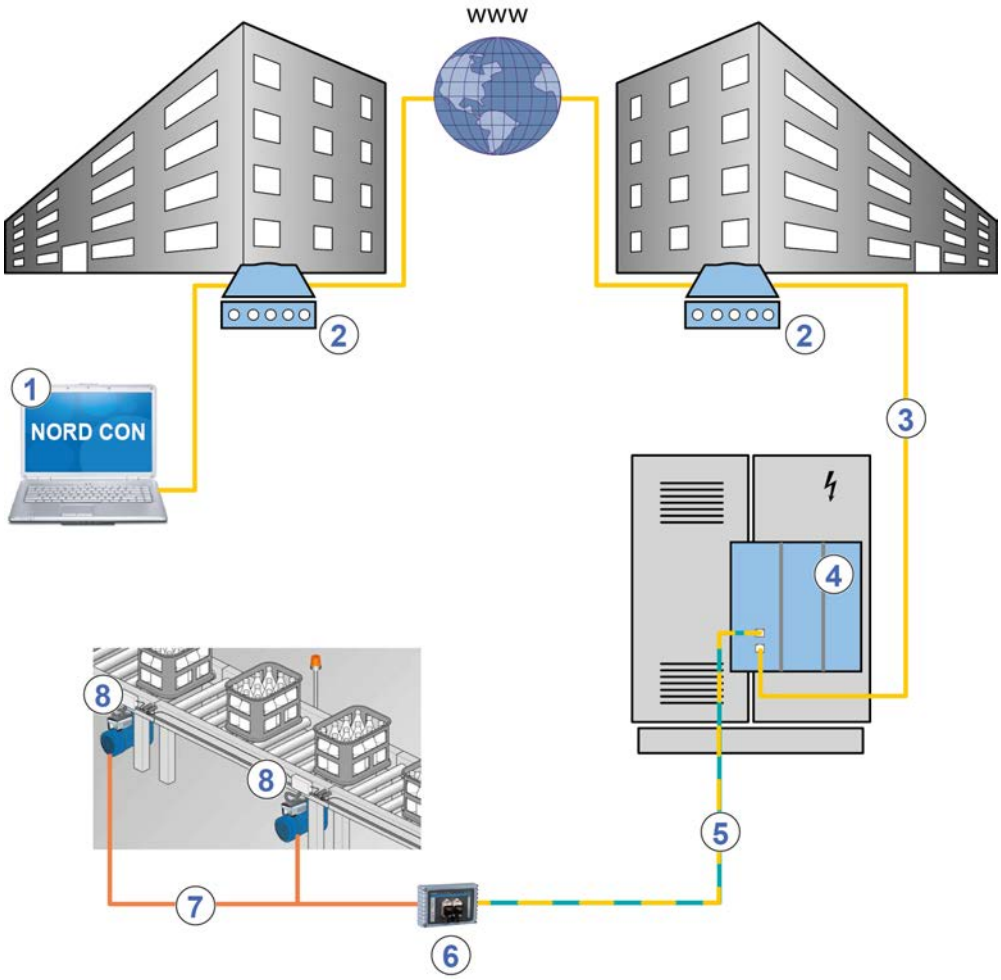


Figure 13: Remote maintenance via Internet (schematic diagram)

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	Section 5.3 "Addressing the bus interface"
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 5.4 "Example: Commissioning the PROFIsafe 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

Connection of the bus interface to the frequency inverter and the PROFINET IO-/PROFIsafe field bus is described in the relevant technical information:

Bus interface	Frequency inverters	Documentation
SK TU4-PNS	Series NORDAC *FLEX* (SK 200E)	Technical Information/Data Sheet TI 275281116
SK TU4-PNS-C		Technical Information/Data Sheet TI 275281166
SK TU4-PNS-M12		Technical Information/Data Sheet TI 275281216
SK TU4-PNS-M12-C		Technical Information/Data Sheet TI 275281266
SK CU4-PNS	Series NORDAC *LINK* (SK 2x0E-FDS)	Technical Information/Data Sheet TI 275271014

5.2 Integration into the bus master

5.2.1 PROFINET IO controller

For communication with the bus interface, the bus master (PLC project of the IO controller) must first be configured. The configuration must be produced with a software system for PROFINET IO field bus systems (e.g. “TIA Portal” from Siemens AG).

For integration of NORD frequency inverters into the Siemens AG SIMATIC Manager, Getriebebau NORD GmbH & Co. KG provides KG TIA modules, which can be used for both PROFINET IO- as well as for PROFIBUS field bus systems (🕮 Manual BU 0950).

5.2.2 PROFIsafe F-Host

The PROFIsafe safety controller (F-Host) must specify the basic communication parameters for the PROFIsafe communication for the exchange of safety-relevant data with the bus interface. This is done by setting the so-called "F-parameters" which are read in with the NORD device description file (🕮 Section 5.2.3 "Device description file installation").

In addition, a checksum check (CRC) for the so-called "i-parameters" (PROFIsafe standard parameters for the bus interface, (🕮 Section 7.1.5 "PROFIsafe standard parameters")) must be configured in the safety PLC. If the calculated checksum does not match the checksum which is calculated by the NORD CON software, an error is triggered (🕮 Section 8 "Error monitoring and error messages")

5.2.2.1 F-Parameters

Detailed description of the F-Parameters and the F-Parameter telegram structure 🕮 Section 6.5 "F-Data transmission")

5.2.2.2 Checksum check (CRC)

After setting the i-parameters with the NORD CON software, the checksum of the i-Parameters must be read out and transmitted to the safety controller. Readout of the checksum is carried out with parameter **P840 I-Para CRC**, transmission of the value to the bus interface is carried out via parameter **P830 Save I-Para** (🕮 Section 7.1.5 "PROFIsafe standard parameters").

5.2.3 Installing the device description file

The functionality and the device characteristics of the bus interface are described in a device description file (GSDML file). This file contains all the relevant data which are of importance for both the engineering and the exchange of data with the bus interface.

The current device description file can be obtained from our website www.nord.com directly from the link Fieldbus Files by selecting the "PROFINET" option.

GSDML Version	550 P	TU4-PNS	CU4-PNS	TU4-PNT (V1.x)	TU4-PNT (V2.x)	CU4-PNT (V1.x)	CU4-PNT (V2.x)	TU3-PNT (V1.x)	TU3-PNT (V2.x)
V2.35	X	X	X		X		X		X
V2.25				X	X 1)	X	X 1)	X	X 1)

1) reduced function range (error numbers in plain text)

Sequence

1. Install the GSDML file in the configuration software.
2. Create the hardware configuration (project) in the configuration software.
3. Drag (insert) the required bus interface into the project from the hardware catalogue.
   - After insertion of each individual bus interface the frequency inverter **FI1** is planned.
   - If several frequency inverters are used, this must be configured in the configuration software. For this, the corresponding modules must be dragged from the hardware catalogue into the slots of the planned hardware configuration.

5.2.4 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").

5.3 Addressing the bus interface

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

5.3.1 PROFINET IO field bus address

The following bus interface parameters are relevant for establishing communication via PROFINET IO:

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

Only the assignment of the device name (**P162**) by the commissioner is necessary. Assignment of the IP address data (**P160, P161, P164**) is normally carried out automatically by the IO controller.

Requirement

- The PROFINET IO field bus system has been installed and commissioned according to the manufacturer's instructions.
- Access to the bus interface parameters is possible (a ParameterBox (📖 BU 0040) or a NORD CON computer are available (📖 BU 0000)).

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. With the aid of the ParameterBox or the NORD CON software, call up the parameter**P162 Device name** of the bus interface, enter the device name and save this.

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 a 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).

In addition, the IP address data can be parameterised in the bus interface as follows:

3. With the aid of the ParameterBox or the NORD CON - software, call up the parameter**P160 IP address** of the bus interface, enter the IP address and save this.

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 "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.

4. Enter parameter **P161 IP subnet mask**, enter the IP subnet mask and save.

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 "0". 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.

5. Enter Parameter **P164 IP gateway**, enter the IP address for the gateway function and save.

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 "0". In this case, the currently set IP address can be obtained via parameter **P187**.

5.3.2 PROFIsafe - F-Address

To ensure that safety-relevant components have a unique communication relationship, an F-Address must be assigned to the PROFIsafe bus interface.

To transfer safety-relevant data, with each data package, the bus interface transmits the F-Address, which is checked by the F-Host (comparison via F-Parameter). The cyclic exchange of the safe process data is only started if the matching data set for the F-Address has been received.

The F-Address is set via DIP switches (🕮 Technical information/Data sheet) or via parameter **P831**.

Information

F-Parameter “F_Dest_Add”

The F-Address, which is set via the DIP switch must match the value of the F-Parameter “F_Dest_Add” in the configuration project of the F-Host.

The F-Address is read in by the bus interface itself when the bus interface is connected to the power supply (“POWER ON”).

The F-Address which is set can be read out via the parameter **P846 Status Dip-switches** (🕮 Section 7.1.6 "PROFIsafe information parameters").

5.4 Example: Commissioning the PROFIsafe bus module

The following example contains an overview of the necessary steps for commissioning the bus interface in a PROFINET IO / PROFIsafe 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-PNS	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
PROFIsafe	1	Set the F-Address for safe communication with the F-Host.	Set DIP switches 2-9 (of 12) on the bus interface or set F-Address via **P831**.
NORD system bus	2	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.
	3	Set up system bus.	A 24 V supply is required! (🕮 Technical Information for the bus interface)
	4	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.
	5	Set the system bus baud rate.	Set "250 kBaud" on FI 1 to FI 3 as well as on AG 1 to AG 3.
	6	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)

Communication	Step		Explanation
			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 word
PROFINET IO and PROFIsafe	7	Set up the bus interface for field bus communication.	🕮 Sections 5.1 "Connecting the bus interface"to 5.3 "Addressing the bus interface"
PROFINET IO	8		Set the following parameters on the bus interface (🕮 Section 7.1.1 "NORD standard parameters"):
			P151 200 ms (Timeout external bus)
PROFIsafe	9	Set up the bus interface for safe field bus communication.	Set the following parameters on the bus interface (🕮 Section 7.1.5 "PROFIsafe standard parameters"):
			P800…P830
NORD system bus	10	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)
	11	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)
			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	12	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"

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 as well as safety -relevant data (F-Data) are exchanged.

The F-Data are transmitted in the application data of the PROFINET IO communication, independent from the PROFINET IO channel.

6.1.1 Process data

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

📖 Section 6.3 "Transfer of process data".

6.1.2 Parameter data

- Parameter data are the setting values and device data for the bus interface and the connected frequency inverter.
- Transfer of the parameter data is carried out 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".

6.1.3 F-Data

- F-Data (safety data) are process and parameter data of the bus interface and the connected frequency inverter, which are transmitted in order to comply with the limit values and trigger application-related safety functions.
- The exchange of F-Data is performed cyclically with priority, or as necessary (due to an event), between the safety controller (F-Host) and the bus interface (F-Device).

📖 Section 6.5 "F-Data transmission".

6.2 Structure of application data

The cyclic exchange of application data between the IO controller and the frequency inverter or the safety controller (F-Host) is carried out via two areas:

- PKW area = **P**arameter **L**abel **V**alue (parameter level)
- PZD area = **Pro**cess**D**ata (process data level)

The PROFIsafe safety data are included in the PROFINET IO application data and transmitted via a separate channel ("Black Channel" principle).

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

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

An access always consists of an order and a response telegram. In the order telegram, the application data from the IO controller/F-Host are transferred to the IO device/F-Device. In the response telegram, the application data is transferred from the IO device/F-Device to the IO controller/F-Host.

