Intelligent Drivesystems, Worldwide Services

GB

BU 0220

PROFIBUS DP – Supplementary manual
for NORD Frequency Inverter SK 200E

NORD DRIVESYSTEMS

NORD frequency inverters

Safety and operating instructions for drive power converters

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

1. General

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

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

Further information can be found in this documentation.

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

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

2. Proper use in Europe

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

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

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

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

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

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

3. Transport, storage

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

4. Installation

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

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

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

5. Electrical connection

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

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

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

6. operation

Where necessary, systems where drive power converters are installed must be equipped with additional monitoring and protective equipment according to the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc.

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

All covers must be kept closed during operation.

7. Maintenance and repairs

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

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

Documentation

Designation: BU 0220 GB
Part No.: 607 22 01
Device series: PROFIBUS DP for SK 2xxE
Device types: **SK CU4-PBR**
SK TU4-PBR(-C) with SK TI4-TU-BUS
SK TU4-PBR-M12(-C) with SK TI4-TU-BUS

Version list

Designation of previous versions	Software Version	Remarks
BU 0220 DE, June 2009 Part No. 607 2201 / 2609	V 1.1 R1	First issue
BU 0220 GB, February 2012 Part No. 607 2201 / 0912	V 1.2 R0	The bus module also recognises the SK 54xE, Firmware update also possible via the CAN system bus, Error corrections (e.g. connection via the Profibus data cables PBA / PBB) Supplements to Section 7.2.1.7 and 7.2.1.8 (assignment of functions BIT 8/9 STW or BIT 10/13 ZSW Parameters (P153) and (P154) supplemented

Publisher

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NOTE

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

Intended use of the frequency inverter

The **compliance** with the operating instructions is **necessary for fault-free operation** and the acceptance of possible warranty claims. **These operating instructions must be read** before working with the device!

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

The field bus technology options described here are intended for use in combination with SK 200 E series frequency inverters. The SK 5xxE can only be used with other series by means of SK TU4-... Technology Units. The use of these technology options with other devices is not permitted and can lead to their destruction.

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

Commissioning (implementation of the intended use) is not permitted until it has been ensured that the machine complies with the EMC directive 204/108/EEC and that the conformity of the end product meets the machine directive 2006/42/EEC (note EN 60204).

1 General information

Various technology options are available for Getriebebau Nord frequency inverters. General information regarding these can be found in the relevant main manual of the frequency inverter series (e.g. Manual BU0200 for the SK 200E frequency inverter series). Further information concerning special technology options (e.g. the field bus module) is included in the relevant supplementary operating instructions.

This PROFIBUS DP documentation contains supplementary descriptions concerning the PROFIBUS DP options for the SK 200E frequency inverter series.

The description of other optional modules (e.g. CANopen) is dealt with in other supplementary documentation.

In order to set up communication with PROFIBUS DP, either an internal **Customer Unit** or an external **PROFIBUS DP Technology Unit** (according to the particular application) must be installed and connected.

The PROFIBUS DP bus system

A large number of different automation devices can exchange data with frequency inverters using PROFIBUS DP. PLC's, PC's, operating and monitoring devices can all communicate via a uniform bus in serial bit mode. PROFIBUS DP is primarily used for communication between sensor and actuator where system response needs to be very fast. PROFIBUS DP is used where the time for rapid and complex communication between the individual devices is critical. PROFIBUS DP is a suitable alternative to expensive 24-volt parallel signal transmission and transmission of measured values. This type of PROFIBUS, which is optimised to speed, is used for instance for operating frequency inverters on automation devices.

PROFIBUS communication is standardised and specified in the international standards IEC 61158 and IEC 61784. Application and planning aspects are specified and documented in the guidelines of the PROFIBUS users´ organisation (PNO). This ensures intercommunication between devices from different manufacturers. Data exchange is specified in DIN 19245 Part 1 and 2 and application-specific upgrades in Part 3 of this standard. Within the European field bus standardisation process, PROFIBUS is integrated into the European field bus standard EN 50170.

1.1 Overview

Features of the PROFIBUS DP modules

- Electrically isolated bus interface
- Transfer rate: 12Mbit/s
- Easy connection, optionally via M12 round plugs or screw terminals
- Looping of the PROFIBUS DP via the module
- Integrated bus terminating resistor (switchable)
- PROFIBUS DP-specific status indication with 2 LEDs on the internal (Customer Unit) and external (Technology Unit) technology option
- DEVICE or FI-specific status indication with 2 LEDs on the internal (Customer Unit) and external (Technology Unit) technology option
- PROFIBUS DP basic functionality as per DP-V0
- Acyclic data traffic as per DP-V1
- Up to four 24V inputs and two 24V outputs are integrated into the bus module
- Direct connection of up to 4 sensors and 2 activators via M12 round plug connectors on the SK TU4-PBR-M12(-C) version. Visualisation of signal status via LEDs
- Transmission and reading of process and parameter data
- PROFIBUS DP Gateway solution → up to 4 frequency inverters can be connected to a PROFIBUS DP module
- Up to 122 PROFIBUS DP modules can be connected to the bus. This enables the operation of up to 488 frequency inverters on one bus.
- Automatic detection of baud rate and PPO type by the PROFIBUS DP module
- "Simultaneous" access by up to 4 PROFIBUS DP masters (1 x DPM1 and up to 3 x DPM2) possible. The DPM2 masters do not need to be permanently connected to the PROFIBUS DP network for communication.
- Interface (RS232/RS485) for parameter access by means of the SK PAR-3H manual control unit or NORDCON software via RJ12 connector (Except for SK CU4-PBR. Here parameter access via the SK 2xxE frequency inverter is possible)
- Available as versions for installation in the inverter (IP20) or in a separate housing (optionally IP55 / IP66)

1.2 Delivery

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

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

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

1.3 Scope of supply

Standard version: **SK CU4-PBR** IP20 or

SK TU4-PBR(-M12)(-C) IP55 **(optionally IP66)**

Operating instructions as PDF file on CD ROM
including NORDCON, (Windows PC-based parameterisation software)

Available accessories: **SK TI4-TU-BUS(-C)** (bus connection unit, required for SK TU4…)

SK TIE4-WMK-TU, wall-mounting kit TU4

M12 round plug connector (Section 8.2 "Cable glands and shielding connections")

Matching **RJ12 to SUB-D9** adapter cable to connection to a PC

ParameterBox: **SK PAR-3H**, ParameterBox, plain text LCD display

1.4 Certifications

1.4.1 European EMC Directive

If the SK 2xxE frequency inverter or its options are installed according to the recommendations in this instruction manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3. (see also Section 8.1.3 "Cable layout and shielding (EMC measures)")

1.4.2 RoHS compliance

SK 200E series frequency inverters or their options are designed to be RoHS compliant according to Directive 2002/95/EEC

1.5 Type code / Optional BUS modules

BUS = Bus module or I/O extension

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

- Wall mounting kit: for external technology unit, TU4
- M12 system connector: only TU4, alternative to terminals
- IP protection class: *Standard* = IP55, C = "coated" IP66
- Option type: CAO = CANopen, PBR = Profibus, DEV = DeviceNet, IOE = I/O extension
- Option series: TU4 = external technology unit; CU4 = internal customer unit

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

Optional external
technology unit, SK TU4-…

Optional internal
customer unit, SK CU4-…

1.6 Version with protection class IP55 / IP66

The **SK 2xxE** frequency inverter and the **external additional modules** are available with protection classes IP55 (Standard) or IP66 (optional) and in all sizes and power ratings.

The protection class IP66 must always be stated when ordering!

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

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

IP55 version:

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

IP66 version:

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

NOTE

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

Special measures:

Impregnated PCBs, coated housing

Diaphragm valve for pressure compensation on temperature changes.

Low pressure test

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

NOTE

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

2 Assembly and installation

2.1 Installation and assembly

Internal and external technology modules designed for the SK 2xxE frequency inverter series are available for PROFIBUS DP. Except for the number of digital inputs and outputs, the functionalities of the various PROFIBUS modules are identical.

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

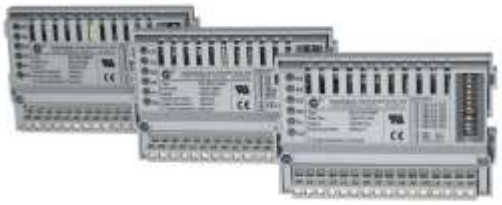
SK TI4-… with integrated technology unit SK CU4-…

SK 200E with external technology unit SK TU4-... and BUS connection module SK T14-TU-BUS

SK TIE4-WMK-TU with BUS connection module SK T14-TU-BUS and external technology unit SK TU4-... or SK TU4-...-M12

The internal **technology modules (Customer Unit, SK CU4-...)** – designated as the **customer unit** – are integrated into the connection unit of the SK 2xxE. Electrical connection to the SK 2xxE is made via the internal system bus. The connection to external peripheral devices is made via screw terminals. The use of the optionally available 4 or 5 pin M12 round plug connector, installed in the connection unit of the SK 2xxE, provides a possible interface for connection to the field bus. A maximum of one customer interface (including any 24V module) can be installed in the SK 2xxE frequency inverter.

Optional internal customer units, SK CU4-…



The external **technology modules (Technology Unit, SK TU4-...)** – designated as the **technology unit** – are externally attached to the SK 2xxE connection unit and are therefore easy to access. Mounting of the SK TU4-... separate from the frequency inverter is possible by means of the wall mounting kit **SK TIE4-WMK-TU**. Electrical connection to the SK 2xxE is made via the internal system bus. 4 or 5 pin M12 round plug connectors (for installation in the BUS connection unit **SK TI4-TU-BUS**) are available as an option for connection of the field bus cable. The external modules are also available as a version with integrated M12 round plug connectors (SK TU4-xxx-**M12**). These enable the connection of up to 4 digital inputs and 2 digital outputs.

Optional external
technology unit, SK TU4-…

NOTE

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

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

The external technology units (SK TU4-...(-M12) cannot be operated without the BUS connection unit (SK T14-TU-BUS)!

NOTE

Only one field bus module (e.g. SK CU4-PBR or. SK TU4-PBR) can be connected to a single system bus.

2.1.1 Overview of the PROFIBUS DP modules

Bus Module	Description	Data
Profibus module **SK CU4-PBR** Part No. 275271000 (IP20)	 This option enables control of the SK 2xxE via PROFIBUS DP. This option is integrated into the connection unit of the frequency inverter.	Protocol: DP-V0 (cyclical data traffic) DP-V1 (acyclic data traffic) Baud rate: up to 12 MBaud Connection: 16-terminal screw terminal bar 2x digital inputs: Low: 0-5V, High: 11-30V System bus
Profibus module *) **SK TU4-PBR(-C)** Part No. 275281100 (IP55) Part No. 275281150 (IP66)	 This option enables control of the SK 2xxE via PROFIBUS DP. This option is installed externally to the frequency inverter. According to the installation location, at least one "BUS connection unit"* is required.	Protocol: DP-V0 (cyclical data traffic) DP-V1 (acyclic data traffic) Baud rate: up to 12 MBaud Connection: 36 pin spring terminal bar of the "BUS connection unit" * 4x digital inputs: Low: 0-5V, High: 11-30V 2x Digital outputs: 0/24V System bus
Profibus module with M12 *) **SK TU4-PBR-M12(-C)** Part No. 275281200 (IP55) Part No. 275281250 (IP66)	 This option enables control of the SK 2xxE via PROFIBUS DP. This option is installed externally to the frequency inverter. According to the installation location, at least one "BUS connection unit"* is required.	As SK TU4-PBR, but with: 6x M12 socket for the connection of up to 4 sensors and 2 actuators via 5 pin M12 round plug connectors (A coded)
Connection unit for TU4 **SK TI4-TU-BUS** Part No. 275280000 (IP55) Part No. 275280500 (IP66)	 The connection unit is always required in order to use an external technology unit (SK TU4-...). This implements the mechanical and electrical connection of the Technology Unit to the SK 2xxE or the wall-mounting kit.	Connection: 36 pin spring terminal bar 36x 2,5mm^2 AWG 26-14 Spring terminals
TU4 Wall-mounting kit **SK TIE4-WMK-TU** Part. No. 275274002	 With the wall mounting kit, a technology unit can be used/installed separately from the SK 2xxE.	
*) in order to use the TU4 modules, a suitable SK TI4-TU-BUS connection unit must always be available!		

2.1.2 Installing the Customer Unit SK CU4-PBR

WARNING

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

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

Installation of the SK CU4-... customer unit **remote** from the frequency inverter is not permitted. This must be mounted directly in the connection unit of the SK 2xxE frequency inverter.

The installation of customer units is carried out in the connection unit SK T14-…of the SK 2xxE underneath the control terminal bar. Fastening is by means of the terminal bar of the frequency inverter and two M4x20 screws (bag enclosed with the customer unit). Only one customer unit per FI is possible!

The pre-assembled cables for connection to the frequency inverter (SK 2xxE) are also included in the bag enclosed with the customer unit. Connections are made according to the following table:

SK TI4-… with integrated technology unit SK CU4-PBR

internal customer unit SK CU4-PBR

Bag enclosed with internal customer unit

Function	Terminal label		Cable colour
Power supply (between frequency inverter and customer unit)	**44**	24V	brown
	40	GND	blue
System bus	**77**	SYS+	black
	78	SYS-	grey

NOTE

Set the termination resistors of the system bus!

see Section 2.2.3 "Configuration")

2.1.3 Installing the SK TU4-PBR-… technology unit

WARNING

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

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

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

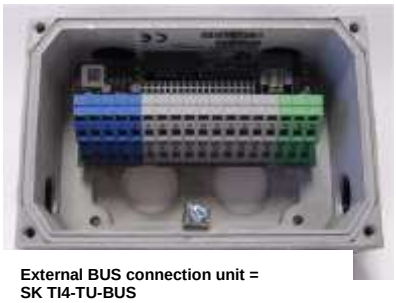
Together with the BUS connection unit SK TI4-TU-BUS(-C) the technology unit SK TU4-PBR-…(-C) forms a stand-alone functional unit. This can be attached to the SK 2xxE frequency inverter or installed separately by means of the optional SK TIE4-WMK-TU wall-mounting kit.

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

The optional wall-mounting kit has the following dimensions.

2.1.3.2 BUS connection unit SK T14-TU-BUS(-C)

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



External BUS connection unit = SK TI4-TU-BUS

The following holes are available as cable inlets:

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

The transparent screw-on cover (M20 x 1.5) on the upper right serves as access to the diagnostic interface (RJ12 socket, interface RS232/RS485). The top left screw connection is a blank screw cap.

NOTE

The IP protection class is not complied with if the screw connections are not connected properly. In this case, the module may be damaged by the entry of dirt or moisture.

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

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

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

1. Switch off the mains.
2. Remove the two M25 caps on the required side of the frequency inverter (right / left).
3. Remove the printed circuit board (with terminal bar) from the BUS connection unit.
4. Install the SK T14TUBUS (with adhered seal) on the SK 200E using the 4 enclosed bolts.
5. Replace the printed circuit board (See point 3) and carry out the electrical connections.
6. Fit and screw on the SK TU4 module.

Mounting the external technology unit on the SK 200E

Technology unit SK TU4-PBR (-M12)

BUS connection unit SK T14-TU-BUS

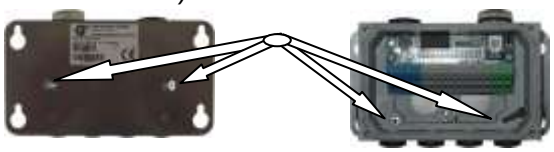
2.1.3.4 Wall-mounting the SK TI4-TU-BUS

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

The connecting cable between the technology unit and the SK 2xxE should not be longer than 30m.

1. Mount the SK T14-TU-BUS connecting unit with adhered seal on the wall-mounting kit. To do this: Insert the 2 x cheese-head screws (enclosed with wall-mounting kit) into the (countersunk) holes from the outside and with the 2 x bolts (enclosed with the wall-mounting kit) securely screw both components together from the inside (BUS connection unit).

Bus Technology Unit with wall-mounting kit



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

2.2 Electrical connection

WARNING THE DEVICES MUST BE EARTHED.

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

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

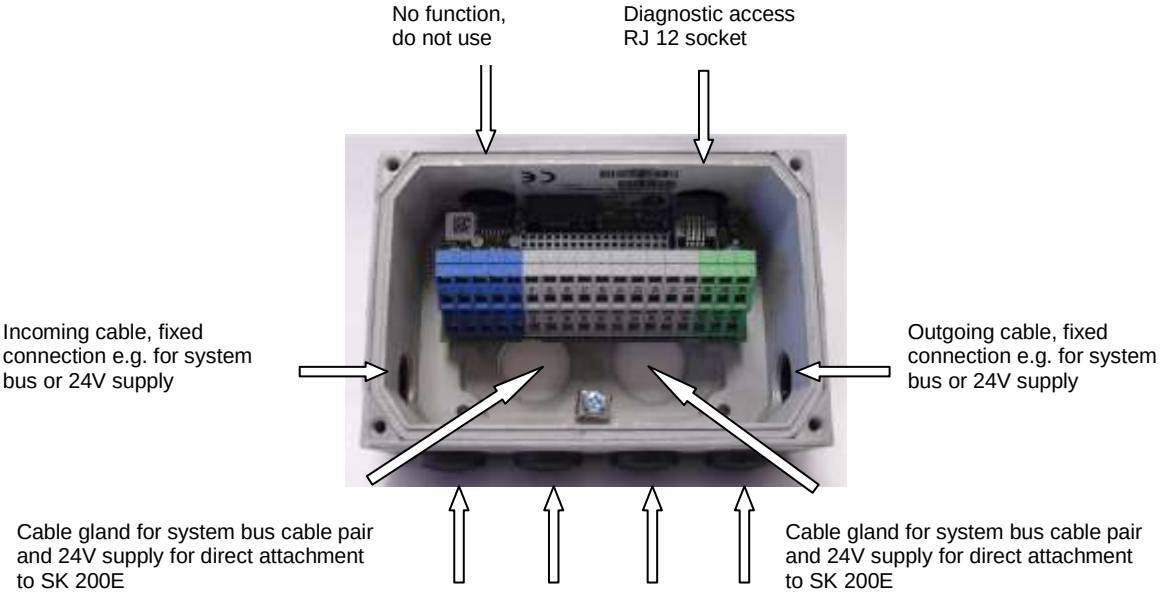
Dangerous voltages can be present at the motor connection terminals of the frequency inverter even when the inverter is switched off. Always use insulated screwdrivers on these terminal fields.

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

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

2.2.1 Cable gland

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



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

- incoming and outgoing PROFIBUS DP cable
- 24V and 24V (for DO) supply
- System bus
- I/O peripherals: sensors and actuators

2.2.2 Control connections

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

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

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

NOTE

The PROFIBUS DP is already installed in the customer unit with voltage isolation from the other signal connections.