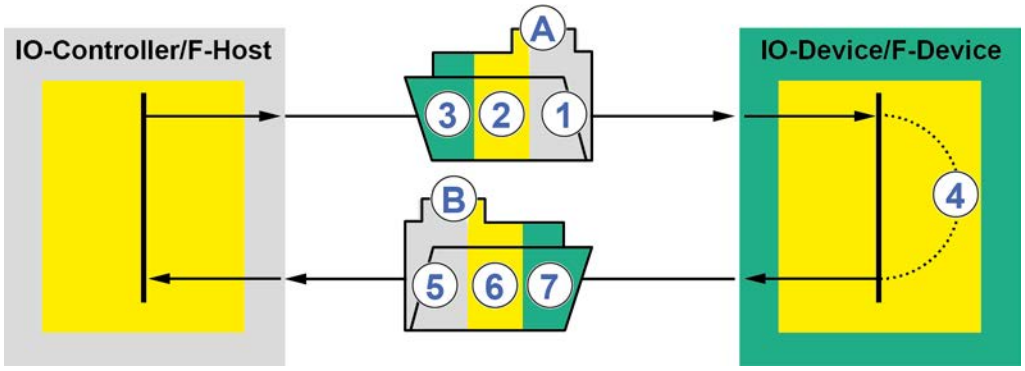


Figure 14: Structure of the application data area – Telegram traffic

Item	Meaning
A	Order telegram
1	Parameter order
2	Safety data
3	Control word and setpoints
4	Processing
B	Response telegram
5	Parameter response
6	Safety data
7	Status word and actual values

Processing of the process data in the frequency inverter is carried out 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 which are defined in PROFIBUS (PPO) which are defined in PROFIBUS, with which both process data (PZD) as well as parameters (PKW) are transferred from the IO controller/F-Host to the IO device/F-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 3 Setpoints (SW) are transferred from the IO controller to the frequency inverter and the status word (ZSW) and up to 3 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").

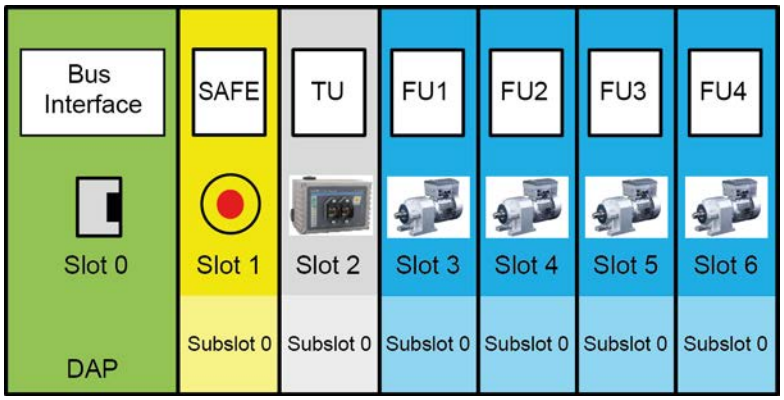


Figure 15: Example – PROFINET IP / PROFIsafe device model for decentralised devices

Designation	Description
DAP	Device Access Point, access point for communication with the Ethernet interface
SAFE	Extension for PROFIsafe field bus systems
TU	Bus interface
FI1…FI4	Frequency inverters 1…4

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 inhibit").	**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 inhibit" 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 to 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 faults are acknowledged.	**7**
		1	**Note:** If a digital input has been programmed for the "ack.fault" function, this bit must not permanently be set to 1 via the bus, as otherwise, flank evaluation would be prevented.	
8	Start function 480.11	0		—
		1	Bus bit 8 of the control word is set 🕮 Parameter **P480** in the frequency inverter manual.	
9	Start function 480.12	0		—
		1	Bus bit 9 of the control word is set 🕮 Parameter **P480** in the frequency inverter manual.	
10[2]	Control data valid	0	The transmitted process data are invalid.	—
		1	The bus master transfers valid process data	
11[3]	Rotation right is on	0		—
		1	Switch on rotation right.	
12[3]	Rotation left is on	0		—
		1	Switch on rotation left (priority).	
13	Reserved			
14	Parameter set Bit 0 On	0	<table><tr><th>Bit 15</th><th>Bit 14</th><th>it activates the parameter set</th></tr><tr><td>0</td><td>0</td><td>Parameter set 1</td></tr><tr><td>0</td><td>1</td><td>Parameter set 2</td></tr><tr><td>1</td><td>0</td><td>Parameter set 3</td></tr><tr><td>1</td><td>1</td><td>Parameter set 4</td></tr></table>	—
		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.
If Bit 12 = 1, "rotational direction left ON" applies, irrespective of Bit 11.

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 to switch-on".

Bit	Meaning	Value	Status message
0	Ready to switch-on	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 inhibit".
		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 inhibit".
4	Voltage enabled	0	"Disable voltage" command present.
		1	
5	Emergency stop	0	"Emergency stop" command present.
		1	
6	Switch-on inhibit	0	
		1	With the command "Standby" the frequency goes into status "Ready to 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	
		1	
15	Parameter set Bit 1 On	0	
		1	

Bit 15	Bit 14	parameter set, that is active
0	0	Parameter set 1
0	1	Parameter set 2
1	0	Parameter set 3
1	1	Parameter set 4

6.3.3 Frequency inverter status machine

The frequency inverter passes through a status machine. 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.

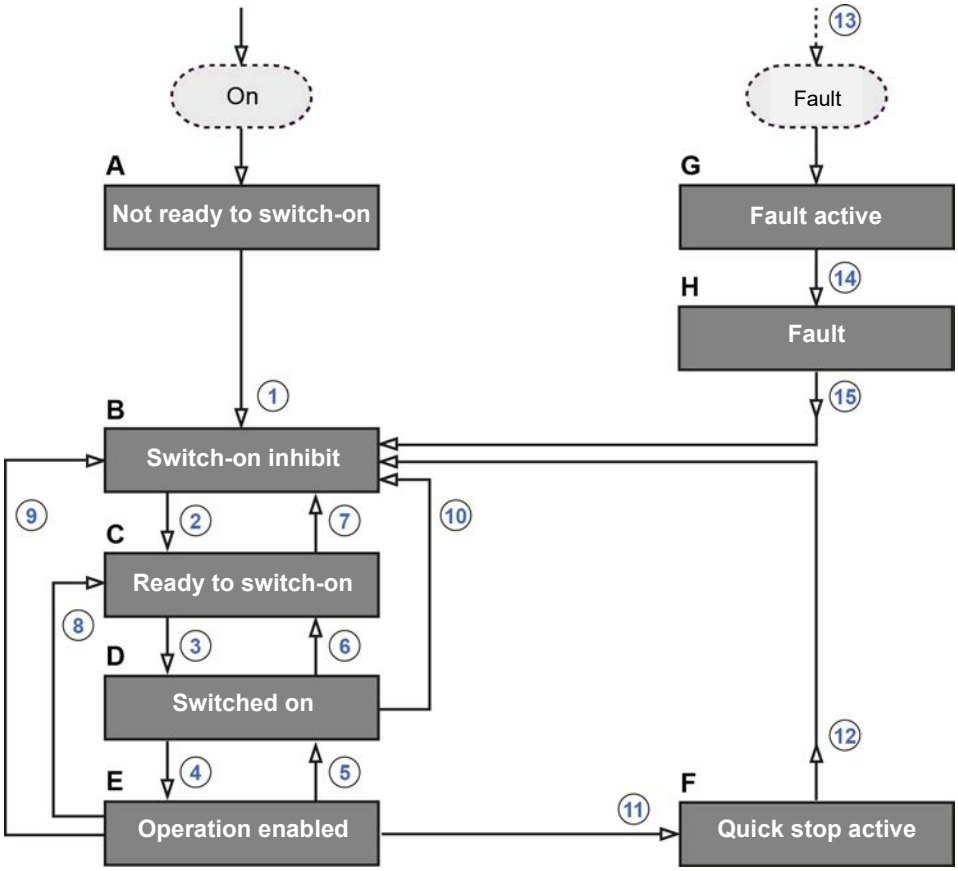


Figure 16: Frequency inverter status machine

Item	Meaning
A…H	Frequency inverter statuses (🕮 Table “Frequency inverter statuses”)
1…15	Status transitions (🕮 Table “Status transitions”)

Frequency inverter statuses

Status		Description
A	Not ready to switch-on	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 inhibit".
B	Switch-on inhibit	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	Ready to switch-on	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	Switched on	Frequency inverter ready for operation.
E	Operation enabled	The frequency inverter receives and processes setpoint values.
F	Quick stop active	The emergency stop function is being executed (the drive is stopped), and the frequency inverter changes to the status “Switch-on inhibit”.
G	Fault 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 (fault active) 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 to switch-on” to “Switch on inhibit”	—	—							
	Automatically, after activation of the charging relay									
2	From “Switch-on inhibit” to “Ready to switch-on”	Shut down	X	X	X	X	X	**1**	**1**	**0**
3	From “Ready to 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**
	The output voltage is disabled									
6	From “Switched on” to “Ready to switch-on”	Shut down	X	X	X	X	X	**1**	**1**	**0**
	Voltage enabled at “f = 0 Hz”									
7	From “Ready to switch-on” to “Switch-on inhibit”	Voltage disable	X	X	X	X	X	X	**0**	X
		Quick stop	X	X	X	X	X	**0**	**1**	X
8	From “Operation enabled” to “Ready to switch-on”	Shut down	X	X	X	X	X	**1**	**1**	**0**
9	From “Operation enabled” to “Switch on inhibit”	Voltage disable	X	X	X	X	X	X	**0**	X
10	From “Switched on” to “Switch on inhibit”	Voltage disable	X	X	X	X	X	X	**0**	X
		Quick stop	X	X	X	X	X	**0**	**1**	X
11	From “Operation enabled” to “Quick stop active”	Quick stop	X	X	X	X	X	**0**	**1**	X
12	From “Quick stop active” to “Switch on inhibit”	Voltage disable	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 fault response (“Fault active”)	—	—							
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 achieving the status. Please also note the list of control bits.

[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 to switch-on	0	X	X	0	0	0	0
Switch-on inhibit	1	X	X	0	0	0	0
Ready to 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
Fault active	0	X	X	1	1	1	1
Quick stop active	0	0	1	0	1	1	1

[1] Complete list of status bits (Bit 0…15) 🕮 Section 6.3.1 "Control word".

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
To bus interface	Setpoint 1	**P546, Array [-01]**
	Setpoint 2	**P546, Array [-02]**
	Setpoint 3	**P546, Array [-03]**
From bus interface	Actual value 1	**P543, Array [-01]**
	Actual value 2	**P543, Array [-02]**
	Actual value 3	**P543, Array [-03]**

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

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**			
	1st word	**2nd word**	**3rd word**	**4th word**
To bus interface	Control word	32 Bit setpoint		Setpoint 3
From bus interface	Status word	Actual value 1	32 Bit actual value	

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

6.3.5 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)	
	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)			
	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)					
	1st word	2nd word	3rd word	4th word	5th word	6th 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	-	-

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)					
	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)							
	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 (🕮 6.3 "Transfer of process data") parameter processing can also be carried out in cyclic data traffic. The F-Host formulates a request and the frequency inverter formulates the suitable response. The PKW area is only used for the communication with the PPO types 1 and 2.

The PKW area basically consists of

- a **parameter ID (PKE)**, in which the type of request (write, read etc.) and the relevant parameter are specified,
- an **index (IND)**, with which the individual parameter sets or arrays are addressed,
- the **parameter value (PWE)**, which contains the value read or to be written.