In case of EMC problems, voltage separation of the field bus supply, the digital inputs and system bus interface and for the external technology unit also for the two additional digital outputs should be provided.

NOTE

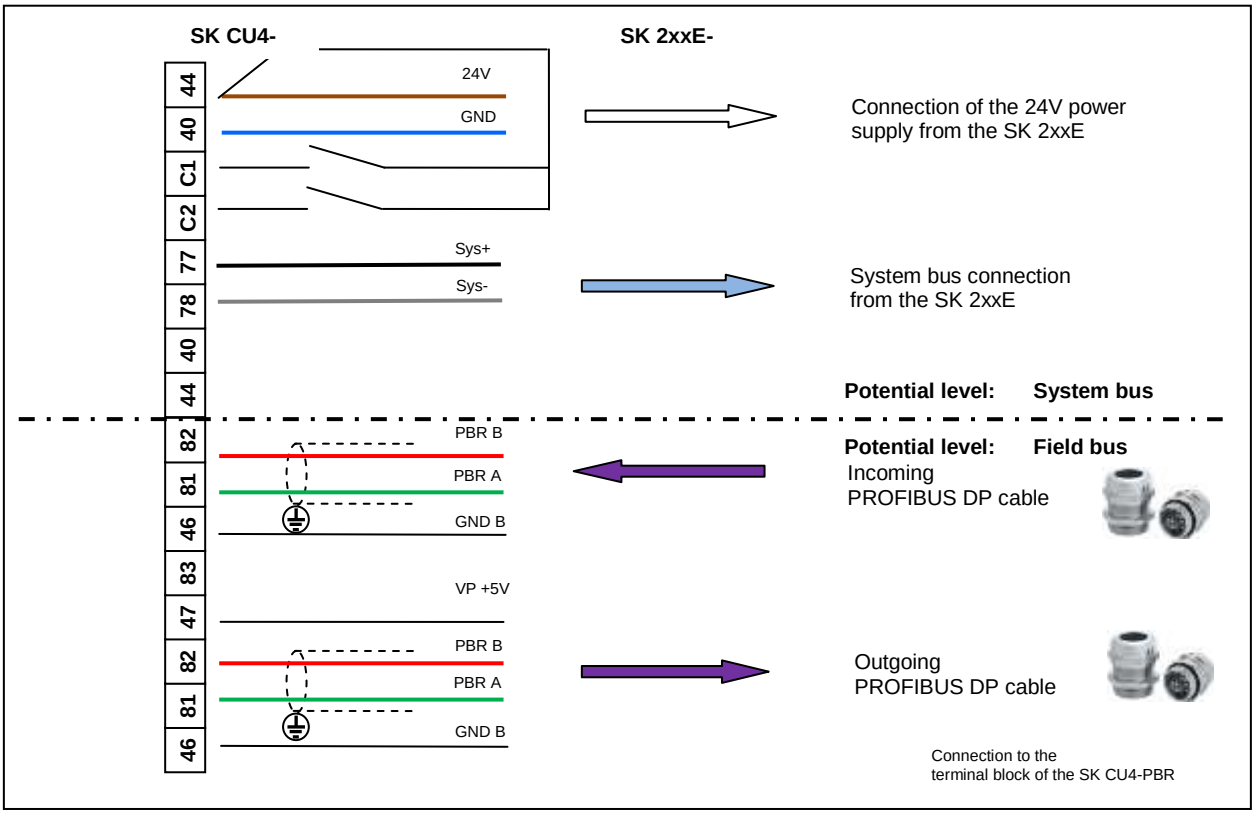
The cable shielding must be connected to the *functional earthing* [1] (usually the electrically conducting mounting plate) in order to prevent EMC interference in the device.

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

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

2.2.2.1 Control connections SK CU4-PBR

The terminal bar of the customer unit SK CU4-PBR is divided into two potential levels.



Connection of up to 2 sensors is made on the terminal bar (terminals C1 and C2).

NOTE

Looping of the 24V supply voltage (terminals 40/44) is possible, however a maximum current load of **2A** for the **SK CU4-PBR** must not be exceeded.

Control connection details

Terminal/ Name	Function	Data	Description / wiring suggestion	Parameter
44 24V	24V supply (Module, field and system bus level)	24VDC ±20% ≈ 90mA reverse polarity protected max. permissible current load: 2A	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 and DIN2)	-
40 GND / 0V	Reference potential for digital signals			-
C1 DIN1	Digital input 1 (I/O PROFIBUS DP DIN1)	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms	Each digital input has a reaction time of 1ms. Inputs as per EN 61131-2 Type 1	P174
C2 DIN2	Digital input 2 (I/O PROFIBUS DP DIN2)			P174
77 Sys H	System bus data cable +		System bus interface	-
78 Sys L	System bus data cable -			-
40 GND / 0V	Reference potential for digital signals	24VDC ±20% ≈ 90mA reverse polarity protected max. permissible current load: 2A	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 and DIN2)	-
44 24V	24V supply (Module, field and system bus level)			-
Potential isolation				
82 PBR B (incoming)	Bus + (red lead) RxD/TxD-P	RS485 transfer	The use of twisted, shielded two-conductor cable / Type A Profibus cable is highly recommended	-
81 PBR A (incoming)	Bus - (green lead) RxD/TxD-N			-
46 GND/ 0V BUS	Data ground bus			-
83 RTS	Ready to send			-
47 VO/ 5V BUS	+5V bus supply voltage	Internal Profibus voltage supply	Note: Must not be used externally!	-
82 PBR B (outgoing)	Bus (red lead) RxD/TxD-P	RS485 transfer	The use of twisted, shielded two-conductor cable / Type A Profibus cable is highly recommended	-
81 PBR A (outgoing)	Bus (green lead) RxD/TxD-N			-
46 GND/ 0V BUS	Data ground bus			-

2.2.2.2 Control connections of the SK TU4-PBR(-...)

The double spring-loaded terminal bar of the bus connection unit is **colour coded**, and therefore indicates the **three** different **potential levels**.

Terminals 1 and 2 have the same potential as the 24V terminals of the system bus level (e.g. Terminal 11). However, electrical connection between these terminals is only implemented by mounting the bus module onto the bus connection unit. Terminals 1 and 2 must only be used to supply sensors. Looping of a 24V supply must not be performed via these terminals (1 and 2).

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

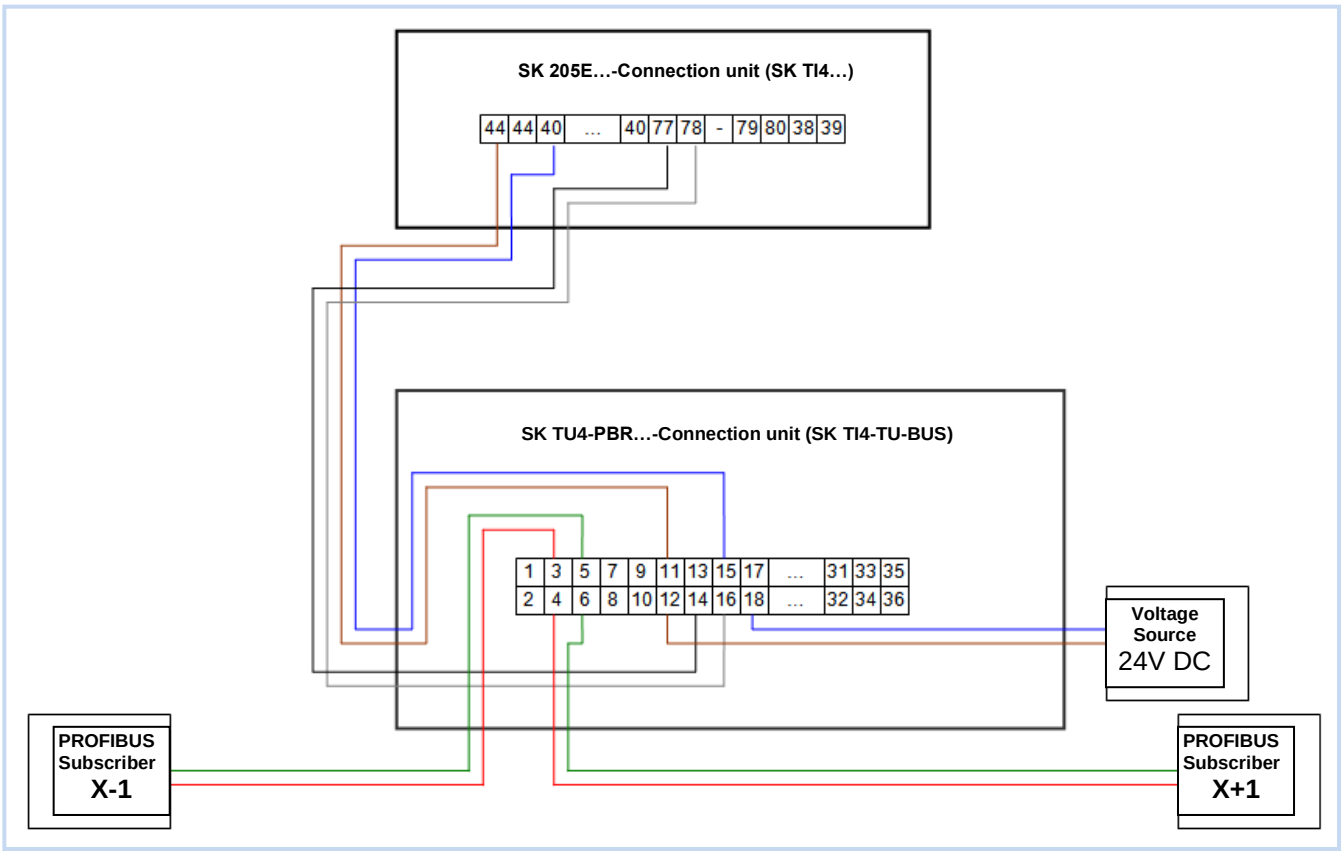
Connection of the sensors and actuators is made via the terminal bar. Alternatively, the SK TU4-PBR-**M12** enables the connection of the digital I/Os via the M12 round plug connector (5 pin socket, A-coded) mounted on the front.

Double use of the inputs via the terminal bar and the M12 round plug connector *must be avoided*.

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

Terminal block of the bus Adapter Unit SK TI4-TU-BUS and assignment of functions

Connection example: SK TU4-PBR to SK 205E



NOTE

The data cables (Terminals 3/4 or Terminals 5/6) or the Terminals 1 and 2 to Terminal 11 are only contacted by mounting the bus module.

NOTE

Looping of the 24V supply voltage or GND is possible (except for Terminals 1 and 2), however a maximum current load of **3A** for the **SK TU4-PBR(-…)** must not be exceeded.

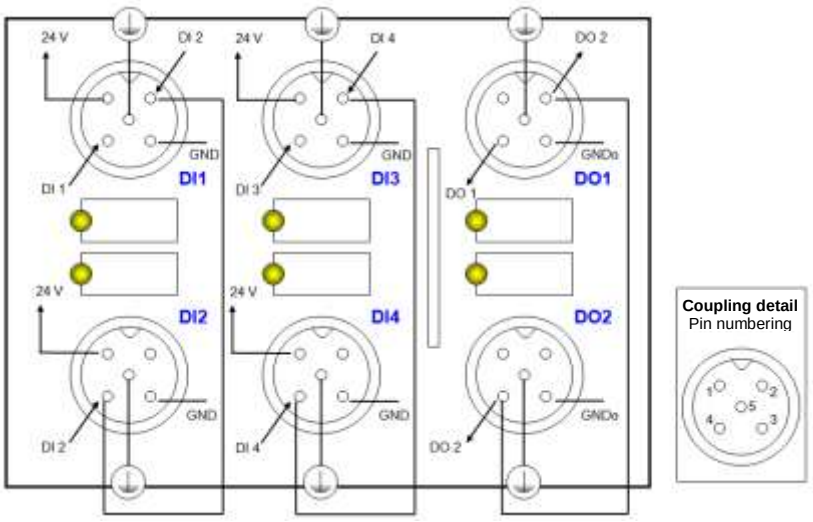
Only adjacent terminals (e.g.: X5:11/12) may be used for looping.

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

Details of the M12 connections of the SK TU4-…-M12

The special wiring of the M12 round plug connector enables the connection of both single and double sensors, which are equipped with normal M12 system connectors in the standard sensor/actuator configuration.

With the use of M12 round plug connectors, the terminal bar connectors for the digital inputs (Terminals 19, 20, 25, 26) must not be used.



Wiring of the M12-plug connector to SK TU4-…-M12

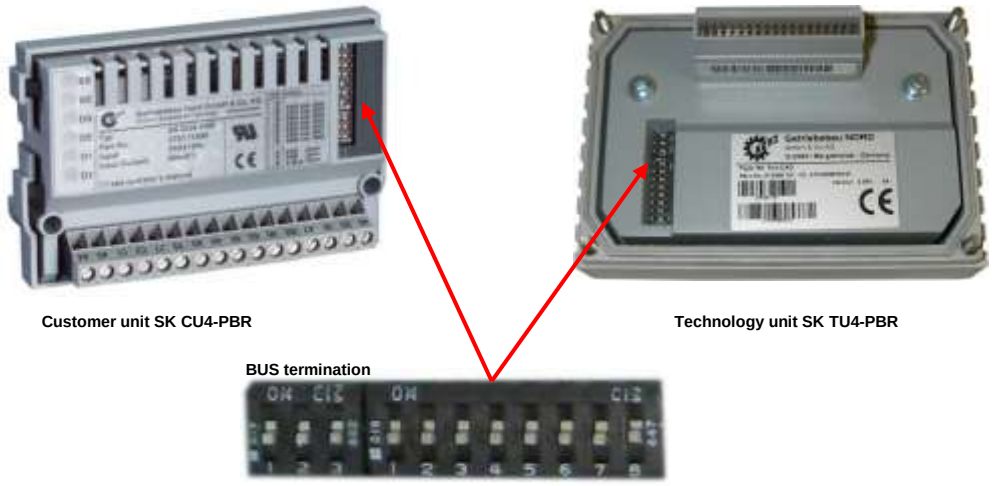
Control connection details

Terminal/ Name	Function	Data	Description / wiring suggestion	Parameter
1 24V 2	24V supply (Module, field and system bus level)	24VDC ±20% ≈ 90 mA reverse polarity protected Max. permissible current load: **500mA**	Connection of the sensor supply voltage via DC/DC converter to Terminal 11.	-
Potential isolation				
3 PB B (incoming) 4 (outgoing)	PBR B Bus + (red lead) RxD/TxD-N	RS485 transfer	The use of twisted, shielded two-conductor cable / Type A Profibus cable is highly recommended	-
5 PB A (incoming) 6 (outgoing)	PBR A Bus - (green lead) RxD/TxD-P			-
7 0V-B 8	Data ground bus	Reference potential for internal Profibus voltage supply		-
9 RTS	Ready to send			-
10 5V B	5V bus supply voltage	Internal Profibus voltage supply	Note: Must not be used externally!	-
Potential isolation				
11 24V 12 13	24V supply (Module, field and system bus level)	As for terminal 1 However, max. permissible current load: **3A**	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN4)	-
15 0V 17 18	GND Reference potential for digital signals			-
14 Sys +	System bus data cable +		System bus interface	-
16 Sys -	System bus data cable -			-
19 DIN1	Digital input 1 (I/O Profibus DIN1)	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms Inputs as per EN 61131-2 Type 1	Each digital input has a reaction time of 1ms.	P174
20 DIN3	Digital input 3 (I/O Profibus DIN3)			P174

Terminal/ Name	Function	Data	Description / wiring suggestion	Parameter
21 0V 22	GND Reference potential for digital signals	As for terminal 15	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN4)	-
23 24V 24	24V supply (Module, field and system bus level)	As for terminal 1 However, max. permissible current load: **3A**		-
25 DIN2	Digital input 2 (I/O Profibus DIN2)	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms Inputs as per EN 61131-2 Type 1	Each digital input has a reaction time of 1ms.	P174
26 DIN4	Digital input 4 (I/O Profibus DIN4)			P174
27 0V 28	GND Reference potential for digital signals	As for terminal 15	Connection of supply voltage for module and 24V source for supply of the digital inputs (DIN1 to DIN4)	-
29 24V 30	24V supply (Module, field and system bus level)	As for terminal 1 However, max. permissible current load: **3A**		-
Potential isolation				
31 24V2	24V supply of digital outputs	24VDC -/+20% Up to 1A, according to load reverse polarity protected	Supply voltage connection for digital outputs (DO1 and DO2) If necessary, bridge to 24V terminal	-
32 0V2	GND 2 Reference potential for digital outputs		Ground for digital outputs (DO1 and DO2) If necessary, bridge to 0V terminal	-
33 DO1	Digital output 1 (I/O Profibus DO1)	Low = 0V High: 24V Rated current: 500mA each	The digital outputs should be used with a separate 24V supply	P175
34 DO2	Digital output 2 (I/O Profibus DO2)			P175
35 0V2 36	GND 2 Reference potential for digital outputs		Ground for digital outputs (DO1 and DO2) If necessary, bridge to 0V terminal	-

2.2.3 Configuration

The configuration for all PROFIBUS DP module versions is identical. All necessary settings are made using the hardware via a DIP switch element (3+8 part switching block).



DIP switch 3 + 8 part

Addressing

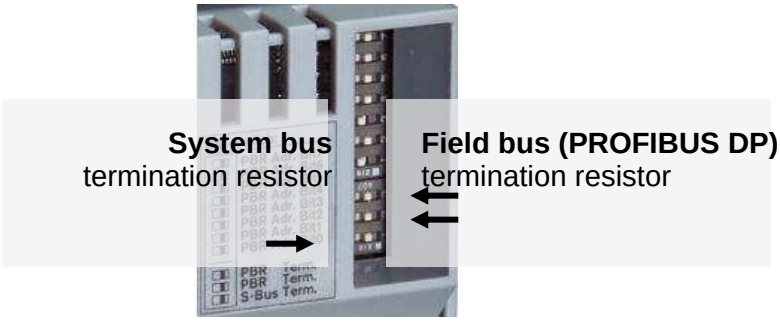
Note:

- PROFIBUS DP - Address: Setting only via DIP switch in binary code
- Permissible address range: 3 … 125 → other addresses result in an error message
- Address changes: only become effective after switching the BUS module off and on again

Termination resistor

The termination of the BUS system is made for the first and last participants by connecting the relevant termination resistors (DIP switch).

PROFIBUS DP module (view of DIP switch)



E.g.: SK CU4-PBR

SK 200E (internal view)

E.g.: SK 200E

NOTE

For the termination of the PROFIBUS DP **both** termination resistors "PB Term" must be set to "ON".