Field [1]		Data size	Explanation
PKE	Parameter ID (request ID **AK** and parameter number **PNU**)	2 Byte	Parameter of bus interface or frequency inverter. Parameter number plus “1000” The request ID is attached to the parameter number (upper nibble [2]).
IND	Parameter index	2 Byte	Parameter array
PWE	Parameter value	4 Byte	New setting value

1) Description of fields in the following sections.

2) 1 nibble = 4 bit

A parameter request must be repeated until the frequency inverter responds with the relevant response telegram.

Information

Max. 100,000 permissible write cycles

If parameter changes are made (request by the F-Host via the PKW channel), the maximum number of permissible write cycles to the frequency inverter’s EEPROM (100,000 cycles) must not be exceeded. That means, continuous cyclic writing must be prevented. This is also valid for other parameterisation approaches and the acyclic data transfer.

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

6.4.1 Structure of acyclic parameter data exchange (Records)

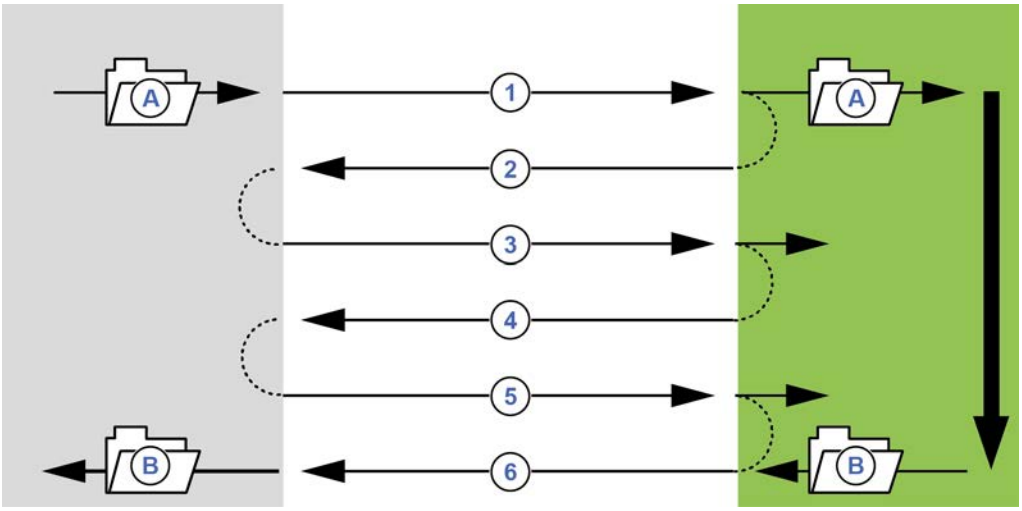


Figure 17: Sequence of acyclic PROFINET IO parameter data exchange

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

Parameter requests are transferred as data sets. The data sets are generally transferred to the bus interface 1 (Slot 2). The number of the data set determines the recipient of the parameter request:

Data set 100	Request to bus interface (parameters P150…P199 and P800…P849)
Data set 101	Request to frequency inverter 1 (parameters P000…P149, P200…P799 and P850…P999)
Data set 102	Request to frequency inverter 2 (parameters P000…P149, P200…P799 and P850…P999)
...	
Data set 104	Request to frequency inverter 4 (parameters P000…P149, P200…P799 and P850…P999)

The structure of these data sets is described in section 📖 6.4 "Parameter data transmission"(“PKW area”).

6.4.3 Data record format

6.4.3.1 Parameter ID PKE

The request or the response, and the related parameter have been encrypted in the parameter ID 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 ID 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 from the frequency inverter.
Parameter number 🕮 Manual for the respective frequency inverter

SPM Bit 11 is the toggle bit for instant messages. This function is **not** supported.

AK Bits 12…15 contain the request and response ID.

Information

Parameter numbers

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

Request ID and response ID AK

Up to 15 parameter requests can be transmitted by the F-Host.

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

Meaning of requests IDs

Request ID	Function	Response ID (positive)
0	No request	0
1	Request parameter value	1 or 2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
4[1]	Reserved	—
5[1]	Reserved	—
6	Request parameter value (array)	4 or 5
7	Change parameter value (array, word)	4
8	Change parameter value (array, double word)	5
9[1]	Request the number of array elements	6
10[1]	Reserved	—
11[1]	Change parameter value (array, double word) without writing to the EEPROM	5
12[1]	Change parameter value (array, word) without writing to the EEPROM	4
13[1]	Change parameter value (double word) without writing to the EEPROM	2
14[1]	Change parameter value (word) without writing to the EEPROM	1

[1] Only relevant for frequency inverters with mounted 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.

Meaning of response IDs

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

For all request IDs, the ID of a negative response is always the value “7” (Request cannot be executed). In case of a negative response, an error number or code is also listed in the parameter value PWE2 of the frequency inverter’s response.

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 subindex
4	No array
5	Invalid data type
6	Reset only (only 0 may be written)
7	Description element cannot be changed
9	Description data does not exist
201	Invalid request element in the last request received
202	Internal response ID cannot be mapped

6.4.3.2 Parameter index IND

Structure and function of the parameter index depend on the type of the 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**											
	Subindex																	

For **parameter set-dependent values**, 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 subindex can be addressed via Bit 10 to Bit 15 (0 = Array element 1, 1 = Array element 2, etc.).

For **non-parameter set-dependent parameters**, Bit 8 to Bit 15 are used for the array. For an array to be effective, the corresponding request ID (numbers 6, 7, 8 as well as 11 and 12) must be used.

Examples for address generation in case of parameter set-dependent array parameters

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								
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)									

For parameter and array structure 🕮 Manual of used frequency inverter.

6.4.3.3 Parameter value PWE

Parameter values are transmitted depending on the respective parameter properties as word (16 bit) or double word (32 bit). In case of signed values, attention must be paid to the fact that the file type (integer or double integer) match the parameter’s file type. If, for example, a 16-bit variable with a negative value is written to a 32-bit frequency inverter parameter, this value will be interpreted as a positive value. In this case, perform a data type conversion prior to the data transfer.

The parameter value is transmitted as an integer value.

For parameters with resolution “0.1” or “0.01”, the parameter value must be multiplied by the reciprocal value of the parameter resolution.

Example

You want to set an acceleration time of 99.99 seconds.

PWE = P102 * (1 / parameter resolution P102) = 99.99 * (1 / 0.01) = 9999 = 270Fh

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

6.4.4 Examples of data record transfer

Read parameter P717 Current speed

Data set 100 is used.

Sample telegram

Field	Data size	Byte	Date				Explanation
Request ID AK	4 Bit	1 (upper nibble)	1h				Request parameter value (read)
Instant message SPM	1 Bit	1 (lower nibble)		0h			Instant message
Parameter number PNU	11 Bit	1 (lower nibble) and 2		6h	Bh	5h	Parameter number P717 (717+1000) = 6B5h
			16B5h				
Parameter index	2 Byte	3	00h				Parameter array
		4	00h				
Parameter value	4 Byte	5	00h				Setting value not set for read request
		6	00h				
		7	00h				
		8	00h				

Sample code (SIMATIC STEP 7 V5.5)		Explanation
CALL	“WRREC”, DB53	→ Write request
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnostic address
INDEX	:=100	→ Data set 100
LEN	:=8	→ Length: 8 Byte
DONE	:=#bEnd	
BUSY	:=#bBusy	
ERROR	:=#bError	
STATUS	:=wStatus	
RECORD	:=P#DB10.DBX0.0 BYTE 8	→ Data: 16h,B5h, 00h,00h, 00h,00h, 00h,00h
CALL	“RDREC”, DB52	→ Read response
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnostic address
INDEX	:=100	→ Data set 100
MLEN	:=8	
VALID	:=…	
BUSY	:=…	
ERROR	:=…	
STATUS	:=…	
LEN	:=…	
RECORD	:=P#DB10.DBX12.0 BYTE 8	→ Response: 16h,B5h, 00h,00h, 00h,00h, 03h,FCh
Read value: P717 = 1020 (03FCh)		

Write parameter P102 Acceleration time, Index 1

Data set 100 is used.

Sample telegram

Field	Data size	Byte	Date				Explanation
Request ID AK	4 Bit	1 (upper nibble)	2h				Request parameter value (read)
Instant message SPM	1 Bit	1 (lower nibble)		0h			Instant message
Parameter number PNU	11 Bit	1 (lower nibble) and 2		4h	4h	Eh	Parameter number P102 (102+1000) = 44Eh
			244Eh				
Parameter index	2 Byte	3	01h				Parameter array
		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				

Sample code (SIMATIC STEP 7 V5.5)		Explanation
CALL	“WRREC”, DB53	→ Write request
REQ	:=#bStart	
ID	:=DW#16#7FC	→ Diagnostic address
INDEX	:=100	→ Data set 100
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	:=100	→ Data set 100
MLEN	:=8	
VALID	:=…	
BUSY	:=…	
ERROR	:=…	
STATUS	:=…	
LEN	:=…	
RECORD	:=P#DB10.DBX12.0 BYTE 8	→ Response: 14h, 4Eh, 01h, 00h, 00h, 00h, 00h, 00h

6.4.4.1 Telegram structure for parameterisation via PPO1 or PPO2

The parameter **P102 Acceleration time** is to be set to the value "2,5 s" in parameter set 3 (only the PKW channel is considered). As the acceleration time has a parameter resolution of “0.25 s” in the FI, the parameter value “250” (“FAh”) must be transmitted.

Procedure

1. Define request ID (7 = “Change parameter value (array, word)”.
2. Select parameter (P102 + 1000 = 44Eh).
3. Select parameter set 3 (IND = 02).
4. Set parameter value (250 = FAh).
5. Check response telegram (positive for array word 4).

Request telegram from IO controller

Word	1		2		3		4	
Byte	1	2	3	4	5	6	7	8
Name	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	74h	4Eh	02h	00h	00h	00h	00h	FAh

Response telegram from frequency inverter (after complete request processing)

Word	1		2		3		4	
Byte	1	2	3	4	5	6	7	8
Name	PKE	PKE	IND	IND	PWE	PWE	PWE	PWE
Value	44h	4Eh	02h	00h	00h	00h	00h	FAh

6.5 F-Data transmission

Transmission of the F-Data (safety data) is performed within a PROFINET IO telegram.

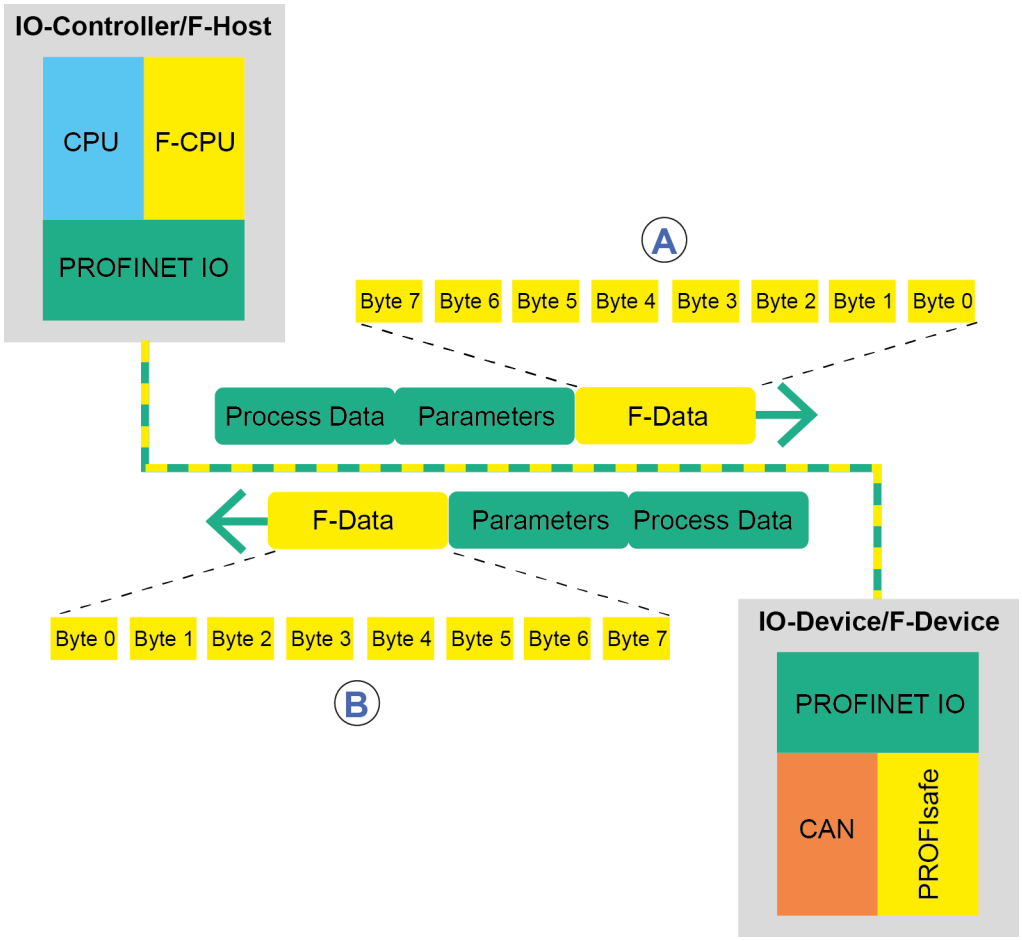


Figure 18: F-Data exchange

Order telegram A

Byte	Bit	Meaning
0	0	Switch OSSD 1
	1	Reserved
	2	
	3	Enable SOS
	4	Enable SLS
	5	Reserved
	6	
	7	
1	0	Reserved
	1	Select SLS speed
	2	
	3	Reserved
	4	Enable SDI-P
	5	Enable SDI-N
	6	Reserved
	7	

Byte	Bit	Meaning
2	0	Reserved
	1	
	2	
	3	
	4	
	5	
	6	
	7	
3	0	Switch OSSD2
	1	Switch OSSD3
	2	Reserved
	3	
	4	
	5	
	6	Enable SSR
	7	Acknowledge channel passivation

Byte	Bit	Meaning
4	0	Control Byte
	1	
	2	
	3	
	4	
	5	
	6	
	7	
5	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	

Byte	Bit	Meaning
6	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	
7	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	

Response telegram B

Byte	Bit	Meaning
0	0	Status OSSD1
	1	Reserved
	2	
	3	SOS status
	4	SLS status
	5	Reserved
	6	
	7	
1	0	Reserved
	1	SLS speed coding
	2	
	3	Reserved
	4	SDI-P status
	5	SDI-N status
	6	
	7	SSM status
2	0	Reserved
	1	
	2	
	3	
	4	
	5	
	6	
	7	
3	0	OSSD2 status
	1	OSSD2 status
	2	Clock output 1 status
	3	Clock output 2 status
	4	Digital input 1 status
	5	Digital input 2 status
	6	SSR status
	7	Reserved

Byte	Bit	Meaning
4	0	Status Byte
	1	
	2	
	3	
	4	
	5	
	6	
	7	
5	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	
6	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	
7	0	Checksum check CRC2
	1	
	2	
	3	
	4	
	5	
	6	
	7	

6.5.1 F-Parameters

When the PROFINET IO field bus system is started, the safety-relevant parameters (F-Parameters) from the F-Host are transmitted to the PROFIsafe bus interface and checked for plausibility. The exchange of data only starts after a successful plausibility check.

The following table lists the F-Parameters which must be transmitted from the F-Host to the bus interface.

Parameters	Byte	Type	Meaning	Explanation
F_Check_iPar	**0**	1 Bit	0 = No Testing	The parameter cannot be changed and is set to "NoCheck".
F_SIL		2 Bit	00 = SIL 1 01 = SIL 2 10 = SIL 3 (default)	This parameter states the safety integrity level which the user expects from the F-Device. The PROFIsafe bus interface supports the safety classes "No SIL", and SIL 1 to SIL 3 (default value = SIL 3).
F_CRC_Length		2 Bit	00 = 3-Byte CRC	The PROFIsafe bus interface supports a CRC length of 3 byte. This value is pre-set and cannot be changed.
F_Block_ID	**1**	3 Bit	001 = Default = 1	This parameter is pre-set with the value "1" (F_iPar_CRC in the data block) and cannot be changed.
F_Par_Version		2 Bit	01 = V2 Mode	This parameter identifies the implemented PROFIsafe version "V2 Mode". This value is pre-set and cannot be changed.
F_Source_Add	**2** **3**	Unsigned 16	Source address, Default = 1, Range: 1…65534	This parameter identifies a unique source address within the PROFIsafe network.
F_Dest_Add	**4** **5**	Unsigned 16	Destination address, Default = 1, Range 1…65534	This parameter identifies a unique destination address within the PROFIsafe network.
F_WD_Time	**6** **7**	Unsigned 16	Watchdog time, Default = 100, Range: 1…10000 ms	This determines the monitoring time (in ms) in the PROFIsafe system (the pre-set time is "100 ms"). If no valid safety telegram is received from the F-Host within this time, the bus interface switches to the safe condition. The watchdog time must be selected so that telegram run times are tolerated by the communication and the response function is executed quickly enough in case of a fault.
F_iPar_CRC	**8** **9** **10** **11**	Unsigned 32	CRC of the i-Parameters, Range: 0…4295967295	This parameter states the checksum (CRC3), from which all i-Parameters of the bus interface are calculated and ensures the safe transmission of the parameters.
F_Par_CRC	**12** **13**	Unsigned 16	CRC of the F-Parameters, Range: 0…65535	This parameter states the checksum (CRC1), from which all F-Parameters of the bus interface are calculated and ensures the safe transmission of the F-Parameters.

6.5.2 Structure of F-Input and F-Output data

F-input data

Information

Important: The F-Input data switches the safe outputs and the safety functions. If these are not enabled via i-Parameter, an error is triggered.

Date	"High" function	"Low" function
F-Data In 0.0	Switch on OSSD 1	Switch off OSSD 1
F-Data In 0.1	—	—
F-Data In 0.2		
F-Data In 0.3	Switch on SOS monitoring after activation time	Switch off SOS monitoring immediately
F-Data In 0.4	Switch on SLS monitoring after activation time	Switch off SLS monitoring immediately
F-Data In 0.5	—	—
F-Data In 0.6		
F-Data In 0.7		
F-Data In 1.0		
F-Data In 1.1	Selection of SLS speed Bit 0 – monitoring enabled after activation time	
F-Data In 1.2	Selection of SLS speed Bit 1 – monitoring enabled after activation time	
F-Data In 1.3	—	—
F-Data In 1.4	Switch on SDI-P monitoring after activation time	Switch off SDI-P monitoring immediately
F-Data In 1.5	Switch on SDI-N monitoring after activation time	Switch off SDI-N monitoring immediately
F-Data In 1.6	—	—
F-Data In 1.7		
F-Data In 2.0		
F-Data In 2.1		
F-Data In 2.2		
F-Data In 2.3		
F-Data In 2.4		
F-Data In 2.5		
F-Data In 2.6		
F-Data In 2.7		
F-Data In 3.0	Switch on OSSD 2	Switch off OSSD 2
F-Data In 3.1	Switch on OSSD 3	Switch off OSSD 3
F-Data In 3.2	—	—
F-Data In 3.3		
F-Data In 3.4		
F-Data In 3.5		
F-Data In 3.6	Switch on SSR after activation time	—
F-Data In 3.7	Acknowledge channel passivation → Error is cancelled	—

F-Output data

Date	"High" function	"Low" function
F-Data Out 0.0	OSSD 1 switched off	OSSD 1 switched on
F-Data Out 0.1	—	—
F-Data Out 0.2		
F-Data Out 0.3	SOS enabled (combination of i-Parameters and F-Data) and deviation of position within the limit value	SOS not enabled or deviation of position outside of the limit value
F-Data Out 0.4	SLS enabled (combination of i-Parameters and F-Data) and speed within the set range	SLS not enabled or speed outside of the set range
F-Data Out 0.5	—	—
F-Data Out 0.6		
F-Data Out 0.7		
F-Data Out 1.0		
F-Data Out 1.1	SLS speed Bit 0	
F-Data Out 1.2	SLS speed Bit 1	
F-Data Out 1.3	—	—
F-Data Out 1.4	SDI-P enabled (combination of i-Parameters and F-Data) and direction of rotation positive or speed = "0"	SDI-P not enabled or direction of rotation negative
F-Data Out 1.5	SDI-N enabled (combination of i-Parameters and F-Data) and direction of rotation negative or speed = "0"	SDI-N not enabled or direction of rotation positive
F-Data Out 1.6	—	—
F-Data Out 1.7	SSM speed within the set range	SSM speed outside of the set range
F-Data Out 2.0	—	—
F-Data Out 2.1		
F-Data Out 2.2		
F-Data Out 2.3		
F-Data Out 2.4		
F-Data Out 2.5		
F-Data Out 2.6		
F-Data Out 2.7		
F-Data Out 3.0	OSSD 2 switched off	OSSD 2 switched on
F-Data Out 3.1	OSSD 3 switched off	OSSD 3 switched on
F-Data Out 3.2	Clock 1 switched off	Clock 1 switched on
F-Data Out 3.3	Clock 2 switched off	Clock 2 switched on
F-Data Out 3.4	Input 1 enabled	Input 1 not enabled
F-Data Out 3.5	Input 2 enabled	Input 2 not enabled
F-Data Out 3.6	SSR enabled (combination of i-Parameters and F-Data) and speed within the set range	SSR not enabled or speed outside of the set range
F-Data Out 3.7	—	—

6.6 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 to 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 switches to "Ready to switch-on" status The motor brakes to a standstill according to the parameterised ramp and is disconnected from the power supply.
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 settings on the bus interface

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

Parameter No.	Description
P15x	NORD standard parameters (can be set and saved)
P16x	PROFINET IO standard parameters (can be set and saved)
P800…P839	PROFIsafe standard parameters (can be set and saved)
P17x	NORD information parameters (display)
P18x	PROFINET IO information parameters (display)
P840…P850	PROFIsafe information parameters (display)

The following sections contain detailed descriptions of bus interface parameters.

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-PNS**
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 PROFINET. 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-PNS, SK TU4-PNS**
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 a fault (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, bus-communication 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 P151	Error of the bus interface
Invalid control word set (e.g. PLC to Stop)	-1	Frequency inverter continues operation
Connection to F-Host lost	-1	Frequency inverter continues operation
Ethernet cable interrupted	-1	Frequency inverter continues operation
Invalid control word set (e.g. PLC to Stop)	0 sec	Frequency inverter continues operation
Connection to F-Host lost	0 sec	Error E10.2*
Ethernet cable interrupted	0 sec	Error E10.5*
Invalid control word set (e.g. PLC to Stop)	1 sec	Error E10.3*
Connection to F-Host lost	1 sec	Error E10.2*
Ethernet cable interrupted	1 sec	Error E10.5*

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

P152	Factory setting
Setting range	0…3
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Reset the present parameter settings of the bus interface to the factory setting.