PPO-Type

The PPO type used by the bus master is automatically detected by the PROFIBUS DP modules (SK CU4-PBR und SK TU4-PBR-…).

Configuration example

A PROFIBUS participant SK TU4-PBR is connected to an SK 200E series frequency inverter via a BUS connection unit SK T14-TU-BUS. The field bus address (PROFIBUS DP address) is to be "14". The PROFIBUS DP subscriber is not a final subscriber. The system bus only includes the frequency inverter and the PROFIBUS DP module. The termination resistor for the system bus is to be set at the frequency inverter. The DIP switches on the PROFIBUS DP module must be set as follows:

Area	Meaning		DIP Switch ON - OFF	Configuration example
Addressing	No significance	-		-
	Address bit 6	$2^6 = 64$		0
	Address bit 5	$2^5 = 32$		0
	Address bit 4	$2^4 = 16$		0
	Address bit 3	$2^3 = 8$		8
	Address bit 2	$2^2 = 4$		4
	Address bit 1	$2^1 = 2$		2
	Address bit 0	$2^0 = 1$		0
		Example address:		14
BUS termination	PB Term.			OFF *
	PB Term.			OFF *
	S-Bus Term.			ON
* in order to terminate the PROFIBUS DP, both DIP switches must be set to "PB Term".				

3 Displays and diagnosis

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

PROFIBUS DP module SK CU4-PBR
status **LEDs**

PROFIBUS DP module unit SK TU4-PBR-M12 with SK TI4-TU-BUS and SK TIE4-WMK-TU

Status **LEDs** and viewing window (transparent screw-on cover) for **RJ12** diagnostic interface

Frequency inverter SK 200E
viewing window (transparent screw-on cover) for diagnostic interface **RJ12,** status **LEDs, potentiometer**

3.1 LED displays

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

A differentiation into 3 categories is made

- **Module** or module-specific displays (S and E or DS and DE)
- Displays specific to **PROFIBUS DP** ((BS)BR and BE)
- Status displays for the additional digital **I/Os** of the module (D1/2 or DI1...4 and DO1/2)

The possible displays differ according to the device.

3.1.1 Device-specific display versions

3.1.1.1 frequency inverter SK200E

LED S/E

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

LEDs **BS** and **BE**

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

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

3.1.1.2 Customer unit SK CU4-PBR

LEDs **BR** (or BS) and **BE**

The dual LEDs **BR (BUS Ready)** and **BE (BUS Error)** indicate the communication status of the PROFIBUS DP.

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

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

LEDs **D1** and **D2**

The single colour LEDs **D1 (DIN 1** (Digital input 1)**)** and **D2 (DIN 2** (Digital input 2)**)** indicate the signal status of the digital inputs of the PROFIBUS DP module. The corresponding LED lights up in case of a High signal.

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

3.1.1.3 Technology unit SK TU4-PBR (-M12)

LEDs **BR** (or BS) and **BE**

The dual LEDs **BR (BUS Ready)** and **BE (BUS Error)** indicate the communication status of the PROFIBUS DP.

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

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

LEDs **DI1** to **DI4** and **DO1** and **DO2**

The single colour LEDs **DI1 (DIN 1** (digital input 1)**)** to **DI4 (DIN 4** (digital input 2)**)** and **DO1** (**DOUT 1** (digital output 1) and **DO2** (**DOUT 2** (digital output 2)) indicate the signal status of the digital inputs or outputs of the PROFIBUS DP module. The corresponding LED lights up in case of a High signal.

These LEDs are only available in the PROFIBUS DP module SK TU4-PBR-**M12**.

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

3.1.2 Signal status LEDs

This manual only describes the LED signal statuses of the PROFIBUS DP modules. Information for the frequency inverter LEDs (SK 2xxE) can be found in the relevant manual (BU0200).

3.1.2.1 Module-specific displays

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

LED (green) DS → Device State	**LED (red)** DE → **Device Error**	**Meaning** ... Slow flashing = 2Hz (0.5s cycle) … Rapid flashing= 4Hz (0.25s cycle)
OFF	OFF	Technology unit not ready, no control voltage
ON	OFF	Technology unit ready, no error, at least one frequency inverter is communicating via the system bus
ON	Flashing 0.25s	Technology unit ready, however → one or more of the connected frequency inverters has a fault status (see frequency inverter manual)
Flashing 0.5s	OFF	Technology unit ready and at least one further subscriber is connected to the system bus, but → No frequency inverter on the system bus (or connection interrupted) → Address error for one or more system bus participants
Flashing 0.5s	Flashing 0.25s Flash interval **1** x - 1s pause	System bus is in status "Bus Warning" → Communication on system bus interrupted or → No other participant present on the system bus
Flashing 0.5s	Flashing 0.25s Flash interval **2** x - 1s pause	→ System bus is in status "Bus off" or → The system bus 24V power supply was interrupted during operation
Flashing 0.5s	Flashing 0.25s Flash interval **3** x - 1s pause	→ No system bus 24V power supply (system bus is in status "Bus off")
Flashing 0.5s	Flashing 0.25s Flash interval **4** x - 1s pause	→ PROFIBUS DP error of the technology unit Details: LED flashing code:**BR** and **BE** (Section 3.1.2.2 "PROFIBUS DP displays")
OFF	Flashing 0.25s Flash interval **1…7** x - 1s pause	System error, internal program sequence interrupted → EMC interference (observe wiring guidelines!) → Module faulty

3.1.2.2 PROFIBUS DP displays

The status of the PROFIBUS DP module is indicated by the **BR** and **BE** LEDs.

LED (dual colour) BR → **B**us **R**eady	**LED** (dual colour) BE → **B**us **E**rror	**Meaning** ... Slow flashing = 2Hz (0.5s cycle)
OFF	OFF	Technology unit not ready, no control voltage or → system error is indicated Details: LED flashing code: **DS** and **DE** (Section 3.1.2.1 "Module-specific displays").
ON (green)	OFF	Normal operation, cyclic data exchange via PROFIBUS DP
Flashing 0.5s (green)	OFF	Technology unit not yet configured from DP master, no cyclic data exchange → PROFIBUS DP cable not connected → Address error → DP master in STOP → Hardware configuration fault (e.g. more than 4 frequency inverters are to be accessed)
ON (red):	**ON (red):**	Communication timeout → "Address monitoring time" in DP master expired
ON (red):	Flashing 0.5s (red)	Communication timeout → Timeout in process data reception the time set in parameter **(P151)** has expired, without new process data being received
Flashing 0.5s (red)	Flashing 0.5s (red)	No communication between technology unit and DP master → Incorrect address range (Address can be set with DIP switch, Permissible range: 3 .. 125) → Module faulty

3.1.2.3 I/O Displays

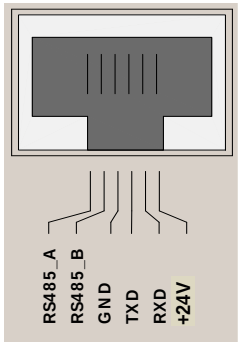
The status of additional digital inputs and outputs on the BUS module is indicated by corresponding LEDs (except for SK TU4-PBR(-C)).

I/O Channel	Status display	Meaning
Customer unit **SK CU4-PBR**		
	LED (green)	
Digital input 1 **D1**	**ON**	**High** potential on terminal ***C1***
	OFF	**Low** potential on terminal ***C1***
Digital input 2 **D2**	**ON**	**High** potential on terminal ***C2***
	OFF	**Low** potential on terminal ***C2***
Technology unit **SK TU4-PBR-M12(-C)**		
	LED (yellow)	
Digital input 1 **DI1**	**ON**	**High** potential on terminal ***19*** or on M12 socket ***DI1***
	OFF	**Low** potential on terminal ***19*** or on M12 socket ***DI1***
Digital input 2 **DI2**	**ON**	**High** potential on terminal ***25*** or on M12 socket ***DI2***
	OFF	**Low** potential on terminal ***25*** or on M12 socket ***DI2***
Digital input 3 **DI3**	**ON**	**High** potential on terminal ***20*** or on M12 socket ***DI3***
	OFF	**Low** potential on terminal ***20*** or on M12 socket ***DI3***
Digital input 4 **DI4**	**ON**	**High** potential on terminal ***26*** or on M12 socket ***DI4***
	OFF	**Low** potential on terminal ***26*** or on M12 socket ***DI4***
Digital output 1 **DO1**	**ON**	**High** potential on terminal ***33*** or on M12 socket ***DO1***
	OFF	**Low** potential on terminal ***33*** or on M12 socket ***DO1***
Digital output 2 **DO2**	**ON**	**High** potential on terminal ***34*** or on M12 socket ***DO1***
	OFF	**Low** potential on terminal ***34*** or on M12 socket ***DO1***

3.2 RJ12 Diagnostic socket

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

Although the customer unit SK CU4-PBR does not have an RJ12 connection, it can be accessed from any other participant (frequency inverter) on the same system bus.

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

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

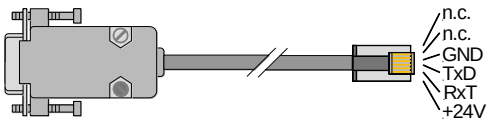
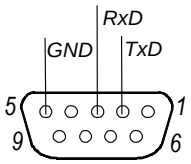
NOTE

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

The NORDCON software and the ParameterBox **SK PAR-3H** are available as diagnostic tools.

For a detailed description of the use of these ParameterBoxes, please refer to Manual BU0040. The NORDCON software is available free of charge under www.nord.com. Connection cables for the SK PAR-3H are included in the scope of delivery of the box. The necessary cables for connecting the bus module to the PC (RJ12-SUB/D) can be ordered under the part number 278910240. Adapters for connection to a USB port are commercially available.

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

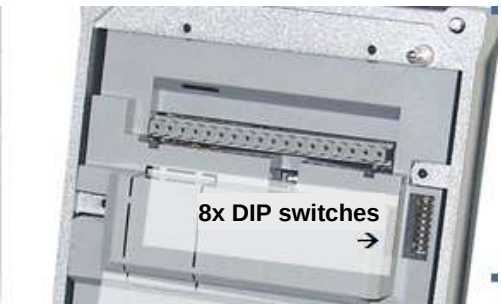
Terminal/ Name	Function	Data	Description / wiring suggestion	Parameter
Accessory cable (optional) for PC connection				
Adapter cable RJ12 to SUB-D9	... for direct connection to a PC with NORD CON software	Length 3m Assignment RS 232 (RxD, TxD, GND) Part. No. 278910240	 Assignment of SUBD9 connector: Pin2: RS232_TxD Pin3: RS232_RxD Pin5: GND 	

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

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

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

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



Underside of SK 200E

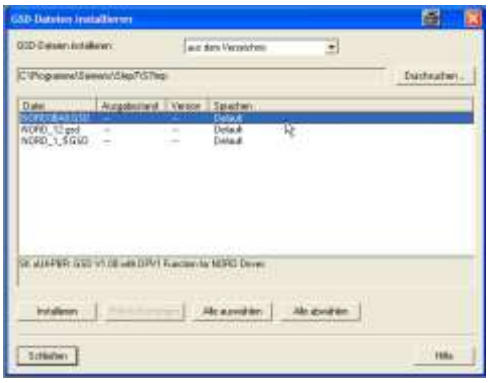
4 Commissioning

In order to operate the SK 200E frequency inverter with the PROFIBUS DP protocol, in addition to the bus connection to the master, the PROFIBUS DP modules must be implemented in the automation concept. This section describes the hardware planning and network structure on the basis of a SIMATIC S7 project with diagrams from the planning tool STEP 7. In addition, several parameters for the PROFIBUS DP connection must be changed and set in the frequency inverter (Section 5"Parameterisation").

4.1 GSD file

The GSD file **(D**evice **M**aster **D**ata file) must be integrated into the engineering system for the DP master for configuration and setup of the PROFIBUS network. For this, in the *HW config.* mask of the SIMATIC Manager, the function *install GSD files* must be executed under the menu item *Extras*. For the integration of the GSD files, no other project must be open in the *Hardware config.*

Installing GSD files



GSD file selection

For SK 200E applications on PROFIBUS DP, the GSD file **NORD0BA8.GSD** must be installed, as this is the only file which contains the SK xU4-PBR (-M12) with DPV1 functionality. This file is contained on the documentation CD, which is provided with the hardware. Updates on a daily basis are available on www.nord.com.

4.2 Hardware configuration: Configuration of the PROFIBUS DP Technology Unit

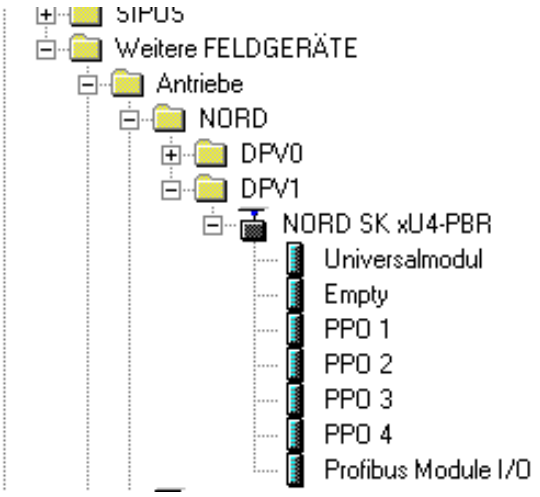
After the DP master has been planned and the PROFIBUS DP has been linked, DP slave can be selected from the catalogue and copied onto the network bus string.

After installation of the GSD file (NORD0BA8.GSD), the DP slaves from Getriebebau NORD are saved in the directory "PROFIBUS-DP/Weitere FELDGERÄTE/Antriebe/NORD".

After this, the configuration mask for the planned NORD drive unit can be opened by clicking on the DP slave symbol in the configuration mask.

Allocation of the DP slave participants to the PROFIBUS DP is then carried out.

The number of frequency inverters to be operated on a technology unit must then be defined. This results in the number of PPO type modules to be integrated in the *Hardware config.* of STEP 7.



A separate PPO module in the DP slave must be used for the input and output data of each connected SK 200E frequency inverter. This must be configured on the corresponding slot of the participant.

Configuration steps

The following items must be configured in the planning of an SK CU4-… or SK TU4-PBR(-M12) technology unit:

• **PROFIBUS address**	Setting the PROFIBUS DP with DIP switches (Section 2.2.3 "Configuration ")
• **Integration of the DP slave** (technology unit) **on the PROFIBUS DP**	Select the components from the catalogue and integrate them into the PROFIBUS DP string.
• **The frequency inverters connected to the technology unit must be defined**	Specification of the frequency inverter designation and allocation of the associated addresses / slot allocation.
• **Configuration of the DP slave**	Assign the names and addresses
• **Selection of PPO types**	Each frequency inverter must be assigned a PPO type (parameterise on the appropriate slot)
• **Technology unit I/Os**	For the use of additional technology unit I/Os, the Profibus module I/O must be integrated into **Slot 1** of the DP slave

4.2.1 DP slave slot assignment

The following slot assignments must be observed in the DP slave for the planning of frequency inverters:

Cyclic data traffic

The assignment of the input and output address ranges to the frequency inverters is made via the assignment of the slot position.

Slot	Cyclic process data transfer	Device
1	Profibus I/O Modules	Technology unit I/Os
2	PPO type 1 to 4	Frequency inverter 1
3	PPO type 1 to 4	Frequency inverter 2
4	PPO type 1 to 4	Frequency inverter 3
5	PPO type 1 to 4	Frequency inverter 4

Acyclic data traffic

The assignment of acyclic data packages to the individual frequency inverters and the technology unit is not carried out via the slot position, but rather via Slot 0 and the relevant index (Table):

Index	Acyclic parameter transfer	Device
100	only parameter data	Technology unit
101	only parameter data	Frequency inverter 1
102	only parameter data	Frequency inverter 2
103	only parameter data	Frequency inverter 3
104	only parameter data	Frequency inverter 4

Therefore no settings and configurations are required in the *Hardware config.* of the SIMATIC Manager are necessary for the use of acyclic data traffic for the transfer of parameter data.

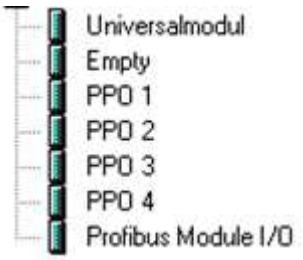
The system modules SFB 52 "RDREC" (read record) and SFB 53 "WRREC" to be used for acyclic data traffic in the PLC program sequence access Slot 0 via the "diagnosis address" of the PROFIBUS DP technology unit. The "diagnosis address" can be read out via the "object properties" of the DP slave.

Use of these system modules requires additional details of the index (see previous table) and the length, whereby due to the transfer of parameter data via the USS protocol (includes parameter data transfer), the length is always 8 byte (see also Section 7.2 "PROFIBUS DP PPO types").

4.2.2 Definition of PPO types

For cyclic data traffic, the **P**arameter- **P**rocess data **O**bject (PPO) with which the process data (PZD) is transferred from the DP master to the frequency inverter is defined. The following settings may be selected:

- Universal module — no function
- Empty — Empty slot
- PPO type 1 to 4 — for PKW and PZD
- Profibus I/O Modules — to control additional input and output signals of the bus module



NORD Modules

4.2.2.1 Universal module

A universal module is not defined. This setting has no function.

4.2.2.2 Empty

The setting Empty must always be selected if there is no device (frequency inverter) connected to the slot or the I/Os of the BUS module are not to be accessed.

4.2.2.3 PPO type 1 to 4

The setting of the PPO types is reserved for the connected frequency inverters (integrated into "Slots 2 - 5"). Here, each frequency inverter must be assigned the intended (required) PPO type.

With PPO types 1 and 2, both process data and parameters can be cyclically communicated between the DP master and the frequency inverter.

With PPO types 3 and 4, only process data is transferred.

More detailed information about PPO type definitions is given in Section 7.2 "PROFIBUS DP PPO types".

The PROFIBUS DP modules (SK CU4-PBR and SK TU4-PBR-…) are equipped with an automatic PPO type detection.

4.2.2.4 Profibus I/O Modules

This setting variant is exclusively reserved for the PROFIBUS DP module SK CU4-PBR or SK TU4-PBR…) which is connected to the system bus. This setting enables the DP master to directly access the digital I/Os of the module. In this 1 byte module, the digital outputs must be set as "output byte" and the digital inputs as "input byte".

The "Profibus module I/O" must always be set to Slot 1 in the DP slave.
If the additional I/Os are not used, an "empty module" must be set on Slot 1.

The bits are allocated to the inputs and outputs as follows:

PLC I/Os	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Inputs	n. c.	n. c.	n. c.	n. c.	**DIN4**	**DIN3**	**DIN2**	**DIN1**
Outputs	n. c.	n. c.	n. c.	n. c.	n. c.	n. c.	**DO2**	**DO1**

NOTE

The digital inputs of the PROFIBUS DP modules (SK CU4-PBR and SK TU4-PBR-…) cannot be directly assigned with frequency inverter functionalities. These must be transferred via the PROFIBUS and can be returned to the frequency inverter from the bus master via bits 8 and 9 of the control word by assignment of the required function in the BUS I/O In bits (P480 [-11] or [-12]).

4.2.3 Timeout monitoring

There are two different communication monitoring variants.

4.2.3.1 Access monitoring of DP master

Access monitoring is a monitoring function which is controlled by the PROFIBUS DP master. With this, the DP master communicates a calculated time interval to each DP slave, within which a communication step must take place. If this time interval is exceeded the DP slave exits the "data exchange mode" and switches to the so-called safe mode. The frequency inverter to which it is connected is set to error status (Error E010 → 10.2).

During system planning, the access monitoring time is automatically calculated for the entire PROFIBUS DP network by the software tool STEP 7 / SIMATIC Manager. This value usually corresponds to 6x the "worst case" cycle time, and is in the range between 10ms to 650s.

The access monitoring serves as a protective function against incorrect parameterisation or failure of the transfer facilities and can by explicitly enabled or disabled for each individual DP slave.

DP slave properties

Access monitoring setting

ATTENTION

In case of errors, disabling of access monitoring can result in the outputs of the affected slaves not being set to "0". It is therefore strongly recommended that the access monitoring is only disabled for test purposes during commissioning.

4.2.3.2 DP slave watchdog

The technology unit provides an additional timeout monitoring function. This can be enabled by the user in parameter (P151) "External bus timeout" and set in ms steps. **The time-out time must be set to at least 2x the value of the Profibus cycle time in parameter (P151).** This watchdog function is started on receipt of the first valid PROFIBUS DP telegram (STW Bit 10 = "1" signal ("Process data valid")).

If all process data telegrams (PZD) are declared as invalid (STW Bit 10 = "0") the error message E10.2 is generated. The bus module switches off all of its outputs (0V). This situation occurs if the automation device is in STOP mode and the PROFIBUS DP master continues to send telegrams with data content "0".

As long as one of the connected frequency inverters is still in an error status, i.e. an error message has not been acknowledged, the technology unit remains in timeout error status.

5 Parameterisation

In order to enable communication via PROFIBUS DP, the frequency inverter and the PROFIBUS DP technology Unit must be parameterised accordingly.

With the PROFIBUS DP protocol, the inverter parameters are mapped in the range 1000 to 1999, i.e. for parameterisation via the bus in cyclic data traffic (PPO type 1 or 2) 1000 must be added to the parameter numbers (e.g. (P508) - (P1508).

5.1 Parameterisation of frequency inverter SK 200E

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

5.1.1 Basic parameters (P100)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P120 **… [-01]** **...** **… [-04]**	**Option monitoring**		S	
0 ... 2 { 1 }	**Array levels:** **… [-01] =** Extension 1 (BUS-TB) **… [-02] =** Extension 2 (IO-TB) **… [-03] =** Extension 3 (reserved) **… [-04] =** Extension 4 (reserved)	Setting value for each array: **0 = Monitoring OFF** **1 = Auto**, communication is only monitored if an existing communication is interrupted. If a module which was previously present is not found after switching on the mains, this does not result in an error Monitoring only becomes active when an extension starts communication with the FI. **2 = Monitoring active immediately**; the FI starts monitoring the corresponding module immediately after it is switched on. If the module is not detected on switch-on, the FI remains in the status "not ready for switch-on" for 5 seconds and then triggers an error message.		

5.1.2 Control clamp parameter (P400)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P420 **… [-01]** **... … [-04]**	Digital inputs 1 to 4			

0 ... 77

{ [-01] = 01 }

{ [-02] = 02 }

{ [-03] = 04 }

{ [-04] = 05 }

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

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

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

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

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

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

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

Excerpt...

Value	Function	Description	Signal
00	No function	Input switched off.	---
…			
14 [1]	Remote control	With bus system control, Low level switches the control to control via control terminals.	High
…			
[1] Also effective for bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P480 **... [-01]** **...** **... [-12]**	**Function Bus I/O In Bits**			
0 ... 77 { [-01] = 01 } { [-02] = 02 } { [-03] = 05 } { [-04] = 12 } { [-05...-12] = 00 }	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420). These I/O bits can also be used in combination with the AS Interface (SK 225E or SK 235E) or the I/O extension (SK CU4-IOE or SK TU4-IOE). **… [-01] =** Bus I/O In Bit 0 **… [-02] =** Bus I/O In Bit 1 **… [-03] =** Bus I/O In Bit 2 **… [-04] =** Bus I/O In Bit 3 **… [-05] =** Bus I/O In Bit 4 **… [-06] =** Bus I/O In Bit 5 **… [-07] =** Bus I/O In Bit 6 **… [-08] =** Bus I/O In Bit 7 **… [-09] =** Flag 1 **… [-10] =** Flag 2 **… [-11] =** Bit 8 BUS control word **… [-12] =** Bit 9 BUS control word The possible functions for the bus In bits can be found in the table of functions for the digital inputs in parameter P420.			
P481 **... [-01]** **...** **... [-10]**	**Function Bus I/O Out Bits**			
0 ... 39 { [-01] = 18 } { [-02] = 08 } { [-03] = 30 } { [-04] = 31 } { [-05...-10] = 00 }	The bus I/O Out bits are perceived as multi-function relay outputs. They can be set to the same functions (P434). These I/O bits can also be used in combination with the AS Interface (SK 225E or SK 235E) or the I/O extension (SK CU4-IOE or SK TU4-IOE). **… [-01] =** Bus I/O Out Bit 0 **… [-02] =** Bus I/O Out Bit 1 **… [-03] =** Bus I/O Out Bit 2 **… [-04] =** Bus I/O Out Bit 3 **… [-05] =** Bus I/O Out Bit 4 **… [-06] =** Bus I/O Out Bit 5 **… [-07] =**Flag 1 **… [-08] =** Flag 2 **… [-09] =** Bit 10 BUS status word **… [-10] =** Bit 13 BUS status word The possible functions for the Bus Out Bits can be found in the table of functions for the relay P434.			
P482 **... [-01]** **...** **... [-08]**	**Standardisation of bus I/O Out bits**			
-400 … 400 % { all 100 }	Adjustment of the limit values of the bus Out bits. For a negative value, the output function will be output negative. Once the limit value is reached and positive values are delivered, the output produces a High signal, for negative setting values a Low signal.			
P483 **... [-01]** **...** **... [-08]**	**Hysteresis of bus I/O Out bits**		S	
1 … 100 % { all 10 }	Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

5.1.3 Supplementary parameters (P500)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P509	**Source Control Word**		S	
0 ... 4 { 0 }	Selection of the interface via which the FI is controlled. **0 = Control terminals or keyboard control**** with the SimpleBox (if (P510)=0), the ParameterBox or via BUS I/O Bits. **1 = Only control terminals** *, the FI can only be controlled via the digital and analog input signals or via the Bus I/O Bits. **2 = USS control word *,** the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies. **3 = System bus** *, the control signals (enable, direction of rotation, ...) are transferred via the system bus (the field bus module and the frequency inverter communicate via the system bus). I.e. the setting "3" - "System bus" must be selected in parameter (P509) for control of the frequency inverter via the field bus. **4 = System bus broadcast *** *) Keyboard control (SimpleBox, ParameterBox, PotentiometerBox) is disabled, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will disable without an error message.			
NOTE:	For details of the optional bus systems, please refer to the relevant supplementary bus manuals (BU02x0). - www.nord.com – As an alternative to setting the parameter, **System Bus** can also be selected with DIP switch 3.			
P510 **... [-01]** **... [-02]**	**Setpoint source**		S	
0 ... 4 { [-01] = 0 } { [-02] = 0 }	Selection of the setpoint source to be parameterised. **… [-01] =** Main setpoint source **… [-02] =** Subsidiary setpoint source Selection of the interface via which the FI receives the setpoint. **0 = Auto:** The setpoint source is automatically derived from the setting in the parameter P509 >Control word source<. **1 = Control terminals**, digital and analog inputs control the frequency, including fixed frequencies **2 = USS** **3 = System bus** **4 = System bus broadcast**			
P513	**Telegram time-out**		S	
-0.1 / 0.0 / 0.1 ... 100.0 sec { 0.0 }	Monitoring function of the active bus interface. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the FI reports an error and switches off with the error message E010 >Bus Time Out<. **0.0 = Off**: Monitoring is switched off. **-0.1 = no error**: Even if communication between BusBox and FI is interrupted (e.g. 24V error, Box removed, etc.), the FI will continue to operate unchanged. **Note:** In BUS mode (e.g.: PROFIBUS DP), monitoring is controlled via parameter (P120). Settings in parameter (P513) therefore have no effect. Exception: Setting {-0,1}			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P514	**CAN baud rate (system bus)**		S	
0 ... 7 { 5 }**	Setting of the transfer rate (transfer speed) via the system bus interface. All bus participants must have the same baud rate setting. **0 =** 10kBaud **3 =** 100kBaud **6 =** 500kBaud **1 =** 20kBaud **4 =** 125kBaud **7 =** 1Mbaud * **2 =** 50kBaud **5 =** 250kBaud** *) Reliable operation cannot be guaranteed **) for communication with the bus module, the parameter must be left at the factory setting (250kBaud) otherwise no communication is possible.			
P515 **... [-01] … ... [-03]**	**CAN address (system bus)**		S	
0 ... 255 dec { all 32 dec} or { all 20 hex}	Setting of the system bus address. **… [-01] =** Receive address for system bus **… [-02] =** Broadcast – Receive address for system bus (slave) **… [-02] =** Broadcast – Transmit address for system bus (master)			
	NOTE: If up to four SK 200E are to be linked via the system bus, the addresses must be set as follows → FI 1 = 32, FI 2 = 34, FI 3 = 36, FI 4 = 38. The system bus addresses should be set via the DIP switches 1/2 (Section 2.2.3).			
P543 **… [-01] ... … [-03]**	**Actual bus value 1 … 3**		S	P
0 ... 24 { [-01] = 01 } { [-02] = 04 } { [-03] = 09 }	The return value can be selected for bus actuation in this parameter. **NOTE:** For further details, please refer to the description for P418. **… [-01] = Actual bus value 1** **… [-02] = Actual bus value 2** (only for PPO Type 2 or 4) **… [-03] = Actual bus value 3** (only for PPO Type 2 or 4) **Possible values which can be set:** **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Electricity **4 =** Torque current (100% = P112) **5 =** State of digital inputs and outputs [2] **6 =** ... 7 Reserved **8 =** Setpoint frequency **9 =** Error number **10 =** ... 11 Reserved **12 =** Bus Out bits 0...7 **13 =** ... 16 Reserved **17 =** Value analog input 1 *(BU0200)* **18 =** Value analog input 2 *(BU0200)* **19 =** Setpoint frequency master value (P503) **20 =** Setpoint frequency after master value ramp **21 =** Actual frequency without master value slip **22 =** Speed from encoder **23 =** Actual frequency with slip **24 =** Master value, actual freq. with slip			

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

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P546 **… [-01]** **...** **… [-03]**	**Function Bus setpoint 1 ... 3**		S	P

0 ... 32

{ [-01] = 01 }

{ [-02] = 00 }

{ [-03] = 00 }

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

NOTE: For further details, please refer to the description for P400.

… [-01] = Bus setpoint value 1

… [-02] = Setpoint bus value 2 (only for PPO Type 2 or 4)

… [-03] = Setpoint bus value 3 (only for PPO Type 2 or 4)

Possible values which can be set:

0 = Off
1 = Setpoint frequency (16 bit)
2 = Frequency addition
3 = Frequency subtraction
4 = Minimum frequency
5 = Maximum frequency
6 = PI process controller actual value
7 = PI process controller setpoint
8 = Actual frequency PI
9 = Actual PI frequency limited
10 = Actual PI frequency monitored
11 = Limiting torque current
12 = Torque current switch-off limit
13 = Limiting current
14 = Current switch-off limit
15 = Ramp time
16 = Lead torque (P214) multiplication
17 = Multiplication
18 = Curve travel calculator
19 = Servo mode torque
20 = BusIO In Bits 0-7
21 = ...24 reserved for Posicon
31 = Digital output IOE
32 = Analog output IOE

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

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

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

5.1.4 Information parameters (P700)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P700	**Actual error**			
0.0 ... 21.4	Actual error present. Further details are described in the frequency inverter manual (BU0200). **SimpleBox:** Descriptions of the individual error numbers can be found in the point Error messages. **ParameterBox:** Errors are displayed in plain text, further information can be found in the point Error messages.			
P701 ... [-01] ... ... [-05]	**Last fault 1...5**			
0.0 ... 21.4	This parameter stores the last 5 faults. Further details are described in the frequency inverter manual (BU0200). With the SimpleBox the corresponding memory location 1...5 (Array parameter), must be selected and confirmed with the ENTER key in order to read the stored error code.			
P740 ... [-01] ... ... [-13]	**Process data bus In**		S	
0000 ... FFFF (hex)	This parameter provides information about the actual control word (STW) and the setpoints (SW1-3) that are transferred via the bus systems. For values to be displayed, a bus system must be selected in P509.			
	... [-01] = Control word — Control word, source from P509.			
	... [-02] = Setpoint 1 (P546 [-01]) **... [-03] =** Setpoint 2 (P546 [-02]) **... [-04] =** Setpoint 3 (P546 [-03]) — Setpoint data from main setpoint P510 - 01.			
	... [-05] = Bus I/O In Bits (P480) — The displayed value depicts all Bus In Bit sources linked with *or*.			
	... [-06] = Parameter data In 1 **... [-07] =** Parameter data In 2 **... [-08] =** Parameter data In 3 **... [-09] =** Parameter data In 4 **... [-10] =** Parameter data In 5 — Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)			
	... [-11] = Setpoint 1 **... [-12] =** Setpoint 2 **... [-13] =** Setpoint 3 — Setpoint data from master function value (Broadcast), if P509/510 = 4 (P502/P503)			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P741 **... [-01]** ... **... [-10]**	**Process data bus Out**		S	
0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.			
	... [-01] = Status word — Status word			
	... [-02] = Actual value 1 (P543 [-01])			
	... [-03] = Actual value 2 (P543 [-02])			
	... [-04] = Actual value 3 (P543 [-03])			
	... [-05] = Bus I/O Out Bit (P481) — The displayed value depicts all Bus Out Bit sources linked with *or*.			
	... [-06] = Parameter data Out 1			
	... [-07] = Parameter data Out 2			
	... [-08] = Parameter data Out 3 — Data during parameter transfer.			
	... [-09] = Parameter data Out 4			
	... [-10] = Parameter data Out 5			

P748	**System bus status**			
0000 ... FFFF (hex)	Shows the status of the system bus.			
or	Bit 0: 24V Bus supply voltage			
0 ... 65535 (dec)	Bit 1: CANbus in "Bus Warning" status			
	Bit 2: CANbus in "Bus Off" status			
	Bit 3: Bus module is online			
	Bit 4: Additional module 1 is online			
	Bit 5: Additional module 2 is online			
	Bit 6: The protocol of the CAN module is 0 = CAN / 1 = CANopen			
	Bit 7: Vacant			
	Bit 8: "Bootup Message" sent			
	Bit 9: CANopen NMT State			
	Bit 10: CANopen NMT State			

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

P749	**DIP switch status**				
0000 ... 01FF (hex)	This parameter shows the actual setting of the FI DIP switch "S1" (See BU0200).				
or	Bit 0:	DIP switch 1	Bit 5:	DIP switch 6	
0 ... 511 (dec)	Bit 1:	DIP switch 2	Bit 6:	DIP switch 7	
	Bit 2:	DIP switch 3	Bit 7:	DIP switch 8	
	Bit 3:	DIP switch 4	Bit 8:	EEPROM – Memory module (0=plugged in, 1= not plugged in)	
	Bit 4:	DIP switch 5			

5.2 Parameterisation of the bus module (SK CU4-… or SK TU4-…)

The following parameters affect the bus modules.