Setting values

Value	Meaning	Remarks
0	No change	Current parameter settings will not be changed
1	Load factory setting	All bus interface parameters will be reset to the factory setting. The setting of parameter **P152** then automatically changes back to { 0 }.
2	Basic parameters	All basic parameters of the bus interface will be reset to the factory setting. The setting of parameter **P152** then automatically changes back to { 0 }.
3	i-Parameters	The individual safety parameters (P800 … P830) of the bus interface will be reset to the factory setting. The setting of parameter **P152** then 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-PNS, SK TU4-PNS**
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-PNS, SK TU4-PNS**	
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	
		Array [-01] (inputs)	**Array [-02] (outputs)**
0	No access	No influence by the frequency inverter (FI).	
1	Broadcast	All connected frequency inverters read the inputs	No function.
2	FI 1	FI 1 reads the inputs.	FI 1 writes to the outputs.
3	FI 2	FI 2 reads the inputs.	FI 2 writes to the outputs.
4	FI 3	FI 3 reads the inputs.	FI 3 writes to the outputs.
5	FI 4	FI 4 reads the inputs.	FI 4 writes to the 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 CU4-PNS, SK TU4-PNS**			
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 CU4-PNS, SK TU4-PNS**			
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 CU4-PNS, SK TU4-PNS**
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 (SAFE device – 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 CU4-PNS, SK TU4-PNS**	
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) Not available.

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 CU4-PNS, SK TU4-PNS**			
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] = Current fault bus interface [-02] = Last fault bus interface
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the current fault 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 CU4-PNS, SK TU4-PNS**
Description	Display of the contained software version and revision number of the bus interface. Array [-03] displays possible special versions (0 = Standard version).

P172	Configuration
Display range	0…7
Bus interface	**SK CU4-PNS,**
Description	Display of bus interface identifier.

Display values

Value	Meaning	
0–4	-	Not available
5	TU4safe	Bus interface SK TU4-PNS
6–7	-	Not available

P173	Module status
Display range	0…FFFFh
Arrays*	[-01]…[-02]
Bus interface	SK CU4-PNS, SK TU4-PNS
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 1)
9		
10	FI 2 status	FI6 status 1)
11		
12	FI 3 status	FI7 status 1)
13		
14	FI 4 status	FI8 status 1)
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)				

1) Not available.

P174	State of digital in.
Display range	0…65535 (0000 0000 0000 0000…1111 1111 1111 1111b)
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	The switching state is only displayed in case of an active connection to the PROFIsafe controller. Otherwise, state 0 is displayed.

Display values

Bit	Meaning
0	Safe Input 1 (SI1) of the bus interface
1	Safe Input 2 (SI2) of the bus interface
2-7	-
8	SLS F-Host
9	SLS Bit0 F-Host
10	SLS Bit1 F-Host
11	SSR F-Host
12	SDI_P F-Host
13	SDI_N F-Host
14	SOS F-Host
15	-

P175	State of relays
Display range	0…31 (00000…11111b)
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	The switching state is only displayed in case of an active connection to the PROFIsafe controller. Otherwise, state 0 is displayed.

Display values

Bit	Meaning
0	Safe Output 1 (SO1) of the bus interface
1	Safe Output 2 (SO2) of the bus interface
2	Safe Output 3 (SO3) of the bus interface
3	Clock output 1 (Clock1) of the bus interface
4	Clock output 2 (Clock2) of the bus interface

P176	Process data Bus In				
Display range	-32768…32767				
Arrays	[-01] =	Bus module outputs			
	[-02] =	Control word	[-03]…[-07] =	Setpoint 1…5 [1]	to FI1
	[-08] =	Control word	[-09]…[-13] =	Setpoint 1…5 [1]	to FI2
	[-14] =	Control word	[-15]…[-19] =	Setpoint 1…5 [1]	to FI3
	[-20] =	Control word	[-21]…[-25] =	Setpoint 1…5 [1]	to FI4
	[-26] =	Control word	[-27]…[-31] =	Setpoint 1…5 [1]	to FI5[2]
	[-32] =	Control word	[-33]…[-37] =	Setpoint 1…5 [1]	to FI6[2]
	[-38] =	Control word	[-39]…[-43] =	Setpoint 1…5 [1]	to FI7[2]
	[-44] =	Control word	[-45]…[-49] =	Setpoint 1…5 [1]	to FI8[2]
	[1] Setpoints 4 and 5 are not available. [2] Not available.				
Bus interface	**SK CU4-PNS, SK TU4-PNS**				
Description	Display of data received from the IO-Controller.				

P177	Process data Bus Out				
Display range	-32768…32767				
Arrays	[-01] =	Bus module inputs			
	[-02] =	Status word	[-03]…[-07] =	Actual value 1…5 [1]	from FI1
	[-08] =	Status word	[-09]…[-13] =	Actual value 1…5 [1]	from FI2
	[-14] =	Status word	[-15]…[-19] =	Actual value 1…5 [1]	from FI3
	[-20] =	Status word	[-21]…[-25] =	Actual value 1…5 [1]	from FI4
	[-26] =	Status word	[-27]…[-31] =	Actual value 1…5 [1]	from FI5[2]
	[-32] =	Status word	[-33]…[-37] =	Actual value 1…5 [1]	from FI6[2]
	[-38] =	Status word	[-39]…[-43] =	Actual value 1…5 [1]	from FI7[2]
	[-44] =	Status word	[-45]…[-49] =	Actual value 1…5 [1]	from FI8[2]
	[1] Setpoints 4 and 5 are not available. [2] Not available.				
Bus interface	**SK CU4-PNS, SK TU4-PNS**				
Description	Display of the data sent from the bus interface to the IO-Controller.				

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…16	
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 CU4-PNS, SK TU4-PNS**	
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 - 2	-	
3	Empty slot	
4	Reserved slot	
5	DIG-IO	Process data for bus interface
6	PPO3	Process data for frequency inverter
7	PPO4	Process data for frequency inverter
8	PPO6	Process data for frequency inverter
9	PPO1	Process/parameter data for frequency inverter
10	PPO2	Process/parameter data for frequency inverter
11	DIG-IN	Process data for bus interface
12 – 15	-	
16	PnSafe	Process/parameter data for PROFIsafe bus interface

1) Not available.

P181	MAC address
Display range	0…255
Arrays	[-01]…[-03] = PROFINET identifier [-04]…[-06] =Manufacturer identifier (Getriebebau NORD GmbH & Co. KG)
Bus interface	**SK CU4-PNS, SK TU4-PNS**
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 CU4-PNS, SK TU4-PNS**
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 CU4-PNS, SK TU4-PNS
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 CU4-PNS, SK TU4-PNS
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 CU4-PNS, SK TU4-PNS	
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 2...9:	F-address
	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

7.1.5 PROFIsafe standard parameters

Field-bus specific safety settings of the bus interface are made via the PROFIsafe standard parameters.

P800	**I/O operating mode**
Setting range	0…1
Arrays	[-01] = DigIn SI1 and SI2 [-02] = DigOut SO1 and SO2
Factory setting	{ [-01] = 0 } { [-02] = 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Combination of the two digital inputs SI1 and SI2 (Array [-01]) and/or the two digital outputs SO1 and SO2 (Array [-02] to form a two channel input/output.
Setting values	**Value** / **Meaning** 0 – Single channel 1 – Two channel
Note	• For combination of the two digital inputs SI1 and SI2, both inputs must be switched within the set discrepancy time (**P803**) in order to be recognised as an input signal. • For combination of the two digital outputs SO1 and SO2 both outputs must be switched simultaneously by the system.

P801	**Error response**
Setting range	0…1
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set error response: Passivation of the bus interface or the relevant channel. With passivation of the bus interface (value "0") the entire bus interface (SO1, SO2 and SO3) is passivated if an error is detected. With passivation of the channel (value "1") only the affected channel is passivated and all other channels are not affected.
Setting values	**Value** / **Meaning** 0 – Device passivation 1 – Channel passivation
Note	With enabling of channel passivation, an error in the encoder evaluation only results in a message to the controller which is responsible for the error response.

P802	Channel activation		
Setting range	0…1		
Arrays	[-01] = SI1	[-04] = SO2	[-07] = CLOCK 2
	[-02] = SI2	[-05] = SO3	
	[-03] = SO1	[-06] = CLOCK 1	
Factory setting	{ [-01]…[-07] = 0 }		
Bus interface	**SK CU4-PNS, SK TU4-PNS**		
Description	Select (enable) the inputs and outputs which are to be used		
Setting values			

Value	Meaning	
0	Off	A signal at the input results in an error. An OSSD output cannot be switched, which results in an error, if this is not accessed by the safety PLC.
1	On	Input signals are read in and transmitted to the controller. Output signals are given to the OSSD outputs.

Note	Input and output channels can only be used if they have been enabled. Switching on inputs or outputs without enabling results in an error.

P803	Discrepancy time
Setting range	0…30000 ms
Factory setting	{ 10 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set the discrepancy time for two channel mode (**P800 I/O mode**) for digital inputs SI1 and SI2.
Note	Example 1: Safe input in the "On" state A Low level on one channel sets the input to the "Off" state. At the same time, discrepancy monitoring starts. A Low level must be detected on both channels within the set time, otherwise a discrepancy error is reported. To acknowledge the error, a Low level must be detected on both channels. Example 2: Safe input in the "Off" state A High level on one channel starts discrepancy monitoring. A High level must be detected on both channels within the set time, otherwise a discrepancy error is reported. To acknowledge the error, High level must be detected on both channels.

P804	OSSD pulse
Setting range	0…8
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set the pulse width for testing the outputs. To test the outputs, the pulses are sent with a cycle of 50 ms on the output signal and read back.
Setting values	Value: 0 – Meaning: 300 µs 1 – 400 µs 2 – 500 µs 3 – 600 µs 4 – 800 µs 5 – 1000 µs 6 – 1200 µs 7 – 1500 µs 8 – 2000 µs
Note	The selected pulse width depends on the devices which are controlled by the safe outputs of the bus interface. Select the pulse width so small that the pulse is not detected as a level change.

P805	Filter time
Setting range	2…100 ms
Factory setting	{ 2 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set the filter time for digital inputs SI1 and SI2.

P806	Cycletime monitoring		
Setting range	0…2		
Arrays	[-01] = SI1	[-02] = SI2	
Factory setting	{ [-01]…[-02] = 0 }		
Bus interface	**SK CU4-PNS, SK TU4-PNS**		
Description	Monitoring of clock outputs by coupled safety input.		
Setting values	Value: 0 – Meaning: Off Value: 1 – Meaning: Clock 1 Value: 2 – Meaning: Clock 2		
Note	• The input may only be supplied via the clock output. In case of supply via another source, an error is triggered. The error is present for 10 s. Afterwards, the module can be re-integrated. • The parameter P806 is supported by firmware version 1.5 (SAF SW version V1.5) and higher.		

P810	Encoders
Setting range	0…1
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Switch the evaluation of the connected encoder on or off.
Setting values	Value: 0 – Meaning: Encoder Off Value: 1 – Meaning: Encoder On
Note	An error is triggered if encoder evaluation is enabled, although no encoder is connected.

P811	Speed ratio
Setting range	0.01…100.00
Factory setting	{ 1.00 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set speed ratio "motor speed/encoder speed". If a connected encoder is not mounted directly on the motor shaft, a speed ratio /reduction ratio can be set to monitor the motor speed.
Note	The product of the encoder resolution (**P812**), speed ratio (**P811**) and the set speed limit (**P823** converted into revolutions per second) must not exceed the limit frequency of the system of 150000 (inc/s).