5.2.1 BUS module standard parameters (P150)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P150	**Set relays**			
0 ... 4 { 0 }	**0 =** Via bus **1 =** Outputs OFF **2 =** Output 1 to (DO1) **3 =** Output 2 to (DO2) **4 =** Outputs 1 and 2 ON			
P151	**Timeout for external bus**			
0 ... 32767 ms { 0 }	Monitoring function of the relevant active bus technology unit. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the inverter reports an error and switches off with the error message E010 / E10.3 >Bus Time Out<. **0 = Off:** Monitoring is switched off. Behaviour is identical to parameter (P513) telegram timeout for SK 200E. **NOTE:** The time-out time must be set to at least 2x the value of the Profibus cycle time in parameter (P151).			
P152	**Factory setting**			
0 ... 1 { 0 }	By selecting the appropriate value and confirming it with the ENTER key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0. **0 = No change:** Does not change the parameterisation. **1 = Load factory settings:** The complete parameterisation of the FI is reset to the factory setting. All originally parameterised data are lost.			
P153 **... [-01]** **... [-02]**	**Minimum system bus cycle**			
0 ... 250 ms { [-01] = 10 } { [-02] = 5 }	Reduction of the bus load on the system bus by adjustment of the minimum cycle time (inhibit time): **… [-01] =** SDO Inhibit time **… [-02] =** PDO inhibit time			
P154 **... [-01]** **... [-02]**	**TB-IO access**			
0 ... 5 { [-01] = 0 } { [-02] = 0 } *SW V1.1R0 and higher*	Direct access to the frequency inverter via 2 digital inputs and/or 2 digital outputs of the bus module SK xU4-PBR: **… [-01] =** Access to inputs **… [-02] =** Access to outputs Definition of functions: DigIn1 of the bus module → (P480[-11]) DigOut1 of bus module → (P481[-09]) DigIn2 of the bus module → (P480[-12]) DigOut2 of bus module → (P481[-10]) Settings: **3 = No effect:** The IOs are not evaluated by the FI. Bits 8 and 9 of the control word can be set or read out via the PLC. (Section 7.2.1.7, 7.2.1.8) **4 = Broadcast:** (This setting can only be used with (P154[-01])) - All FIs read the inputs, the settings for (P154[-02]) have no effect. **5 = FI 1:** reads and writes the IO **6 = FI 2:** reads and writes the IO **7 = FI 3:** reads and writes the IO **8 = FI 4:** reads and writes the IO			

5.2.2 BUS module information parameters, general (P170)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P170 **... [-01]** **... [-02]**	**Actual error**			
0 ... 9999	Further details in Section 6.2 "Error messages". **… [-01]** = Current module error **… [-02]** = Last module error **Possible values:** **1000** = EEPROM error **1010** = System bus 24V missing **1020** = System bus timeout (see time in P151) **1030** = System bus OFF **Specific to PROFIBUS DP** **5000 =** PROFIBUS ASIC error **5010 =** PROFIBUS address incorrect **5020 =** PROFIBUS timeout			
P171 **... [-01]** **...** **... [-03]**	**Software version/ Revision**			
0,0 ... 9999.9	This parameter shows the software and revision numbers in the module. Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version. **… [-01]** = Software version **… [-02]** = Software revision **… [-03]** = Special version			
P172	**Configuration**			
0 ... 2	The version can be queried in this parameter. **Possible values:** **0=** internal module **1=** external module **2 =** Bus TO via SPI			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P173	**Module status**			
0 ... FFFF (hex)	**Possible values:** Bit 0 = Bus status “PREOPERATIONAL” (PROFIBUS DP initialisation active) Bit 1 = Bus status “OPERATIONAL” (Data exchange active) Bit 2 = Node-guarding timeout (PROFIBUS DP master watchdog) Bit 3 = Timeout (time in P151) Bit 4 = Module system error Bit 5 = Reserved Bit 6 = System bus “BUS WARNING” Bit 7 = System bus “BUS OFF” Bit 8 = Status FI 1 Bit 9 = Status FI 1 Bit 10= Status FI 2 Bit 11= Status FI 2 Bit 12= Status FI 3 Bit 13= Status FI 3 Bit 14= Status FI 4 Bit 15= Status FI 4 **Status for FI x:** Bit High Bit Low Status 0 0 FI is offline 0 1 unknown FI 1 0 FI is online 1 1 FI missing or switched off			
P174	**Digital inputs**			
0 ... 15	Instantaneous view of input level logic. **Possible values:** Bit 0= Input 1 (DIN1 of the bus module) Bit 1= Input 2 (DIN2 of the bus module) Bit 2= Input 3 (DIN3 of the bus module) Bit 3= Input 4 (DIN4 of the bus module)			
P175	**Digital outputs**			
0 ... 3	Instantaneous view of output level logic. **Possible values:** Bit 1= Output 1 (DO1 of the bus module) Bit 2= Output 2 (DO2 of the bus module)			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P176 **... [-01]** **...** **... [-17]**	**Process data bus In**			
-32768 ... 32767	Bus data received from PROFIBUS DP master **... [-01]** = Bus module outputs **... [-02]** = Control word FI 1 **... [-03]** = Setpoint 1 for FI 1 **... [-04]** = Setpoint 2 for FI 1 **... [-05]** = Setpoint 3 for FI 1 **... [-06]** = Control word FI 2 **... [-07]** = Setpoint 1 for FI 2 **... [-08]** = Setpoint 2 for FI 2 **... [-09]** = Setpoint 3 for FI 2 **... [-10]** = Control word FI 3 **... [-11]** = Setpoint 1 for FI 3 **... [-12]** = Setpoint 2 for FI 3 **... [-13]** = Setpoint 3 for FI 3 **... [-14]** = Control word FI 4 **... [-15]** = Setpoint 1 for FI 4 **... [-16]** = Setpoint 2 for FI 4 **... [-17]** = Setpoint 3 for FI 4			
P177 **... [-01]** **...** **... [-17]**	**Process data bus Out**			
-32768 ... 32767	Bus data transmitted to PROFIBUS DP master **... [-01]** = Bus module inputs **... [-02]** = Status word FI 1 **... [-03]** = Actual value 1 for FI 1 **... [-04]** = Actual value 2 for FI 1 **... [-05]** = Actual value 3 for FI 1 **... [-06]** = Status word FI 2 **... [-07]** = Actual value 1 for FI 2 **... [-08]** = Actual value 2 for FI 2 **... [-09]** = Actual value 3 for FI 2 **... [-10]** = Status word FI 3 **... [-11]** = Actual value 1 for FI 3 **... [-12]** = Actual value 2 for FI 3 **... [-13]** = Actual value 3 for FI 3 **... [-14]** = Status word FI 4 **... [-15]** = Actual value 1 for FI 4 **... [-16]** = Actual value 2 for FI 4 **... [-17]** = Actual value 3 for FI 4			

5.2.3 Module information parameters specific to the bus (P180)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P180	**Profibus address**			
3 ... 125	Shows the PROFIBUS address which is set with the DIP switch. Setting of the address is only carried out via the DIP switch (see Section 2.2.3). After the new setting of addresses, all the devices on this bus must be restarted by switching the power supply off and on again. **Note:** Addresses 0 to 2 and 126 are reserved for PROFIBUS DP special services.			
P181	**Profibus baud rate**			
0 ... 15	Shows the automatically detected baud rate: **Possible values:** **0 =** 12 Mbit/s **1 =** 6 Mbit/s **2 =** 3 Mbit/s **3 =** 1,5 Mbit/s **4 =** 500 kbit/s **5 =** 187,5 kbit/s **6 =** 93,75 kbit/s **7 =** 45,45 kbit/s **8 =** 19,20 kbit/s **9 =** 9,60 kbit/s **10 …** 14 Reserved **15 =** after reset and during a baud rate scan **Note:** The baud rate which is set by the bus master is independently detected by the SK xU4-PBR module. The restriction of the cable length for the set baud rate must be taken into account. (Section 8.1.2 "Cable material").			
P182 **... [-01]** **...** **... [-05]**	**PPO-Type**			
0 ... 255	**… [-01]** = Bus module **… [-02]** = FI 1 **… [-03]** = FI 2 **… [-04]** = FI 3 **… [-05]** = FI 4 Shows the actually selected PPO type. Selection of the required PPO type is made via the PLC configuration program. (Section 7.2 "PROFIBUS DP PPO types"): **0 =** no participant configured **48 =** Bus module **245 =** PPO type 1 **247 =** PPO type 2 **241 =** PPO type 3 **243 =** PPO type 4			

6 Error monitoring and error messages

6.1 Error monitoring

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

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

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

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

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

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

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

NOTE

The display of a bus error is shown in the operating display of the SimpleBox **SK CSX3H** by means of the error group number **E1000**. In order to obtain the precise error number, the module information parameter P170 must be selected. The current error is shown in Array [01] of this parameter; the last error is stored in Array [02].

The PROFIBUS DP module monitors the following functions:

- Cyclic connection to bus master via the PROFIBUS DP watchdog function
  (parameterisation is carried out in the bus master)
- Cyclic connection to the bus master and valid control data via the bus module parameter (P151)

6.2 Error messages

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

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

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P700[-01] / P701		
E010	**10.0**	**Bus Timeout** (Telegram time-out / Bus off 24V int. CANbus)	Data transfer is faulty. Check P513. Check physical bus connections Check Bus Master. Check 24V supply of internal CAN/CANopen Bus. *Nodeguarding* error (internal CANopen) *Bus Off* error (internal CANbus)
	10.2	**External bus module telegram timeout** (Timeout Profibus Watchdog)	Telegram transfer is faulty. Check physical bus connections PLC is in the "STOP" or "ERROR" state.
	10.3	**Timeout via (P151)**	Telegram transfer is faulty. Check watchdog time (P151) Check physical bus connections Check bus protocol program process. PLC is in the "STOP" or "ERROR" state.
	10.4	**External bus module initialisation failure**	Profibus ASIC in the bus module cannot be accessed
	10.8	**External module communication failure**	Connection fault / error in the external module to the FI
	10.9	**Module not found**	The module entered in parameter (P120) is not available.

6.2.2 Table of possible error messages in the bus module

The following error messages concern bus-related messages, which are indicated on the PROFIBUS DP module (SK CU4-PBR or SK TU4-PBR(-…)).

Display in the SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	**Details in P170**		
E1000	**1000**	**EEPROM error**	Module faulty
	1010	**System bus 24V missing**	Check connections and supply cables Ensure 24V voltage supply
	1020	**System bus timeout**	Check physical bus connections FI has been switched off
	1030	**System bus OFF**	Check physical bus connections
	5000	**PROFIBUS ASIC error**	Profibus system error (ASIC cannot be accessed)
	5010	**PROFIBUS address incorrect**	Comply with address range 3 ... 125
	5020	**PROFIBUS timeout**	Telegram transfer is faulty. Check physical bus connections

7 PROFIBUS DP data transfer

7.1 Structure of reference data

This section describes the cyclic data traffic between the DP master and the frequency inverter.

The reference data is divided into two sections:

- PKW section (Parameter Code Value (parameterisation level))
- PZD section (Process data (process data level))

Parameter values can be read and written via the PKW section of the reference data. All tasks which are carried out via the PKW interface are essentially tasks for configuration, monitoring or diagnosis.

The PZD section serves to control the frequency inverter. The control word or status word as well as the setpoint and actual values are transferred in the process data.

Access always consists of an order and a response telegram. In the order telegram, the reference data is transferred to the slave. In the response telegram, the reference data is transferred from the slave to the master. The structure of both telegrams is identical.

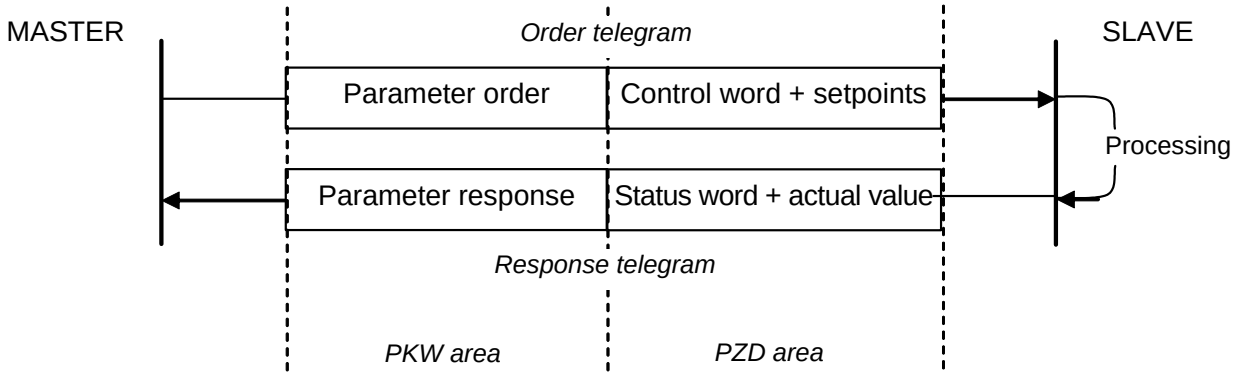


Fig.: Telegram traffic / structure of reference data area

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

On the other hand, the processing speed of the PKW data has a lower priority, so that processing may take considerably longer.

7.2 PROFIBUS DP PPO types

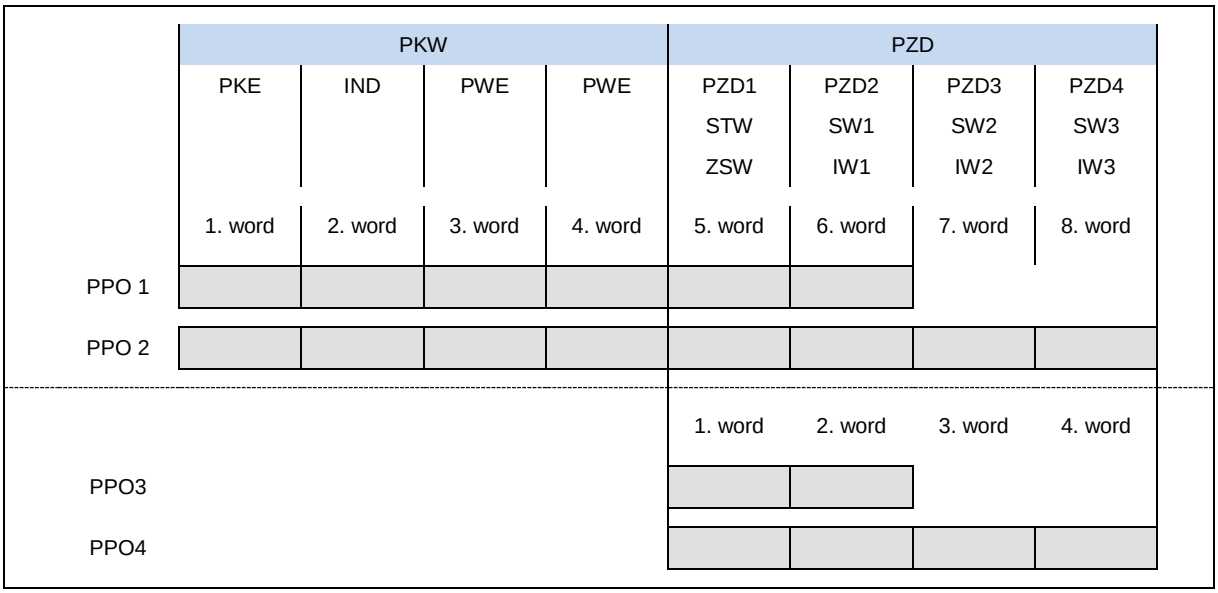
For cyclic data traffic, the **P**arameter- **P**rocess data **O**bject (PPO) with which the process data (PZD) and parameters (PKW) are transferred from the DP master to the frequency inverter is defined. The frequency inverter can process PPO types 1, 2, 3 or 4.

Type	Task
PPO1	extended parameter data telegram with 32 bit parameter values and process data
PPO2	Telegram with extended process data (main and two auxiliary setpoint values) and 32 bit parameter value
PPO3	Process data telegram with main setpoint value without parameter data
PPO4	extended process data telegram with main and auxiliary setpoint values without parameter data

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

Note: A PLC can normally only consistently transfer double words by means of I/O memory access. For longer data formats (PKW channel always / PZD data with PPO2 or PPO4) system functions (e.g. SFC 14, consistent data reading / SFC15, consistent data writing) must be used.

Structure of PPO types



7.2.1 Process data (PZD)

In the process data area (PZD), control words and setpoints are transferred from the master to the slave (frequency inverter) and in return, status words and actual values are sent from the slave to the master. The structure of the PZD area is always the same in terms of the sequence of its elements (words), however, dependent upon direction of data Master ⇒ inverter / inverter ⇒ Master, it is described differently.

The process data area of the reference data has the following structure:

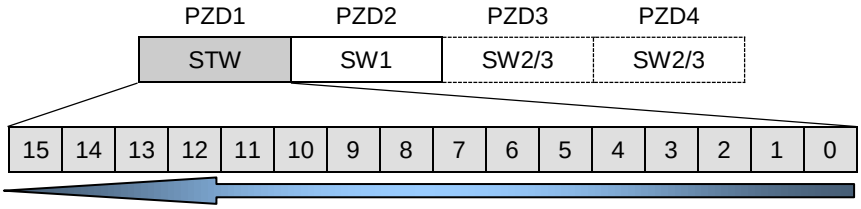
- STW: Control Word; length 16 bit, order telegram
  contains control bits (e.g. enable, rapid stop, error acknowledgement)
- ZSW: Status Word; length 16 bit, response telegram
  contains status bits (e.g. FI running, fault)
- SW1..3: Setpoints; maximum 3 possible, 16 or 32Bit, order telegram
  e.g. frequency setpoint value, position setpoint value, torque setpoint value
- IW1..3: Actual values; maximum 3 possible, 16 or 32Bit, response telegram
  e.g. actual frequency value, actual position value, actual torque value

	1.(/5.) word	2.(/6.) word	3.(/7.) word	4.(/8.) word	
PZD area with 1x16-Bit setpoint	STW ZSW	SW1 IW1			PP0 Type (1,)3
PZD area with up to 3 16-Bit setpoints	STW ZSW	SW1 IW1	SW2 IW2	SW3 IW3	PP0 Type (2,)4

Note: 32-Bit setpoints consist of High and Low words (16-Bit each).

7.2.1.1 Control word (STW)

The control word (STW) is the first word transferred to the frequency inverter in the process data section in an order telegram. For example, a control word "Ready for switch-on" corresponds to $047E_{(hex)}$. The FI is ultimately enabled with $047F_{(hex)}$.



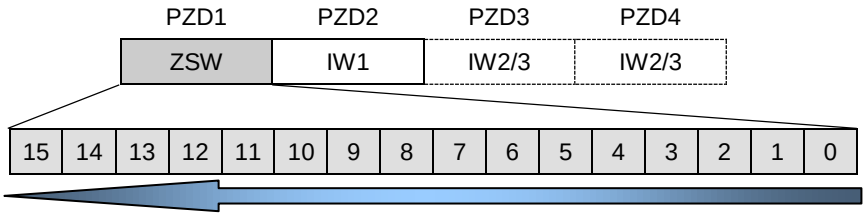
Meaning of the individual bits:

Bit	Value	Meaning	Remarks
0	0	OFF 1	Reverse with the brake ramp, with disconnection from supply at f=0Hz
	1	ON	Ready for operation
1	0	OFF 2	Cut off voltage; the inverter output voltage is switched off; the FI enters a state where switching on is disabled.
	1	Operating condition	OFF 2 is cancelled
2	0	OFF 3	Quick stop with programmed quick stop time; with disconnection from supply at f=0Hz; the FI switches to starting disabled condition.
	1	Operating condition	OFF 3 is cancelled
3	0	Disable operation	Cut off voltage; the inverter output voltage is switched off; the FI enters a state where switching on is enabled.
	1	Enable operation	The output voltage is enabled; ramp to the existing setpoint
4	0	Lock ramp generator	Ramp generator is set to zero; no disconnection from supply at f=0Hz; FI remains in the operation enabled state.
	1	Operating condition	Enable ramp generator
5	0	Stop ramp generator	The setpoint currently provided by the ramp generator is "frozen" (frequency is maintained).
	1	Enable ramp generator	Enable setpoint on ramp generator
6	0	Disable setpoint	Selected setpoint value is set to zero on the ramp generator.
	1	Enable setpoint	Selected ramp generator setpoint is activated.
7	0	No acknowledgement	With the switch from 0 to 1, errors which are no longer active are acknowledged.
	1	Acknowledge	Note: When a digital input has been programmed for the "ack.fault" function, this bit must not permanently be set to 1 via the bus (otherwise, edge evaluation would be prevented).
8	0		
	1	Bit 8 active	Bus bit 8 from the control word is set. (only for SK 200E and SK 500E) For further details of function, please refer to parameter (P480) and Section 7.2.1.7.
9	0		
	1	Bit 9 active	Bus bit 9 from the control word is set. (only for SK 200E and SK 500E) For further details of function, please refer to parameter (P480) and Section 7.2.1.7.
10	0	PZD invalid	The transmitted process data is invalid.
	1	PZD valid	Valid process data is transferred from the master. **Note:** If only setpoints are transferred via the bus, this bit must be set so that the transferred setpoint is valid.
11	0		
	1	Rotational direction: right	Rotational direction right (priority) ON*
12	0		
	1	Rotational direction: left	Rotational direction left ON*
13	0/1		Reserved
14	0/1	Bit 0 to switch parameter set	00 = Parameter set 1 01 = Parameter set 2 10 = Parameter set 3 11 = Parameter set 4
15	0/1	Bit 1 to switch parameter set	

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

7.2.1.2 Status word (ZSW)

In the inverter response telegram, in the area of the process data the status word (ZSW) is transferred as the first word. For example, the status word "Ready for switch-on" corresponds to $0B31_{(hex)}$. For example, the status word "Inverter operating" corresponds to $0B37_{(hex)}$.



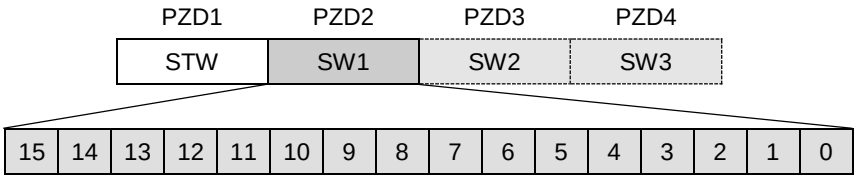
Meaning of the individual bits:

Bit	Value	Meaning	Remarks	
0	0	Not ready to start		
	1	Ready to start	Initialisation completed, charging relay ON, output voltage disabled	
1	0	Not ready for operation	Causes: No command has been activated, fault is signaled, OFF2 or OFF3 activated, starting disabled state activated	
	1	Ready for operation	ON command activated, no faults present. The inverter can be started with the command ENABLE OPERATION	
2	0	Operation disabled		
	1	Operation enabled	The output voltage is enabled; ramp to the existing setpoint	
3	0	No fault		
	1	Fault	Drive fault resulting in stoppage; this state is changed to starting disabled after the fault has been successfully acknowledged	
4	0	OFF 2	OFF2 command applied	
	1	No OFF 2		
5	0	OFF 3	OFF3 command applied	
	1	No OFF 3		
6	0	Starting not disabled		
	1	Starting disabled	Switches first to OFF1, then to ready-to-start status	
7	0	No warning		
	1	Warning	Drive operation continues, no acknowledgement necessary	
8	0	Actual value not O.K.	Actual value does not match the setpoint (with *posicon*: failure to reach setpoint position)	
	1	Actual value O.K.	Actual value matches required setpoint (setpoint has been reached) (with *posicon*: setpoint has been reached)	
9	0	Local guidance	Guidance on local device has been activated	
	1	Guidance requested	The master has been requested to assume guidance.	
10	0			
	1	Bit 10 active	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481 and Section 7.2.1.8.	
11	0			
	1	Rotational direction: right	Inverter output voltage is turning right	
12	0			
	1	Rotational direction: left	Inverter output voltage is turning left	
13	0			
	1	Bit 13 active	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481 and Section 7.2.1.8.	
14	0/1	Currently active parameter set 0	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	Currently active parameter set 1		

7.2.1.3 Setpoint 1 (SW1)

The function of the first setpoint is set in the parameter "Function bus setpoint 1" (SK 200E: (P546[01]) or SK 500E: (P546)) (see relevant frequency inverter manual).

In the order telegram, setpoint 1 follows immediately after the control word. Setpoint 1 is pre-set to the transfer of a setpoint frequency (16 bit value).



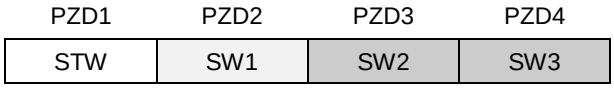
The setpoint is transferred as an integer in the range -32768 to 32767 (8000 hex to 7FFF hex), whereby 16384 (4000 hex) is exactly 100% and -16383 (C000 hex) corresponds to -100%. Due to this resolution, setpoints (depending on function) of up to ± 200% can be transferred.

A setpoint of 100% corresponds to the respective nominal value:

Setting	**100% is equal to**
Off	
Setpoint frequency, actual frequency PID, actual frequency PID limited, actual frequency PID monitored, frequency addition, frequency subtraction, maximum frequency	Maximum frequency
Torque current limit	Torque current limit (P112)
Current limit	Inverter rated current
Servo mode torque	Rated torque
Torque precontrol	Torque precontrol (P214)

7.2.1.4 Setpoints 2 and 3 (SW2/3)

If the PPO type 2 or 4 is used, in addition to setpoint 1, a second setpoint can be transferred in word PZD3 and a third setpoint in PZD4.



The definition of these two setpoints corresponds to that of setpoint 1.

However, the transfer of a third (maximum 16 Bit) setpoint is only possible if the other two setpoints are also 16 Bit values.

If the transfer of a 32 bit setpoint is necessary (Example: setpoint position), this must be divided into two 16 bit values, i.e. into two PZDs (**position High** and **Low word**). It does not matter in which of the three process data words (PZD2 and above) the two position words are transferred.

The definition in the frequency inverter can then, for example, be made via the parameters:

PZD3: „**Bus function - setpoint 2**" (SK 200E / SK 54xE: (P546[-02]) or SK 500E (P547)) and

PZD4: „**Bus function - setpoint 3**" (SK 200E / SK 54xE: (P546[-03]) or SK 500E (P548))

Example

If a position setpoint is to be transferred (Prerequisite: *posicon* inverter functionality) this can be performed either as a 16 bit or 32 bit value. The resolution is always 0.001 rotations/step.

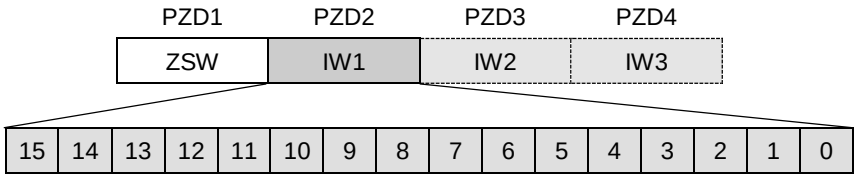
A value range of +32767 (= 32.767 revolutions) to -32768 (= -32.768 revolutions) is possible as a **16 Bit** value. Here, exactly one PZD word is required in order to transfer the position.

The full position range of +/- 50000.000 revolutions is available as a **32 Bit** value. Here, exactly two PZD words are required in order to transfer the position.

7.2.1.5 Actual value 1 (IW1)

The function of the first actual value is set in the parameter "Function bus actual value 1" (SK 200E: (P543[01]) or SK 500E: (P543)) (see relevant frequency inverter manual).

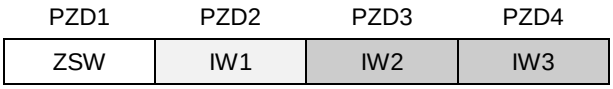
In the order telegram, actual value 1 follows immediately after the control word. The actual value 1 is pre-set to the transfer of the current output frequency of the frequency inverter (16 bit value).



The actual value is transferred as an integer in the range -32768 to 32767 (8000 hex to 7FFF hex), whereby in the settings "actual frequency", "actual speed", "current" and "torque current", the values 16384 (4000 hex) exactly correspond to 100% and -16383 (C000 hex) correspond to exactly -100%. Due to this resolution, setpoints (depending on function) of up to ± 200% can be transferred.

7.2.1.6 Actual values 2 and 3 (IW2/3)

If the PPO type 2 or 4 is used, in addition to actual value 1, a second actual value can be transferred in word PZD3 and a third actual value in PZD4.



The definition of these two actual values corresponds to that of actual value 1.

If the transfer of a 32 bit actual value is necessary (Example: actual position), this must be divided into two 16 bit values, i.e. into two PZDs (**position High** and **Low word**).

The definition in the frequency inverter can then, for example, be made via the parameters:

PZD3: „**Bus function - Actual value 2**" (SK 200E / SK 54xE: (P543[-02]) or SK 500E (P544)) and

PZD4: „**Bus function - Actual value 3**" (SK 200E / SK 54xE: (P543[-03]) or SK 500E (P545))

7.2.1.7 BIT8 and BIT9 control word

Up to 2 inverter functions can be set directly via the bus master or the PLC by means of the control word. For this, the required digital function (see list in parameter P420) must be assigned to Bit 8 of the control word via parameter (P480 [-11]). The same procedure should be applied to Bit 9 of the control word and the function assigned in parameter (P480 [-12]).

Example:

The values of analog inputs 1 and 2 are to be switched off as necessary via the PROFIBUS master on the frequency inverter.

Solution:

Set parameter (P480 [-11]) to function "19" "Analog input 1 ON/OFF"

Set parameter (P480 [-12]) to function "20" "Analog input 2 ON/OFF"

In order to process the value from analog input 1 in the frequency inverter, Bit 8 must be set in the control word. Otherwise the value will not be taken into account by the frequency inverter.

In order to process the value from analog input 2 in the frequency inverter, Bit 9 must be set in the control word. Otherwise the value will not be taken into account by the frequency inverter.

Alternatively, the digital inputs 1 and 2 of the SK xU4-... module can also be processed directly by the frequency inverter. For this, the FI which is allowed access to the inputs must be selected in parameter (P154[-01]). Assignment of the functions is carried out via parameter (P480[-11]) or (P480[-12]) as described above.

7.2.1.8 BIT10 and BIT13 status word

In the same way as Bit 8 and 9 of the control word, 2 functions can be described in the status word, which set Bits 10 or 13 on the occurrence of the relevant inverter status. The list of possible functions corresponds to the "Relay function" or the "Digital output function" (see parameter (P434)).

Example:

The inverter warning "Overcurrent warning" is to be communicated directly in the status word of the frequency inverter.

Solution:

Set parameter (P481 [-09]) to function "9" "Overcurrent warning"

If the conditions for the triggering of the "Overcurrent warning" are fulfilled in the frequency inverter, the inverter sets Bit 10 of the status word to the value "1".

Alternatively, the digital outputs 1 and 2 of the SK xU4-... module can also be processed directly by the frequency inverter. For this, the FI which is allowed access to the inputs must be selected in parameter (P154[-02]). Assignment of the functions is carried out via parameter (P481[-09]) or (P481[-10]) as described above.

7.2.2 The status machine

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

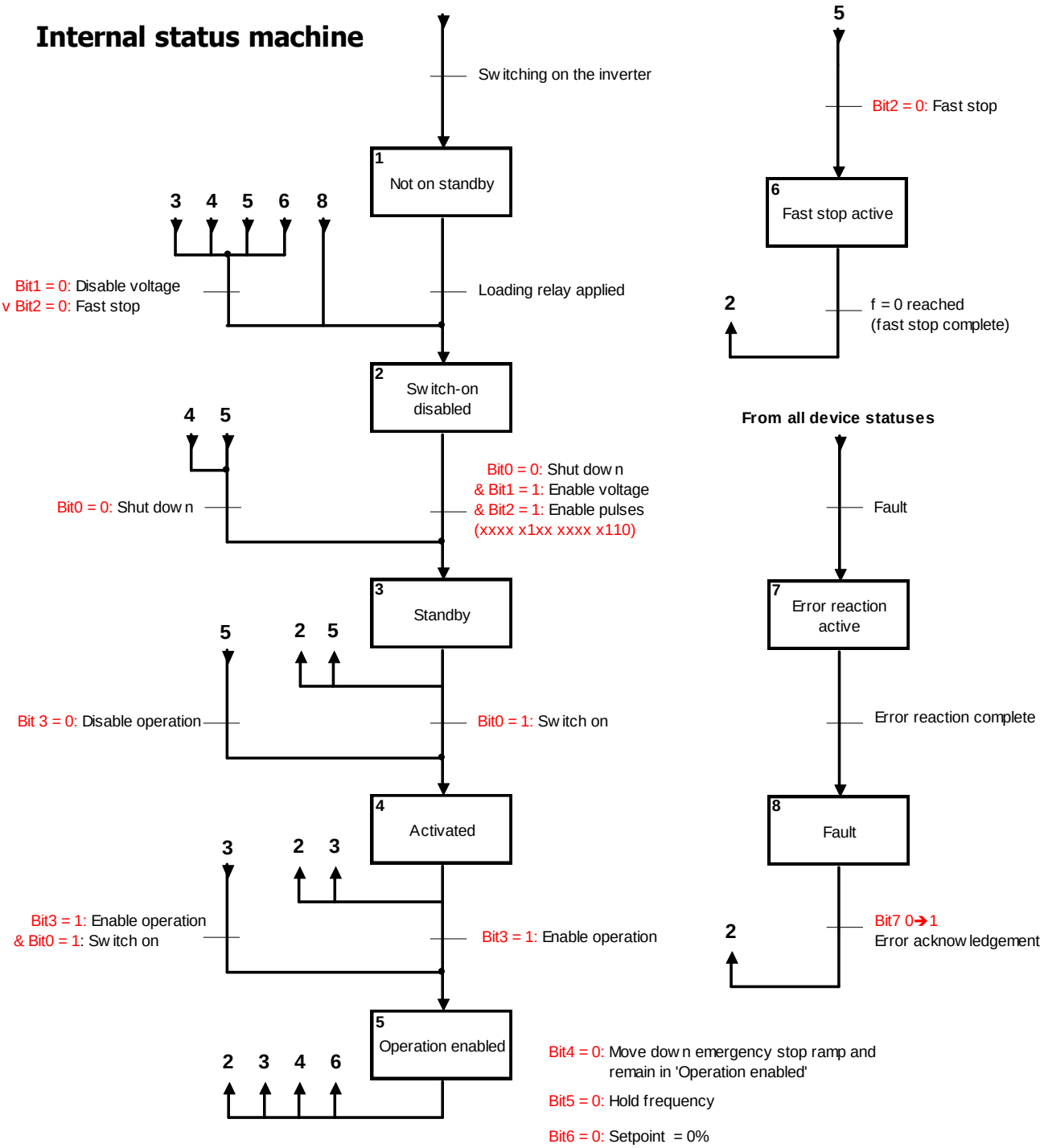
After switching on, the frequency inverter is in **Switch-on disabled** status. This status can only be ended by transmitting the “Shut down (Off 1)” command.

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

The following bits indicate the status of the frequency inverter:

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

Internal status machine



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

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

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

7.2.3 Parameter area (Parameter code value PKW)

Using the PKW mechanism, parameter processing can be carried out in the cyclical data traffic. For this the master formulates an order and the inverter formulates the appropriate response to this. The parameter area is only used for transfer with PPO type 1 and PPO type 2.

In principle, the parameter range consists of a **parameter identification**, in which the type of order (Write, Read etc.) and the relevant parameters are specified. Individual parameter sets or array elements can be addressed with the aid of the **Index**. The **parameter value** contains the value to be written or read.

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

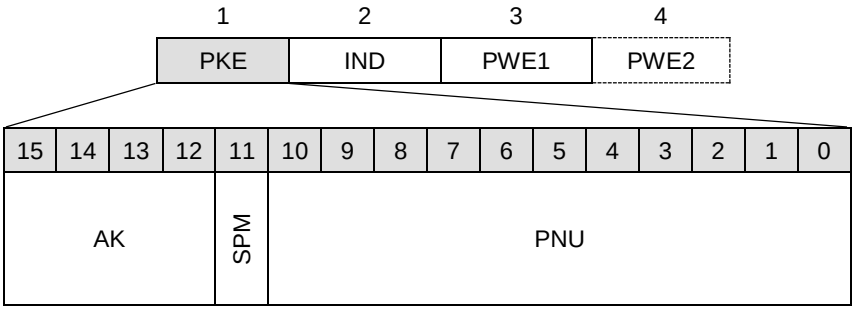
ATTENTION

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

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

7.2.3.1 Parameter label (PKE)

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



The parameter label (**PKE**) is always a 16 bit value. This is divided into the following areas:

PNU: Bits 0 to 10 contain the number of the required parameter (**PNU**), or the number of the current parameter in the response telegram of the frequency inverter.
The parameter numbers (**PNU**) for the particular frequency inverter series can be found in the relevant frequency inverter manual.

SPM: Bit 11 is the toggle-bit for spontaneous messages. This function is **not** supported!

AK: Bits 12 to 15 contain the order or response label.

NOTE

With the PROFIBUS DP protocol, the inverter parameters are mapped in the range from 1000 to 1999 i.e. for parameterisation via the bus, 1000 must be added to the parameter numbers (e.g. P508 → PNU=1508).

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

Meaning of the values sent in the order label:

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

AK	Function	Response label positive
0	No order	0
1	Order parameter value	1 / 2
2	Change parameter value (word)	1
3	Change parameter value (double word)	2
4	Reserved	-
5	Reserved	-
6	Order parameter value (array)	4 / 5
7	Change parameter value (array word)	4
8	Change parameter value (array double word)	5
9	Order the number of array elements	6
10	Reserved	-
Additional orders for SK 200E frequency inverter		
11	Change parameter value (array double word) without writing to the EEPROM	5
12	Change parameter value (array word) without writing to the EEPROM	4
13	Change parameter value (double word) without writing to the EEPROM	2
14	Change parameter value (word) without writing to the EEPROM	1

Meaning of the values sent in the response label:

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

* Only for PPO type 2 and PPO type 4

As long as an order has not yet been executed, the inverter provides the response to the last order. Therefore the master must always check whether the received response matches the order sent.

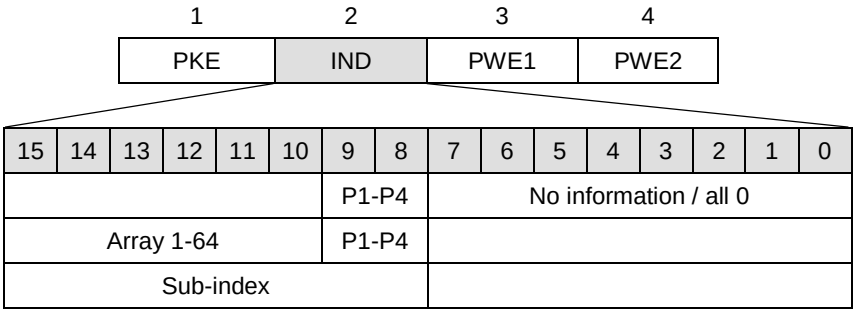
For the plausibility check, the value in the response label (AK), the received parameter number (PNU) with the corresponding Index (IND) as well as the current parameter value (PWE) can be used for the description of parameters.

Error messages if the order cannot be executed

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

No.	Meaning
0	Invalid parameter number
1	Parameter value cannot be changed
2	Lower or upper value limit exceeded
3	Incorrect sub-index
4	No array
5	Invalid data type
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
9	Description data not available or for acyclic access a READ command was triggered without a previous WRITE command
101	the frequency inverter to be accessed does not exist
102	the frequency inverter to be accessed does not exist
103	The frequency inverter to be accessed exists, but the query does not arrive, as the frequency inverter is being heavily queried by another participant.
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

7.2.3.2 Parameter index Sub-index (IND)



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

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

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

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

The structure of individual parameters and the values which can be called up via the sub-indices can be found in Section 5 "Parameterisation" of this supplementary manual or in the relevant section of the inverter manual.