P812	Encoder resolution
Setting range	0…17
Factory setting	{ 5 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Set the resolution of a connected encoder.
Setting values	
Note	The product of the encoder resolution (**P812**), speed ratio (**P811**) and the set speed limit (**P823** converted into revolutions per second) must not exceed the limit frequency of the system of (150000 inc/s).

Value	Meaning	Value	Meaning
0	500 pulses	9	-512 pulses
1	512 pulses	10	-1000 pulses
2	1000 pulses	11	-1024 pulses
3	1024 pulses	12	-2000 pulses
4	2000 pulses	13	-2048 pulses
5	2048 pulses	14	-4096 pulses
6	4096 pulses	15	-5000 pulses
7	5000 pulses	16	-8192 pulses
8	-500 pulses	17	8192 pulses

P820	Safety function	
Setting range	0…1	
Arrays	[-01] = SLS	[-04] = SDI negative
	[-02] = SSR	[-05] = SOS
	[-03] = SDI positive	
Factory setting	{ [-01]…[-05] = 0 }	
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Switch safety functions SLS (Safe Limited Speed), SSR (Safe Speed Range), SDI-P (Safe Direction Positive), SDI-N (Safe Direction Negative) and SOS (Safe Operating Stop) On/Off.	
Setting values	Value: 0 — Meaning: Off — Safety function is switched off Value: 1 — Meaning: On — Safety function is switched on.	
Note	• An error is triggered if a safety function is switched on without enabling of the connected encoder. • In order to be able to use a safety function, this must also be enabled by the safety PLC via the F-Data (safety data). An error is triggered if a safety function is enabled without it having been switched on with this parameter.	

P821	Activation time	
Setting range	0…60.0 s	
Arrays	[-01] = SLS-0	[-05] = SSR
	[-02] = SLS-1	[-06] = SDI positive
	[-03] = SLS-2	[-07] = SDI negative
	[-04] = SLS-3	[-08] = SOS
Factory setting	{ [-01]…[-08] = 0.0 }	
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Set the activation time of the safety function (P820 safety function). The activation time which is set defines the time interval between activation of the safety function by the safety PLC and the start of monitoring by the safety function.	

P822	Response time	
Setting range	0…60.0 s	
Arrays	[-01] = SLS-0	[-05] = SSR
	[-02] = SLS-1	[-06] = SDI positive
	[-03] = SLS-2	[-07] = SDI negative
	[-04] = SLS-3	[-08] = SSM
Factory setting	{ [-01]…[-08] = 0.0 }	
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Set the response time of the safety function (**P820 Safety function**). The response time which is set defines the time interval between the detection of an error and the triggering of an error by the safety function. The response time is implemented with an integration counter which integrates upwards and downwards, so that the set time may be overshot or undershot.	

P823	Speed limit	
Setting range	0…9999 rpm	
Arrays	[-01] = Max. SLS-0	[-05] = Max. SSR
	[-02] = Max. SLS-1	[-06] = Min. SSR
	[-03] = Max. SLS-2	[-07] = Max. SSM
	[-04] = Max. SLS-3	
Factory setting	{ [-01]…[-07] = 0.0 }	
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Set the speed limits for the safety functions. The speed limit which is set specifies the speed above which an error is triggered by the safety function.	
Note	The product of the encoder resolution (**P812**), speed ratio (**P811**) and the set speed limit (**P823** converted into revolutions per second) must not exceed the limit frequency of the system of 150000 (inc/s).	

P824	Max. position error	
Setting range	0…9999 inc	
Arrays	[-01] = Position limit SDI-P	[-03] = Position limit SOS
	[-02] = Position limit SDI-N	
Factory setting	{ [-01]…[-05] = 0 }	
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Set maximum position deviation for safety function. The position deviation which is set specifies the change of position above which an error is triggered by the safety function.	

P830	Save i-Parameter
Setting range	0…65535
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Save the i-Parameter (settings for parameters **P800**…**P824**) in the flash memory. Saving of the i-Parameters is started with transmission of the i-Parameter checksum (CRC).
Note	• If the CRC of the i-Parameter does not match the set i-Parameters, the setting is not saved. • Calculation of the i-Parameter CRC is performed automatically in the NORD CON software and can be read out via parameter **P840 I-Para CRC**.

P831	F-Address
Setting range	0…65535
Factory setting	{ 0 }
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Setting the F-Address.
Note	• The F-address can be set via parameter **P831** or via DIP switch on the module. The F-Address setting via parameter **P831** is, however, only applied if the F-Address set via DIP switch is 0. • The F-Addresses 0 and 65535 are not accepted by the control and generate an error message. • Parameter **P831** is supported by PROFIsafe firmware version V1.5 and higher.

7.1.6 PROFIsafe information parameters

PROFIsafe information parameters are used to display safety-specific statuses and settings.

P840	**i-parameter CRC**
Display range	0/65536
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display i parameter checksum (CRC) of the bus interface.
Note	The CRC is calculated automatically by the NORDCON software from the saved i-Parameters (**P800**...**P824**).

P841	**Actual error**
Display range	5700…5799
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the actual error present. For a list of possible error messages please refer to 🕮 Section 8.4.2.)
Note	• The fault is acknowledged automatically by the safety PLC as soon as the cause of the fault has been remedied. After this, the fault can only be seen via parameter **P842 Last error**. • The error message is reset when the supply voltage is switched off.

P842	**Last error**
Display range	5700…5799
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display last error. For a list of possible error messages please refer to 🕮 Section 8.4.2).
Note	• An existing fault is acknowledged automatically by the safety PLC as soon as the cause of the fault has been remedied. The last fault is displayed in order to show the reason for the fault after it has been acknowledged. • The error message is reset when the supply voltage is switched off.

P843	Software version
Display range	0.0…999.9
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the software version of the PROFIsafe bus interface.

P844	Temperature
Display range	-40…120 °C
Arrays	[-01] = Master [-02] = Slave
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the actual temperature of the PROFIsafe bus interface. The value which is displayed is the internally measured temperature of the two channel system (Master and Slave).

P845	Actual voltage
Display range	2.5…3.6 V
Arrays	[-01] = Master [-02] = Slave
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the actual voltage of the PROFIsafe bus interface. The value which is displayed is the internally measured voltage of the two channel system (Master and Slave).

P846	DIP switch status
Display range	0…255
Arrays	[-01] = Master [-02] = Slave
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the DIP switch settings of the two channel system.
Note	The DIP switch settings are read in separately for each channel. In case of deviation an error is triggered and the bus interface cannot be started,

P847	Speed
Display range	0…9999 rpm
Bus interface	**SK CU4-PNS, SK TU4-PNS**
Description	Display of the actual speed which is measured by the connected encoder.
Note	The speed display is updated after a delay and cannot be used for control.

P848	System error	
Display range	0…65535	
Arrays	[-01] = Number of errors	[-06] = Information 1
	[-02] = Error number	[-07] = Information 2
	[-03] = Information 1	[-08] = Error number
	[-04] = Information 2	[-09] = Information 1
	[-05] = Error number	[-10] = Information 2
Bus interface	**SK CU4-PNS, SK TU4-PNS**	
Description	Display of the total number of system errors and display of the last 3 system errors with information.	
Note	If more than 15 system errors have been triggered, the bus interface can no longer be used and must be replaced.	

7.2 Parameter settings on the frequency inverter

After connecting and addressing the bus interface, the following additional parameters of the frequency inverter must be set. The additional parameters of the frequency inverter are used to set the bus interface, the pulse frequency and the acknowledgement of errors.

A detailed description of the parameters can be found in the related 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 SK CU4/SK TU4 SK 2xxE (-FDS)	Comment
P509	Source control word	“3” = Systembus	
P510	Source Setpoints	“0” = Auto	If **P509** is set to “3”
P513	Telegram time-out	—	
P514	CAN bus baud rate	"5" = 250 kbaud	
P515	CAN bus address (Array [-01])	32, 34, 36 or 38	System bus address
P543	Bus actual value Arrays [-01]…[-03]	○ 1)	Refer to the related frequency inverter manual
P546	Func. bus-setpoint Arrays [-01]…[-03]	○ 1)	Refer to the related frequency inverter manual

○ 1) Depending on the function: Setting required depending on the required function(s).

Information parameter

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

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

No.	Parameter name	SK TU3	SK CU4	SK TU4
P700	Current fault	Array [-01]		
	Actual warning	Array [-02]		
	Reason FI blocked	Array [-03]		
P701	Last fault			
P740	PZD bus in	No display, if **P509** is set to “0”		
P741	PZD bus out			
P748	Status CANopen	Displays the system bus status		

8 Error monitoring and error messages

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

8.1 Bus operation monitoring function

Independent of the specific bus watchdogs, comprehensive monitoring functions are integrated into 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**
	Frequency inverters	**SK 2xxE (-FDS)**
Field bus timeout		**P151**
Optional monitoring (system bus timeout)		**P120**
Bus interface error display		**P170 (P700)**
Error display for frequency inverter and communication errors between the frequency inverter and the bus interface.		**P700**

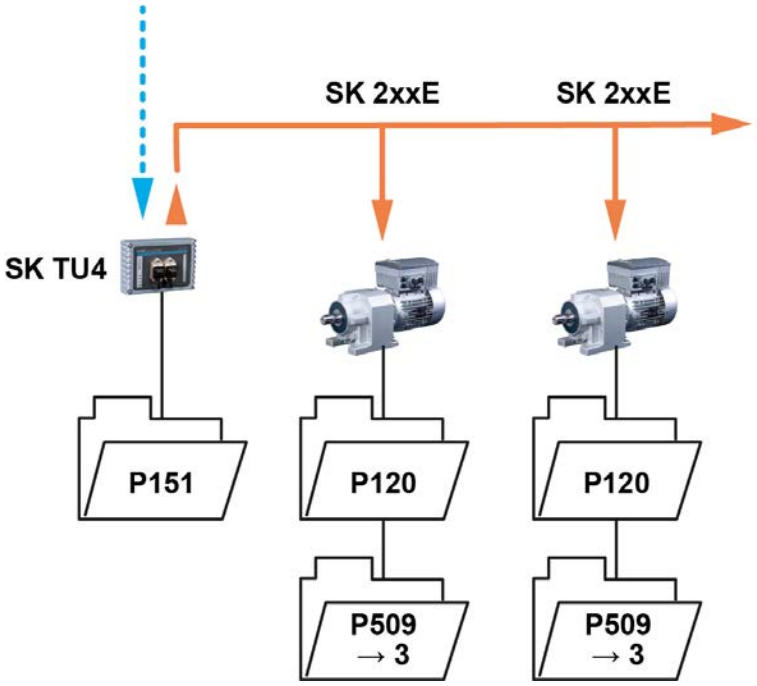


Figure 19: Examples of monitoring parameter settings – SK TU4 bus interface

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

3 = System bus

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
- Enable the programmed digital input with parameter **P420 Digital inputs** (Setting 12 = Fault acknowledgem.), or
- Switch off “Enable” on the frequency inverter (if no digital input is programmed to the “Fault acknowledgem.” function), or
- Perform a bus acknowledgement, or
- Automatic fault acknowledgement by activating parameter **P506 Automatic acknowled.**.

On the bus interface:

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

- Switch the voltage supply of the bus interface off and on again, or
- Acknowledge fault via field bus

Information

Archiving error message

A field bus communication error (display via parameter P170) is only displayed as long as it is active. After troubleshooting, the message expires and is archived as last error message in parameter P170, array [-02]. If the mains supply is interrupted before troubleshooting, the message gets lost, i.e. it will not be archived.

Information

Acknowledging PROFIsafe faults

Processing of faults in the transmission of safety-relevant data differs from the processing of faults in the transmission of PROFINET IO data. For a detailed description, see 📖 Section 8.3 "Handling of errors in the bus interface".