For the use of sub-indices, one of the numbers 6, 7, 8 or 11, 12 must be used as the order label (see previous section)**, in order to be effective.**

7.2.3.3 Parameter value (PWE)

The transfer of the parameter value (PWE) is made in PPO types 1 and 2 and always as a word (16 bit) or double word (32 bit) according to the parameter. Only one parameter value can be transferred in a telegram. Only one parameter value can be transferred in a telegram.

A 32 bit parameter value comprises of PWE1 (higher value word) and PWE2 (lower value word). A 16 Bit parameter value is transferred in PWE2. For negative values the high word must be set to $FFFF_{hex}$.

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

Example: A run-up time of 99.99 seconds is to be set.
99.99s → 99.99 * 1 / 0.01 = 99.99 * 100 = 9999
Therefore the value 9999_{dec} = $270F_{hex}$ is to be transferred.

NOTE

32 Bit parameter values are only used with the *posicon* option. All relevant parameters are described in the additional *posicon* instruction manual.

7.3 Example telegrams

7.3.1 Switch-on disabled → Standby

A frequency inverter is to be switched from the "Switch-on disabled" status (STW Bit 0 – 0), which is active when the device is switched on, to the "Standby" status (STW Bit 0 = 1). The PPO type 1 (Section 7.2) is used, however only the PZD channel is considered.

Procedure:

1) Check last status word (e.g. ZSW **0B 70**)
2) Generate control word (STW **04 7E**)
3) Check response telegram (ZSW **0B 31**)

Procedure - Details

1) Check last status word (ZSW **0B 70**)

word	5		6	
Byte	8	9	10	11
Designation	ZSW		IW1	
Value	0B	70	00	00

Bit	Value	Value HEX	Meaning
15	0	0	Parameter set Bit 1 off
14	0		Parameter set Bit 0 off
13	0		Reserved
12	0		Rotation left is off
11	1	W	Rotation right is on
10	0		Reference value undershot
9	1		Bus controller
8	1		Setpoint = actual value
7	0	7	No warning
6	1		Starting disabled
5	1		No emergency stop
4	1		Voltage not disabled
3	0	0	No fault
2	0		Operation disabled
1	0		Not ready for operation
0	0		Not on standby

2) Generate control word (STW **04 7E**)

The frequency inverter is set to *Standby* status with the following telegram.

word	5		6	
Byte	8	9	10	11
Designation	STW		SW1	
Value	04	7E	00	00

3) Check response telegram (ZSW **0B 31**)

After changing to *Standby* status, the frequency inverter delivers the following response telegram:

word	5		6	
Byte	8	9	10	11
Designation	ZSW		IW1	
Value	0B	31	00	00

NOTE

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

7.3.2 Enable with 50% setpoint

A frequency inverter in the "Standby" status must be enabled for clockwise rotation with 50% setpoint. The PPO type 1 (Section 7.2) is used, however only the PZD channel is considered.

Procedure:

1) Check last status word (e.g. ZSW **0B 31**)
2) Generate control word (STW **04 7F**) and specify setpoint (SW1 **20 00** (=50%))
3) Check response telegram (ZSW **0B 37**, IW1 **20 00**)

Procedure - Details

1) Check last status word (e.g. ZSW **0B 31**)

word	5		6	
Byte	8	9	10	11
Designation	ZSW		IW1	
Value	0B	31	00	00

2) Generate control word (STW **04 7F**) and specify setpoint (SW1 **20 00** (=50%))

word	5		6	
Byte	8	9	10	11
Designation	STW		SW1	
Value	04	7F	20	00

The frequency inverter accelerates the motor in the ramp. When the inverter reaches 50% setpoint, it responds with the following telegram.

3) Check response telegram (ZSW **0B 37**, IW1 **20 00**)

word	5		6	
Byte	8	9	10	11
Designation	ZSW		IW1	
Value	0B	37	20	00

7.3.3 Writing a parameter

When transferring parameter orders, it must be taken into account that the slave does not immediately respond to orders in the parameter channel of the master telegram, but a positive response can be delayed by one or more communication cycles. The master must therefore repeat the required order until the corresponding slave response is received. PPO type 1 or PPO type 2 must be selected (Section 7.2).

The parameter (P102) "run-up time" (PNU = 102_{dec} / 66_{hex}) is to be set to the value 10sec in parameter set 3. (Only the PKW channel is evaluated). (Only the PKW channel is evaluated.)

As the acceleration time has a frequency-internal resolution of 0.01sec, a parameter value of 10 / 0.01 = 1000 ($3E8_{hex}$) must be transferred for 2 sec.

Procedure:

1) Specify order label ("Change parameter value (array word)" → AK = 7)
2) Select parameter (P 102_{dec} + 1000 = P 1102 = P $44E_{hex}$)
3) Select parameter set 3 (IND = 02)
4) Set parameter value (1000_{dec} / $3E8_{hex}$)
5) Check response telegram (positive for array word = 4)

The telegram is composed as follows in hexadecimal notation:

word	1		2		3		4	
Byte	0	1	2	3	4	5	6	7
Designation	PKE		IND		PWE		PWE	
Value	74	4E	02	00	00	00	03	E8

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

word	1		2		3		4	
Byte	3	4	5	6	7	8	9	10
Designation	PKE		IND		PWE		PWE	
Value	44	4E	02	00	00	00	03	E8

ATTENTION

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

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

8 Additional information

8.1 Bus Configuration

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

8.1.1 Laying the PROFIBUS DP cable

A bus segment consists of a maximum of 32 participants. Several segments can be connected together by means of repeaters. In this way, up to 126 participants can participate in reference data traffic. It should be noted that the reaction time increases as the number of participants increases.

The data transfer physics of the serial bus system by means of twisted two-wire cable (with connected shielding) is defined in the specification of the interference-proof RS485 interface.

For applications with potentially high electromagnetic interference (EMC) and for long distances, optic fiber cable should be used as the cable medium and fiber optic couplers should be used for connection.

8.1.2 Cable material

The frequency inverter is usually connected to the PROFIBUS DP system by a twisted, shielded two-wire cable. In EN 50 170, this bus cable is specified as **cable type A**. The guaranteed transfer speeds or transfer distances can only be achieved without errors if the specific cable parameters are complied with.

With these cable types, the following extensions in length result:

Transfer rate **Baud rate [kBit/s]**	9.6	19.2	45.45	93.75	187.5	**500**	**1500**	**3000**	**6000**	**12000**
Cable length [m] **Cable type A**	1200	1200	1200	1200	1000	400	200	100	100	100

These cable length details are defined for a bus segment with 32 participants.

It must be noted that

- the maximum cable length determines the transfer rate and vice versa,
- the transfer rate is set identically for all masters connected to the bus,
- the slaves support the set baud rate (see GSD file).

The standard PROFIBUS DP cable must comply with the following cable specifications:

Parameter	**Value**
Number of wires	2 (twisted)
Impedance	150 Ω (3 to 20 MHz)
Capacitance	< 30pF/m
Loop resistance	< 110 Ω/km
Cable cross section	> 0.32 mm²

NOTE

The lower the shielding resistance of the PROFIBUS DP cable, the better the EMC quality. The electromagnetic compatibility (EMC) describes the normally required state, that technical devices do not interfere with each other due to electrical or electromagnetic effects.

8.1.3 Cable layout and shielding (EMC measures)

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

Appropriate shielding of the bus cable reduces electrical interference which can arise in an industrial environment.

The best shielding characteristics are achieved with the following measures:

- Do not make cable connections shorter than 1m between bus participants
- Avoid long connections between bus subscribers
- Shield the bus cable *on both ends* with large-area connection to the plug housing
- Avoid spur lines (above 1.5MBaud spur lines are no longer permissible)
- Avoid extensions to bus cables via plug connectors

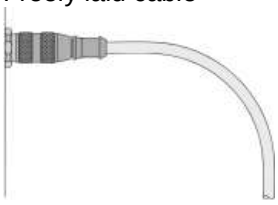
Bus lines should be laid with a minimum spacing of 20cm to other lines which carry a voltage higher than 60V. This applies to lines laid inside and outside of control cabinets.

Special attention should be paid to bending radii:

Fixed cable

Minimum radius
5 x cable diameter

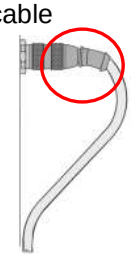
Freely laid cable



Minimum radius
10 x cable diameter

Bending radius of cable

Correct



Incorrect

NOTE

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

8.1.4 Recommendations of the PROFIBUS users´ association

Under www.profibus.com/pb/ important information in association with PROFIBUS can be found in the Internet, including:

- "Installation guidelines for PROFIBUS-DP/FMS", September 1998, Order No. 2.111
- **Guideline Assembling**, Version 1.06, Order Number 8.021/8.022
- **Guideline Commissioning**, Version, 1.02, Order Number 8.031/8.032
- Planning recommendations: www.profibus.com/downloads

  E.g.: **PB**-**Planung**-Beiheft_8041_V10_Aug09.pdf

8.2 Cable glands and shielding connections

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

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

8.2.1 Fixed connection (cable gland)

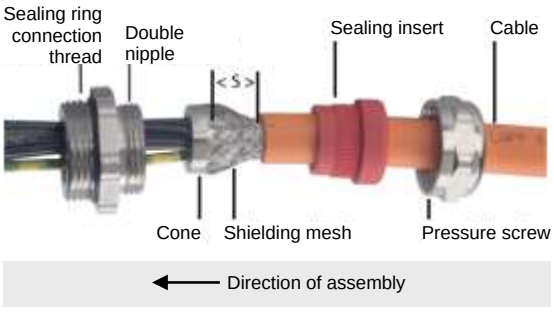
Metallic EMC cable glands with a shielding concept should be used to minimise EMC problems.

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

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

Mounting

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



Function

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

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

8.2.2 Connection with M12 round plug connectors

In order to implement detachable connections, the cable connections for the field and system bus and for sensors and actuators, as well as for the 24V supply voltage can be designed with plug-in connectors.

Here, freely adjustable M12 flanged connectors with metric M16 x 1.5 threads should be used for installation in the relevant housing ((SK TI4-…(-BUS)).

This allows the use of angled or straight M12 round plug connectors for the cable connection.

If required, Getriebebau Nord GmbH can equip the device to be delivered accordingly, or can enclose the required plug with the delivery.

Flanged coupling

Flanged plug

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

8.2.3 Round plug connectors

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

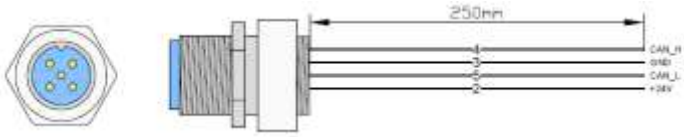
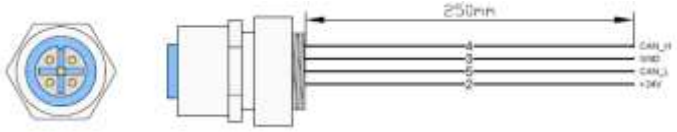
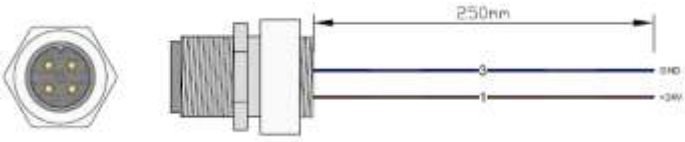
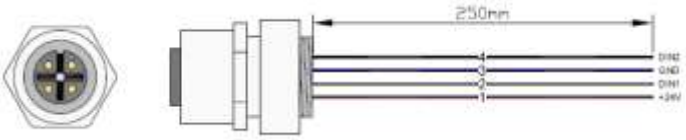
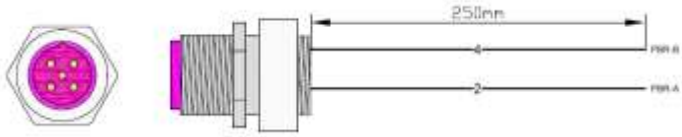
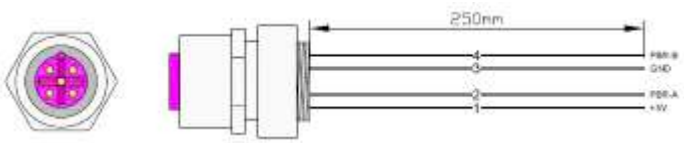
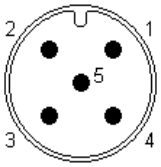
Coding

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

Name	A coding	B coding
Example: Coupling		
Format	M12	M12
Coupling version	with coding groove	with coding pin
Plug version	with coding pin	with coding groove
Field of use	System bus CANopen DeviceNet 24V supply sensors and actuators	PROFIBUS DP

8.2.3.1 M12 flanged connector

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

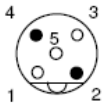
System components	Description	Data
System bus		
SK TIE4-M12-SYSS Part. No. 275274506	 **M12 flanged plug** to connect the incoming system bus cable	A-coded, 5-pin PIN 1 n. c. PIN 2 +24V (brown) PIN 3 GND (blue) PIN 4 Sys-H (black) PIN 5 Sys-L (gray) Plastic body in **light blue**
SK TIE4-M12-SYSM Part. No. 275274505	 **M12 flanged plug** to connect the outgoing system bus cable	A-coded, 5-pin PIN 1 n. c. PIN 2 +24V (brown) PIN 3 GND (blue) PIN 4 Sys-H (black) PIN 5 Sys-L (gray) Plastic body in **light blue**
External voltage supply		
SK TIE4-M12-POW Part. No. 275274507	 **M12 flanged plug** to connect a 24V- supply	A-coded, 4-pin PIN 1 +24V (brown) PIN 2 n. c. PIN 3 GND (blue) PIN 4 n. c. PIN 5 n. c. Plastic body in **black**
Sensors and actuators		
SK TIE4-M12-INI Part. No. 275274503	 **M12 flanged plug** to connect sensors and actuators	A-coded, 4-pin PIN 1 +24V (brown) PIN 2 DI or DO (white) PIN 3 GND (blue) PIN 4 DI or DO (black) PIN 5 n. c. Plastic body in **black**
PROFIBUS DP		
SK TIE4-M12-PBR Part. No. 275274500 **Kit** consisting of M12 flanged plug and flanged socket	 **M12 flanged plug** to connect the *incoming* PROFIBUS DP cable  **M12 flanged plug** to connect the *outgoing* PROFIBUS DP cable	B-coded, 5-pin PIN 1 +5V* (brown) PIN 2 PBR-A (green) PIN 3 GND * (blue) PIN 4 PBR-B (red) PIN 5 n. c. Plastic body and screw cap in **violet** *PIN 1 and PIN 3 are only assigned in the M12 flanged socket
Pin designation of M12 plug		
		The pin designations of the M12 socket are the corresponding mirror image.

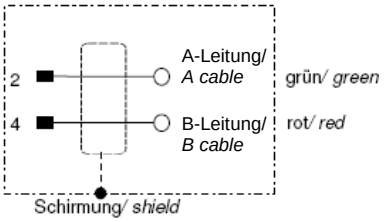
8.2.3.2 M12 round plug connector (cable connector)

The following plug connectors are recommended by Getriebebau NORD GmbH. Plug connectors with a so-called *Part No.* can also be supplied by Getriebebau NORD GmbH.

M12 connector

B coded

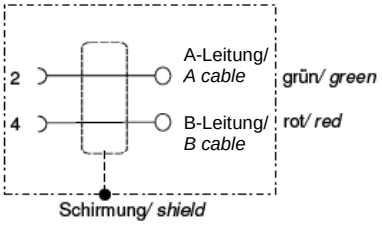




Supplier	Name	Article No. / Part No.	
		straight	angled
MURR Elektronik	M12 plug, 7…8.8mm, 3-pin, cutting type, IP67, shielded	7000-14201-0000000 / Part. No. 275130073	---
MURR Elektronik	M12 plug, 6...8mm, 2-pin, screwed, IP67, shielded	7000-14005-0000000	---
Franz Binder GmbH	M12 plug, 6...8mm, 5-pin, screwed, IP67,	99 1437 810 05	99 1437 820 05 / Part. No. 275130074

M12 socket

B coded



Supplier	Name	Article No. / Part No.	
		straight	angled
MURR Elektronik	M12 plug, 7...8.8mm, 3-pin, cutting type, IP67, shielded	7000-14221-0000000 / Part. No. 275130075	---
MURR Elektronik	M12 socket, 6…8mm, 2-pin, screwed, IP67, shielded	7000-14025-0000000	---
Franz Binder GmbH	M12 socket, 6…8mm, 5-pin, screwed, IP67,	99 1436 810 05	99 1436 820 05 / Part. No. 275130074

If required, ready-made profibus cables of various lengths can be obtained from the manufacturers listed here.

NOTE

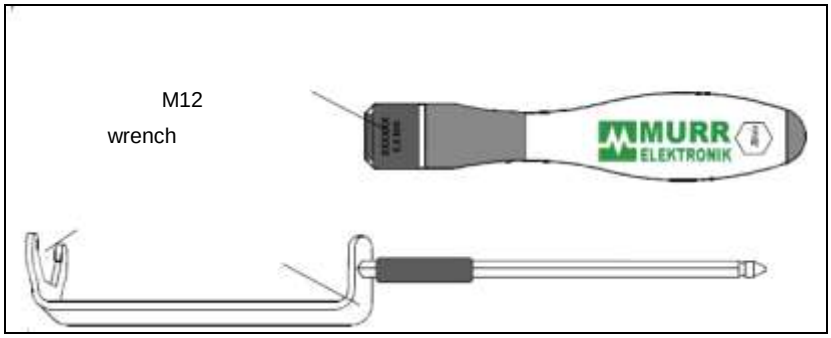
For preference, pre-assembled Profibus cables and connection components should be used.

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

8.2.3.3 Assembly tools

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

Suitable assembly tools are commercially available.




Anwenderhinweise

MURR ELEKTRONIK

Mit Sicherheit dicht!

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

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

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

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

NOTE

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

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

8.3 PROFIBUS DP technology and protocol

The PROFIBUS (Process Field Bus) is the fastest standardised (open) bus system for field use. This technology enables consistent communication down to the lowest field level and is widely used in production, process and building automation systems. PROFIBUS is standardised in the international standard IEC 61158. It is a multi-master system and therefore enables the joint operation of several automation, engineering or visualisation systems with decentralised peripheral devices on a common field bus. The protocol describes the process rules for the transfer of data. The protocol specifies both the format of messages as well as the flow of data in data transfer. A wide variety of field devices can therefore be easily interlinked. In case of failure of individual field devices, data transfer to the remaining bus subscribers continues uninterrupted.