8.3 Handling of errors in the bus interface

8.3.1 PROFINET IO

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.

8.3.2 PROFIsafe

If an error occurs in the safety environment, the bus interface sends a respective error code (📖 Section 8.4 "Error messages") to the F-Host. For the evaluation of errors, a differentiation is made between general errors and system errors.

General errors

General errors are divided into acknowledgeable errors and fatal errors. After the bus interface has detected an error on one or more inputs/outputs, depending on the setting of parameter **P801 Error response** either the channel or the entire bus interface is passivated.

For **passivation of the bus interface** the bus interface is set to a safe state (switch-off of all inputs and outputs). Failsafe values (= “0”) are transmitted to the F-Host, and the device status is set to “Fault” (bus interface in fault status). An error which can be acknowledged would be automatically reset after the cause of the error had been remedied. Therefore, in the F-Host project, care must be taken that the bus interface does not start again automatically, but rather only after acknowledgement with a command from the F-Host (“Acknowledgement for Reintegration” according to the PROFIsafe specification).

With **Channel passivation**, the corresponding channel (SO1 … SO3, CLOCK 1, CLOCK 2 or Encoder) is switched off. An acknowledgeable error is still present after the cause of the error has been remedied and must be acknowledged with a command from the F-Host (control byte Date “F-Data In 3.7” acknowledge channel passivation).

If a fatal error occurs (e.g. due to a failed checksum check), all of the bus interface inputs and outputs are switched off. The error can only be reset by switching the power supply off and on again. The device status is set to “Fault” and “Active_FV” (device in a safe state, all channels passivated).

System error

System errors are triggered by malfunctions of the bus interface and cannot be influenced by the user. If a system error occurs, all of the bus interface inputs and outputs are switched off. The error can only be reset by switching the power supply off and on again. The device status is set to "Fault" and "Active_FV" (device in a safe state, all channels passivated).

Frequent occurrence of system errors is a symptom of a defective bus interface. After the occurrence of a maximum of 15 system errors, the bus interface is automatically shut down and starts with a fatal error when it is restarted. In this case, the bus interface must be replaced.

The number of system errors which have occurred is displayed via parameter **P848 System errors**.

8.4 Error messages

8.4.1 PROFINET IO

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**
103.0	System bus Off	No 24 V voltage on bus, connections not correct
550.0	General configuration error	No Ethernet connection (see **E10.5**)
550.2	Hardware error System bus	EMC fault (see **E10.6**)
550.3	SAFE hardware error	Error in the safety module (see **E10.7**)
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
10.5	General PROFINET connection error	• Connection to the Ethernet lost.
10.6	System bus hardware error	• Remedy EMC fault
10.7	Hardware error, Safe bus interface	• An error has occurred in the safe hardware. – Remedy EMC fault – Restart the bus interface
10.8	Timeout connection error	• Connection between bus interface and frequency inverter interrupted due to timeout.
10.9	Module missing **P120**	• The module entered in parameter **P120** is not available.

8.4.2 PROFIsafe

For error messages which occur on transmission of safety-relevant data, a four digit error code (error code range 5711…5799) is sent to the F-Host.

On the bus interface, the error messages are indicated with the red "FE" (Failsafe Error) LED by means of a flashing code (only tens and units of the error code).

Flashing code of the two digit error code

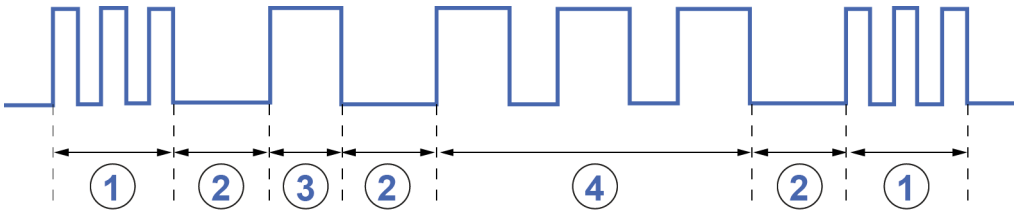


Figure 20: Flashing code – Error example "5713" (Invalid host address)

Item	Flashing code	Meaning
1	Strobe	Three consecutive pulses, pulse length = 400 ms each (200 ms On / 200 ms Off)
2	Pause	LED 2 seconds Off
3	Error code for the 10s decimal place	The LED is switched with a cycle of 1 second (1 second On, 1 second Off)
4	Error code for the 1s decimal place	

A detailed description of all bus interface LEDs can be found in the 🕮 Technical Information.

PROFIsafe error messages

F parameter errors

Error code	Type [1]	Name	Meaning	Remedy
5711	q	Mismatch of F-destination address	The F-destination address set via DIP switches on the bus interface and parameterized in the IO Controller (F_Dest_Add) do not match.	Change the DIP switch setting or parameterised destination address.
5712	q	Invalid F-destination address	The set F-destination address is invalid, only F-destination addresses 1 to 255 are permitted.	Change the DIP switch setting of the parameterised destination address.
5713	q	Invalid host address	The source address which is parameterised in the controller is invalid.	Change the source address.
5714	q	Watchdog time is zero	A watchdog time of zero is invalid.	Set a valid watchdog time in the controller.
5715	q	Incorrect F-SIL	The F-SIL level which is set in the controller is higher than the F-SIL level which is supported by the bus interface.	Change the F-SIL level.
5716	q	Incorrect F-Par version	The F-Par version which is set in the controller is not compatible with the bus interface.	Change the F-Par version.
5717	q	Incorrect F-Parameter checksum.	The F-Parameter checksum (F-Par-CRC) which is determined and transmitted by the controller is not correct.	This error occurs, e.g. if the F-Parameter which is set does not correspond to the specifications.
5718	q	General F-Parameter error		Check the F-Parameter in the controller and re-set.

Error code	Type [1]	Name	Meaning	Remedy
5719	q	Incorrect i-parameter checksum	The checksum of the saved i-Parameter which is calculated in the bus interface and the i-Parameter checksum which is entered in the controller program do not match.	Check the i-Parameters and enter the calculated i-Parameter value (**P840**) in the controller program.
5721	q	The CRC length deviates from the pre-set value		Check the setting of the F-Parameters and correct as necessary.
5722	f	i-parameters have been changed.	The i-Parameters in the bus interface have been changed.	Re-boot the bus interface to adopt the changed i-parameters.
5723	f	Different i-Parameter checksum	The transmitted i-Parameter checksum does not match the newly transmitted i-Parameters.	Re-transmit the i-Parameters, so that they are adopted by the bus interface. Then restart the bus interface.
5724	f	Incorrectly calculated i-Parameter checksum	The checksum of the saved i-Parameter and the saved i-parameter checksum do not match.	Reload the i-Parameters and save.
5725	f	Incorrect F-Parameter telegram		Check the setting of the F-Parameters and correct as necessary.
5726	f	Error when reading in the DIP switch	The DIP switch may be set to zero (invalid value). If this error occurs frequently, the bus interface hardware is defective and the bus interface must be replaced.	Restart the bus interface so that the DIP switch setting is read in again.

[1] f = Fatal error; the device must be switched off and the cause of the error eliminated.
q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

Errors at inputs

Error code	Type[1]	Designation	Meaning	Remedy
5731	q	Different input signals on both channels (discrepancy test)	If the operating mode parameter **P800** is set to “Double channel”, the same state must be set at both inputs within the parameterised discrepancy time (**P803**). If this is not the case, an error is triggered.	The error is reset if both channels are in the "Off" state. Afterwards, the bus interface can be re-integrated.
5737	q	Diagnostic error (OSSD) at input 1	The error occurs in the event of internal errors or a supply from a source other than that of the assigned clock output. The error is present for at least 10 s.	Once the cause of the error has been remedied, the error is reset and the bus interface can be re-integrated.
5738	q	Diagnostic error (OSSD) at input 2		

[1] q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

Errors at outputs

Error code	Type [1]	Name	Meaning
5732	q	Diagnostic error (OSSD) at Output 1	A diagnostic error occurs in case of a short circuit, a cross circuit or an internal error. The error is present for at least 10 sec. Once the cause of the error has been remedied, the error is reset and the bus interface can be re-integrated.
5733	q	Diagnostic error (OSSD) at Output 2	
5734	q	Diagnostic error (OSSD) at Output 3	
5735	q	Diagnostic error (OSSD) at clock Output 1	
5736	q	Diagnostic error (OSSD) at clock Output 2	

[1] q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

i-Parameter error (parameterisation error)

Error code	Type [1]	Name	Meaning	Remedy
5741	q	iPar error OSSD1 channel activation	Output SO1 is activated, although channel activation has not been set (Parameter **P802**, Array 3).	As soon as the cause of the error has been remedied, the bus interface can be re-integrated.
5742	q	iPar error OSSD2 channel activation	Output SO2 is activated, although channel activation has not been set (parameter **P802**, Array 4).	
5743	q	iPar error OSSD3 channel activation	Output SO3 is activated, although channel activation has not been set (parameter **P802**, Array 5).	
5744	q	iPar error Clock Cycle 1 channel activation	CLOCK 1 is activated, although channel activation has not been set (parameter **P802**, Array 6).	
5745	q	iPar error Clock Cycle 2 channel activation	CLOCK 2 is activated, although channel activation has not been set (parameter **P802**, Array 7).	
5746	q	iPar error SI1 channel activation	A signal is present at input SI1, although channel activation has not been set (parameter **P802**, Array 1).	
5747	q	iPar error SI2 channel activation	A signal is present at input SI2, although channel activation has not been set (parameter **P802**, Array 2).	

Error code	Type [1]	Name	Meaning	Remedy
5748	f	iPar error i-Parameter channel activation	Parameter **P802 Channel activation** is incorrectly parameterised (outside of the limits).	Reset the i-Parameters and restart the bus interface.
5749	F	iPar error OSSD signal pulse length	Parameter **P804 OSSD pulse** is incorrectly parameterised (outside of the limits).	
5751	f	iPar error Digital Input filter time	Parameter **P805 Filter time** is incorrectly parameterised (outside of the limits).	
5752	F	iPar error Single/Two channel operation	Parameter **P805 I/O mode** is incorrectly parameterised (outside of the limits).	
5753	f	iPar error input time discrepancy	Parameter **P803 Discrepancy time** is incorrectly parameterised (outside of the limits).	
5754	f	iPar error Passivation	Parameter **P801 Error response time** is incorrectly parameterised (outside of the limits).	
5755	f	iPar error encoder parameter	Parameter **P810 Encoder**, parameter **P811 Speed ratio** or parameter **P812 Encoder resolution** is incorrectly parameterised (outside of the limits).	
5756	f/q	iPar error SLS activation	• Parameter **P820 Safety function SLS** (Array 1) is deactivated or the safety function SLS is activated and parameter **P810 Encoder** is deactivated.	Reset the i-Parameters and restart the bus interface.
			• Parameter **P820 Safety function SLS** (Array 1) is deactivated and is accessed by the controller via the F-Data.	As soon as the error has been remedied, the bus interface can be re-integrated.

Error code	Type [1]	Name	Meaning	Remedy
5757	f/q	iPar error SSR activation	• Parameter **P820 Safety function SSR** (Array 2) is deactivated or the safety function SSR is activated and parameter **P810 Encoder** is deactivated.	Reset the i-Parameters and restart the bus interface.
			• Parameter **P820 Safety function SSR** (Array 2) is deactivated and is accessed by the controller via the F-Data.	As soon as the error has been remedied, the bus interface can be re-integrated.
5758	f/q	iPar error SDI-P activation	• Parameter **P820 Safety function SDS positive** (Array 3) is deactivated or the safety function SDS positive is activated and Parameter **P810 Encoder** is deactivated.	Reset the i-Parameters and restart the bus interface.
			• Parameter **P820 Safety function SDI positive** (Array 3) is deactivated and is accessed by the controller via the F-Data.	As soon as the error has been remedied, the bus interface can be re-integrated.
5759	f/q	iPar error SDI-N activation	• Parameter **P820 Safety function SDS negative** (Array 4) is deactivated or the safety function SDS negative is activated and parameter **P810 Encoder** is deactivated.	Reset the i-Parameters and restart the bus interface.
			• Parameter **P820 Safety function SDI negative** (Array 4) is deactivated and is accessed by the controller via the F-Data.	As soon as the error has been remedied, the bus interface can be re-integrated.

Error code	Type [1]	Name	Meaning	Remedy
5761	f/q	iPar error SOS activation	• Parameter **P820 Safety function SOS** (Array 5) is deactivated or the safety function SOS is activated and parameter **P810 Encoder** is deactivated.	Reset the i-Parameters and restart the bus interface.
			• Parameter **P820 Safety function SOS** (Array 5) is deactivated and is accessed by the controller via the F-Data.	As soon as the error has been remedied, the bus interface can be re-integrated.
5762	f	iPar error Activation time	Parameter **P821 Activation time** is incorrectly parameterised (outside of the limits).	Reset the i-Parameters and restart the bus interface.
5763	f	iPar error Response time	Parameter **P822 Response time** is incorrectly parameterised (outside of the limits).	
5764	f	iPar error Speed	Parameter **P823 Speed** is incorrectly parameterised (outside of the limits) or the speed "Min. SSR" (**P823**, Array 6) is greater than the speed "Max. SSR" (**P823**, Array 5).	
5765	f	iPar error Tolerance	Parameter **P824 Max. position error** is incorrectly parameterised (outside of the limits).	
5766	f	iPar error Limit frequency exceeded	The combination of the set speed ratio **P811**, the encoder resolution **P812** and the limit speed **P823** results in a higher value than the permitted limit frequency for the encoder circuit.	The following condition must be complied with: **P811*P812[number of pulses]*P823/60 < 150000** After this, reset the i-Parameters and restart the bus interface.

[1] f = Fatal error; the device must be switched off and the cause of the error eliminated.
q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

Encoder errors

Error code	Type [1]	Name	Meaning	Remedy
5781	q	SLS error	The SLS speed which has been set and selected by the controller has been exceeded.	As soon as the cause of the error has been remedied, the bus interface can be re-integrated.
5782	q	SSR error	A set SSR Speed has been exceeded or undershot.	
5783	q	SDI_P error	A negative direction has been detected by the encoder and the number of counted values is larger than the set tolerance (**P824**).	
5784	q	SDI_N error	A positive direction has been detected by the encoder and the number of counted values is larger than the set tolerance (**P824**).	
5785	q	SOS error	The number of values counted by the encoder larger than the set tolerance(P824).	

[1] q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

System error

Error code	Type [1]	Name	Meaning	Remedy
5771	f	Temperature outside of specification	The measured temperature has exceeded the limits (< -25 °C or > 75 °C)	Restart the bus interface.
5772	q	Encoder safety condition breached	An error has been detected at the encoder connection.	Check the wiring. An encoder must be connected if an encoder is enabled (**P810**). As soon as the cause of the error has been remedied, the bus interface can be re-integrated.
5773	f	The SYNC signal has not been reduced to "Low" in the meantime	An error has occurred during synchronisation between the two processors of the bus interface.	Restart the bus interface.
5774	f	Supply voltage error	The supply voltage is too high or too low	The supply voltage is specified for the range between 19.2V and 30V. Cause of error: • Voltage is not within the permissible range, • Voltage increase too slow • Voltage decrease too slow
5775	f	Supply voltage error	The supply voltage is too high or too low	See error code **5774**
5776	f	Speed difference error	The difference between the speeds, measured by the two processors is too high.	• Strictly comply with the specifications for connecting the module (ensure EMC). • Restart the bus interface. • A renewed occurrence of the error indicates a defect in the bus interface.
5791	f	System error saved in flash memory	A system error has been triggered and is saved.	Restart the bus interface. If more than 15 system errors have been triggered, the bus interface can no longer be used and must be replaced.

Error code	Type [1]	Name	Meaning	Remedy
5792	f	Maximum number of system errors reached	More than 15 system errors have occurred on the bus interface.	Replace the bus interface, as a large number of system errors indicate a hardware defect.
5797	f	Flash memory access error (does not trigger a system error, because saving is not possible)	A flash memory access error cannot be saved.	Restart the bus interface. The bus interface must be replaced if this error occurs frequently.
5799	f	Reserved for PROFINET		

[1] f = Fatal error; the device must be switched off and the cause of the error eliminated.
q = Acknowledgeable error; the error is reset when the cause of the error has been remedied.

9 Appendix

9.1 Repair information

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

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

NORD Electronic DRIVESYSTEMS GmbH

Tjüchkampstraße 37

26606 Aurich

Information

Third party accessories

Getriebebau NORD GmbH & Co. KG cannot accept liability for third party accessories if these are returned with the device.

Information

Accompanying document

Please complete the accompanying document for the return. This can be found on our homepage www.nord.com or directly under the link Warenbegleitschein

In case of 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:

Tel.: +49 4532 289-2125

Our service is available to you at all times (24/7) and can support you the best if you have the following device information and accessories available:

- 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 275271014	Technical Information/Data Sheet for bus interface **SK CU4-PNS**
TI 275281116	Technical Information/Data Sheet for bus interface **SK TU4-PNS** with RJ45 connection (for IP55 devices)
TI 275281166	Technical Information/Data Sheet for bus interface **SK TU4-PNS-C** with RJ45 connection (for IP66 devices)
TI 275281216	Technical Information/Data Sheet for bus interface **SK TU4-PNS-M12** with M12 connection extension(for IP55 devices)
TI 275281266	Technical Information/Data Sheet for bus interface **SK TU4-PNS-M12-C** M12 connection extension(for IP66 devices)
BU 0200	Manual for frequency inverter **SK 2xxE (NORDAC *FLEX*)**
BU 0230	Functional safety manual for frequency inverter **SK 2xxE (NORDAC *FLEX*)**
BU 0235	Functional safety manual for frequency inverter **SK 2x0E-FDS (NORDAC *LINK*)**
BU 0250	Manual for frequency inverter **SK 2x0E-FDS (NORDAC *LINK*)**
BU 0000	Manual for use of NORDCON software
BU 0040	Manual for use of NORD parameterisation units

Software

Software	Description
GSDML file	Device description file for PROFINET IO/PROFIsafe configuration software
NORDCON	Parametrisation and diagnostic software

Certificates

Certificate	Description
C330705	Certificate for "Fail-safe I/O module"

Key word index

A

Accompanying document 127
Acknowledgement for Reintegration 114
Activation time (P821) 103
Actual (P841) 106
Actual error (P170) 90
Actual value
  IW 54
Actual values 61
Actual voltage (P845) 107
Additional parameters 109
Addressing the bus interface 44, 47, 50
Application data 52

B

Binary transmission 61
Black Channel 17
Bus master
  Integration 44, 45, 54
Bus node 40

C

CAN bus address (P515) 40
CAN bus baud rate (P514) 40
CAN ID 40
CANopen 38
Channel activation (P802) 99
Checksum check (CRC) 45
Commissioning 44, 49
Configuration (P172) 90
Connection: 44
Control bit 55
Control word 55, 59, 60
  STW 54
Cycletime monitoring (P806) 101

D

Data record transfer
  Examples 72
Data records
  Format 68
Data sets
  Parameter requests 67
Data transmission 51
Device description file 46
Device name (P162) 88
Dip switch status (P190) 97
DIP switch status (P846) 108
Discrepancy time (P803) 99
Documents
  other applicable 128

E

Electrician 14
Encoder (P810) 101
Encoder resolution (P812) 102
Error (PROFIsafe)
  General 114
  System error 114
Error messages 45, 90, 110
  Bus interface 114, 115
  Frequency inverter 115
  from frequency inverters 113
  PROFIsafe 116
  Reset 112
Error monitoring 45, 90, 110
Error response (P801) 98

F

Factory settings (P152) 85
F-Address (code name) 48
F-Address (P831) 105
F-Data 51
F-Data exchange 75
F-Data transmission 45, 51, 75
F-Device (safety field device) 17
F-Host (safety controller) 17
Field bus address 47
Filter time (P805) 100
F-Parameters 78

I

I/O operating mode(P800) 98
Information parameter 109
IO
  Controller 15
  device 15
  supervisor 15
IP address
  (P160) 87
IP Gateway (P164) 89
IP sub-net mask (P161) 87
i-parameter CRC(P840) 106

L

Last error (P842) 106

M

MAC address (P181) 96
Max. position error (P824) 105
Min. system bus cycle (P153) 85
Module status (P173) 91
Monitoring functions 110
Monitoring parameter 111

N

NORD CON computer 38
NORD system bus 10, 38
NORDCON software 42

O

OSSD pulse (P804) 100

P

Parameter
  Bus interface 82
  Frequency inverter 109
  index 71
  numbers 68
  order 66
  response 66
Parameter data 51
Parameter data transmission 51, 64, 65, 67
Parameter settings
  Frequency inverter 109
Parameter value PWE2
  Error messages 70
ParameterBox 41
Parameterisation
  PPO1 or PPO2 74
Percentage transfer 61
Permissible write cycles 65
PKW area 68
PPO type PPO1 64
PPO type PPO2 64
PPO type PPO3 63
PPO type PPO4 63
PPO type PPO6 63
PPO types 54
PPO types (Structure) 53
PPO-Type (P180) 95
Present IP address (P185) 96
Present IP Gateway (P187) 97
Present IP sub-net mask (P186) 97
Process data 46, 51
Process data Bus In (P176) 93
Process data bus Out (P177) 94
Process data telegrams 51, 53, 63
PROFIBUS profile 54
PROFINET IO controller 45
PROFIsafe F-Host 45
Proof test 31

R

Records 66
Re-integratable 12
Remote maintenance 43
Repairs 127
Request ID 69
Response ID 69
Response time (P822) 104
Returns 127

S

Safety function (P820) 103
Save i-Parameter(P830) 105
SDI-N (Safe Direction Negative) 35
SDI-P (Safe Direction-Positive) 35
Set relay (P150) 83

Setpoint
SW 54
Setpoint specification
Example 81
Setpoints 61
SimpleBox 41
SLS (Safely Limited Speed) 33
Software 128
Software-Version
P171 90
SOS (Safe Operating Stop) 36
Speed (P847) 108
Speed limit (P823) 104
Speed ratio (P811) 102
SSM (Safe Speed Monitoring) 37
SSR (Safe Speed Range) 34
State of digital in. (P174) 92
State of relays (P175) 92
Status bit 56
Status machine
Frequency inverter 57
Status word 56, 60
ZSW 54
System error (P848) 108

T

TB-IO access (P154) 86
Temperature (P844) 107
Test alarm (P163) 88
Timeout 110
Timeout for external bus (P151) 84
Topology 19
Transfer of process data 46, 51, 54, 65
Transmission of positions 62

U

USS protocol 41

Headquarters
Getriebebau NORD GmbH & Co. KG
Getriebebau-Nord-Str. 1
22941 Bargteheide, Deutschland
T: +49 45 32 / 289 0
F: +49 45 32 / 289 22 53
info@nord.com

6022802 / 4821