The system configuration or bus structure can be implemented both as a mono-master system (only one master) and as a multi-master system (several masters).

8.3.1 Overview /Protocol architecture

The ISO/OSI layer model describes the communication between the individual participants (slaves) of a communication or automation system. Of the seven defined OSI layers, PROFIBUS uses layers 1, 2 and 7. PROFIBUS DP only uses layers 1 and 2 and the DP user interface.

- Layer 1 **Physical layer** defines the hardware, coding, speed etc. of data transfer
- Layer 2 **Connection layer** describes the bus access procedure including data security, i.e. it defines the physics of transfer
- Layer 7 **Application layer** defines the interface to the application program with the application-orientated commands.

Layer 2 of the ISO/OSI model includes

- the general format for data transfer telegrams
- the bus access mechanisms
- the security mechanisms
- the times to be complied with
- possible transfer services.

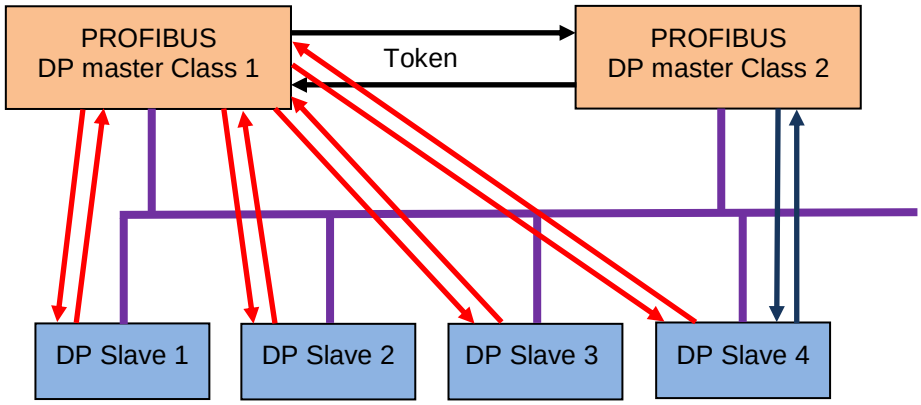
The user only has a slight influence on the design of layer 2, as almost all services are included in the available PROFIBUS ASICs.

8.3.2 Device types

PROFIBUS DP is an acronym for "Process Field Bus for Decentralised Peripherals" i.e. for the simple, rapid, cyclic and deterministic exchange of process data between a PROFIBUS DP master and the assigned PROFIBUS DP slaves connected to the field bus. The exchange of process data takes place between central automation devices such as PLCs, PCs or process control systems and decentralised field devices such as drive units, valves, analysis devices and frequency inverters. Exchange of process data is mainly carried out cyclically between the PROFIBUS DP participants (master ↔ slaves).

Each PROFIBUS DP system can consist of a wide range of different devices. These are divided into three classes:

- **DP master Class 1 (DPM1)** — This master controls the cyclic reference data traffic, i.e. process data is automatically exchanged with the DP slaves (I/Os) in a repetitive sequence. Typical devices for central control are memory-programmed control units (PLCs) or PCs.
- **DP master Class 2 (DPM2)** — These masters are engineering, planning or operating devices (OP, touch-panels).
  They can also access the bus acyclically and additionally enable the configuration and parameterisation of intelligent field devices such as frequency inverters. A DPM2 master does not need to be permanently present on the Profibus DP.
- **DP Slave** — Slaves are peripheral devices with a direct interface to the I/Os, such as I/Os, drive units, valves, measurement transducers, frequency inverters etc., which read in input information and output information to the peripheral devices.



PROFIBUS DP is specially designed for production automation and uses the RS485 standard as the transfer method. RS485 is the most commonly used transfer method and enables transfer rates of up to 12 MBaud. A shielded twisted wire cable is used.

PROFIBUS DP is designed both for rapid time-critical applications as well as for complex communication tasks.

A DP master Class 1 sends a status state (master status) to all assigned and connected slaves in a cyclic time interval which can be configured. If the operating parameter "Auto Clear" is set to "TRUE", the DPM1 master switches the outputs of all associated slaves to the safe condition, i.e. to "0" in case of failure of a slave.

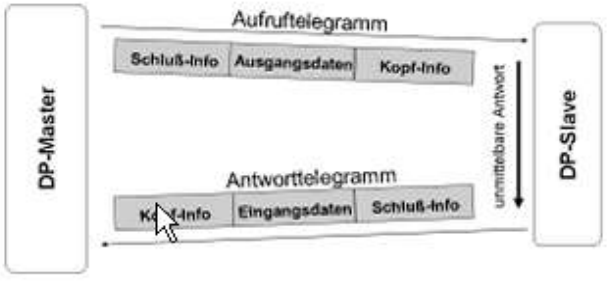


Diagram of telegram sequence

8.3.2.1 PROFIBUS master

PROFIBUS masters are field devices, which take the initiative for the exchange of data with field devices which operate as slaves. A master has the sole access right to slaves on the bus and determines the data transfer on the bus. The master may send out messages without request if it has an access right (token). In the case of several masters in a bus structure, only the master which currently has access rights may send messages. In contrast to the DP slaves, masters are designated as active participants, which have bus access rights for a limited period of time (token-holding time).

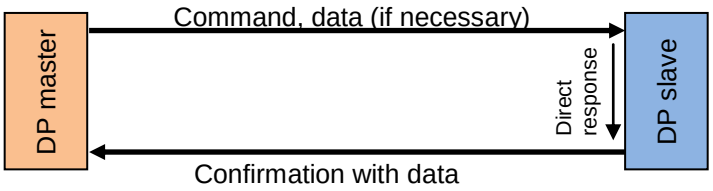
All data which a PROFIBUS master requires for the exchange of data with the slaves (e.g. I/O area), must be created before the system is started and loaded into the master (→ GSD file).

The main tasks of a master are:

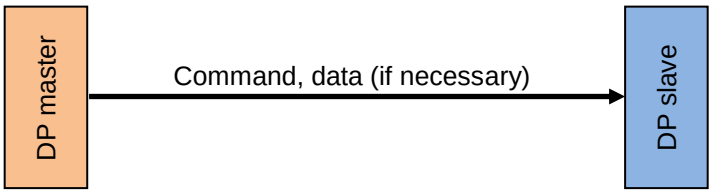
- exchange of data with the planned slaves
- coordination of bus access
- execution of error handling
- providing the user with slave data

The following data transfer services are defined for the PROFIBUS DP:

- **SRD:** Send and request data with acknowledge.
  In a message cycle, the master sends output data to a slave and as a response receives the input data back in the same cycle.



- **SDN:** Send data with no acknowledge, allows the transmission of broadcast telegrams (unacknowledged telegrams).



The PROFIBUS DP master cyclically reads the input information from the connected DP slaves and cyclically writes the output information to the DP slaves.

PROFIBUS DP masters exist as

- modules within a PLC
- CPU module with integrated PLC
- standard PC modules
- Stand-alone boards

8.3.2.2 PROFIBUS slave

PROFIBUS DP slaves are peripheral devices such as I/Os, drive units, HMIs, valves, measurement transponders, frequency inverters. The DP slaves do not receive any access rights, i.e. they can only confirm messages from the master or send messages to the master when requested. DP slaves are designated as passive participants. A slave reads in input information and sends out output information to the peripherals. Because a slave only requires a small portion of the protocol, they are simple to implement in the PROFIBUS system configuration. The amount of input and output information depends on the device and can be up to a maximum of 246 input and 246 output bytes.

All data which a PROFIBUS master requires for the exchange of data (e.g. I/O area) with the slave and its implementation is provided by means of a **D**evice**M**aster**F**ile (→GSD file) which is specific to the particular manufacturer.

The slaves are decentrally coupled to the PLC control unit or the automation device via the transfer medium (PROFIBUS cable and RS485) and complete the configuration of the system.

8.3.3 Performance levels

PROFIBUS DP defines 3 performance levels (basic functions).

- DP-V0 Basic functionalities for cyclic data traffic
- DP-V1 Extensions for acyclic data traffic
- DP-V2 Special extensions and additions for data traffic between slaves

Getriebebau NORD GmbH supports the PROFIBUS DP performance levels DP-V0 and DP-V1.

8.3.3.1 PROFIBUS DP-V0

DP-V0 describes the basic functionalities of the DP communication protocol.

- Cyclic exchange of process data / transfer of reference data between the DP master and slave(s)
- Diagnosis specific to the station, module and channel
- Telegram format: PPO types 1 - 4
- Device classes: DPM1, DPM2 and slave
- Access times*: Reading access (parameter queries) - approx. 30ms
  Writing access (parameter changes) - approx. 50ms
  * for 1 - 4 frequency inverters for each BUS technology unit
- Parameterisation is possible with the use of PPO types 1 and 2

Note:
The bus cycle time must be less than the program cycle time of the central automation device.

Data traffic between the DPM1 and the slaves is structured into the parameterisation, configuration and data transfer phases.

8.3.3.2 PROFIBUS DP-V1

Amongst other things, DP-V1 contains additions for process automation and a series of event-related functions, in particular acyclic data traffic.

- Acyclic exchange of process data for parameterisation, operation, observation and alarm processing of intelligent field devices in parallel with the cyclic reference data traffic.
- Diagnostic functions, status alarm, update alarm and alarm processing specific to the manufacturer.
- Exchange of data during the DP slave initialisation phase
- DP-Master Class 2 - Communication (Section 8.3.2 "Device types" - E.g.: touch panel)
- DP master - master communication (between masters)

Acyclic data traffic, which is made possible by DP-V1 allows the parameterisation and calibration of the connected field devices simultaneously to the cyclic exchange of data.For this, a four-word I/O module is used, which corresponds to the **P**arameter **L**abel **V**alue (PKW) section of PPO types 1 and 2 (see also Section 7.2 "PROFIBUS DP PPO types").

Up to 4 frequency inverters connected via a BUS technology unit can be managed independently from the master via this channel. A DP master Class 1 (DPM1, e.g. PLC or PC) can simultaneously access up to three DP master Class 2 (DPM2, engineering, planning or control devices) in parallel to a technology unit.

Requirements by more complex applications and devices (field devices for process automation, intelligent operating and observations devices, frequency inverters), which often require parameterisation during operation, can therefore be easily implemented.

With the use of this performance class, the parameter values are only rarely changed in comparison to the cyclic measurement values.

8.3.4 Terminology (selection)

8.3.4.1 Bus parameters

Bus parameters are settings which define the time-related behaviour on the physical PROFIBUS DP. The following standardised parameters are set in the DP master by means of the configuration tool. In more recent configuration tools, this is usually carried out automatically:

Name	Meaning	Value range
TS	Master address	0 to 126
Baud rate	Transfer rate	10 options (Section 8.1.2 "Cable material")
T_{SL}	Slot Time	5^2 2^{16}-1 (bit times)
min T_{SDR}	Smallest Station Delay Responder	2^0 to 2^{16}-1 (bit times)
max T_{SDR}	Largest Station Delay Responder	2^0 to 2^{16}-1 (bit times)
T_{QUI}	Quiet Time	0 to 2^8-1 (bit times) (standard value =0)
T_{SET}	Setup Time	2^0 to 2^8-1 (bit times)
T_{TR}	Target Rotation Time	2^0 to 2^{24}-1 (bit times)
G	GAP Update factor (token cycles)	1 to 100 (Standard value = 10)
HSA	Highest Station Address	2 to 126 (Standard value = 126)
Max retry limit	Maximum retries (number of repeat telegrams)	0 to 8

8.3.4.2 Transfer rate (baud rate)

The processing of all DP slaves describes a cycle. The time required for this depends on the transfer rate, the number of DP slaves and the net data to be sent.

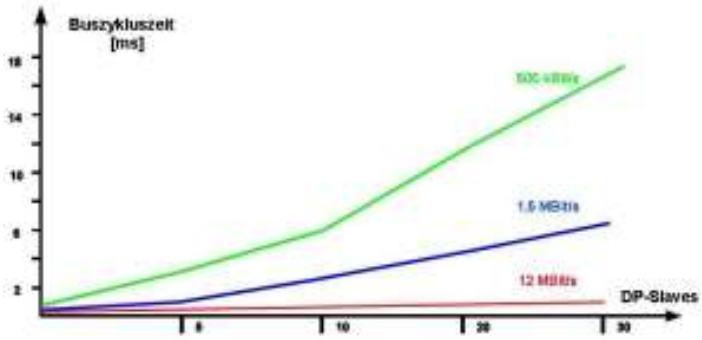


Diagram of bus cycle time

For the transfer of 512 bit input and 512 bit output data divided over 32 bus participants, the PROFIBUS DP requires approx. 1ms with a transfer rate of 12 Mbit/s.

A baud rate of 1.5Mbit/s extends the average cycle time to approx. 6ms.

8.3.4.3 FREEZE and SYNC mode

In addition to the automatic participant-related transfer of reference data, DPM1 masters can also simultaneously sent some control commands to the bus participants for synchronisation of the DP slaves. These control commands are sent as multicast (transfer of messages from a point to a group). The following only lists and describes some of the operating modes/control commands. Detailed information about the basic functionalities is explained in the relevant specialist PROFIBUS DP books.

Note: FREEZE and SYNC functions are used e.g. in applications which require synchronisation. (simultaneous control or acceptance of new setpoints for several DP-slaves or the simultaneous recording of actual process values)

Control command FREEZE

The PROFIBUS DP master sends a FREEZE control command to one or a group of DP slaves (PROFIBUS DP technology unit). The slaves which are addressed in this way "freeze" their current status (actual values). The transfer of the data to the DP-master is then carried out cyclically. The "frozen" data is retained until it is updated by a renewed FREEZE command, or the status is revoked by an UNFREEZE command.

Control command SYNC

The PROFIBUS DP master sends a SYNC control command to one or a group of DP slaves (PROFIBUS DP technology unit). The slaves which are addressed in this way "freeze" their current setpoints. The following incoming setpoints are saved in the DP-slave, however, they are not effective for the process. The saved data is switched to the outputs after the next SYNC command. In the following cycle, an UNSYNC command causes the new setpoints to be adopted and ends SYNC operation.

8.3.4.4 Cyclic and acyclic data traffic

The PROFIBUS technology units enable field bus access to all parameters and functions of the frequency inverter.

Cyclic reference data traffic (process data) enables rapid control of bus participants. Via the standardised process data channel (parameter process data object (PPO)) setpoints (setpoint frequency, position setpoints, current limits etc.) are transferred from the automation device to the frequency inverter. Via the same process data channel, actual values (actual frequency, actual position, current values, error numbers etc.) and status information is read back from the frequency inverter to the automation device. Selection of the PPO type is carried out via the hardware manager (Section 4.2.2). The SK xU4-PBR bus module automatically detects the PPO type which is used and sets it for communication to the frequency inverter.

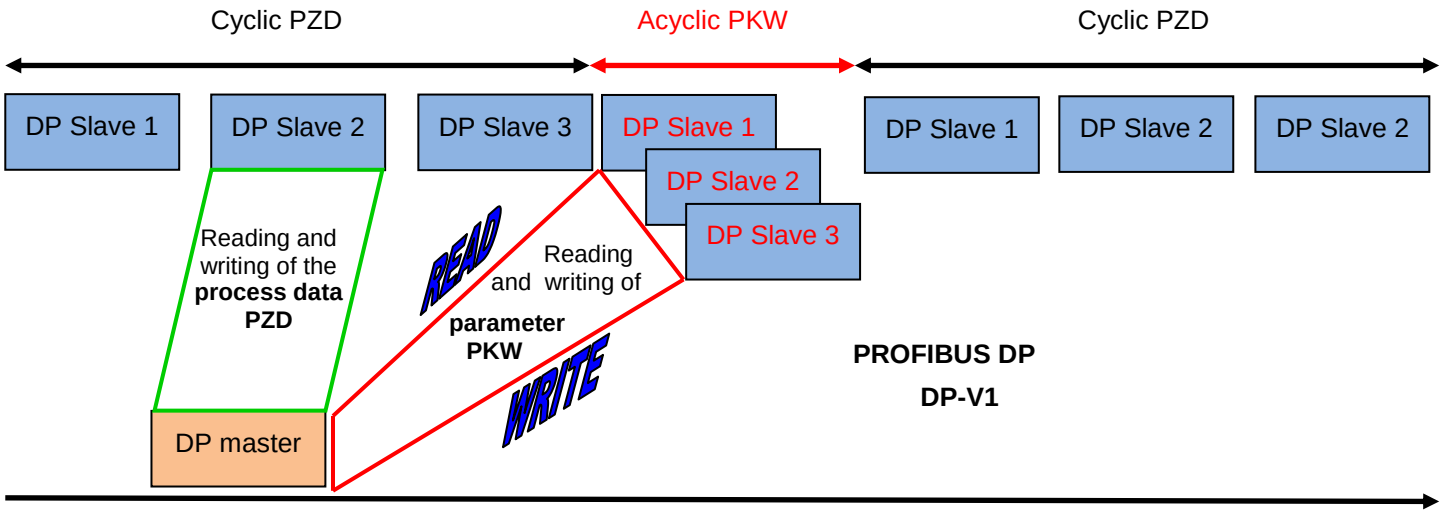
However, some applications require interventions by the user (adaptation of parameters). These interventions can be carried out

- cyclically via the parameter code value channel (only PPO types 1 or 2 and only for frequency inverter parameters) within the process data, or also
- acyclically via special READ / WRITE commands according to the PROFIBUS DP-V1 specification.

Parameter adaptations of the Profibus module SK xU4-PBR (parameter (P150) ... (P154) can only be carried out via acyclic data communication.

The acyclic data traffic is carried out parallel to the cyclic reference data traffic of the process information during operation and can only be used for parameterisation. For the acyclic data traffic, a 4 byte data block, which corresponds to the PKW component of PPO types 1 and 2 is transferred via the PROFIBUS DP.

The acyclic exchange of data sets can extend over several bus cycles or their "gaps".



With SIMATIC STEP 7 applications, two ready-made system modules are available for the handling of acyclic data traffic.

Reading parameters

Within the DPM2 master program, the system module SFB52 "RDREC" (read record) is used to read parameters. This system module reads the data set of the addressed component (module) of a DP slave. This may be a central module or a decentralised component (PROFIBUS DP), a technology unit. If an error occurs during data transfer, this is indicated via an output parameter (ERROR and STATUS) of the system module.

Several settings must be noted for the use of this system module.

If for example a DP-V1 slave is planned via GSD (Rev. 3 or later), the DP master must be set to "DPV1". Otherwise (example setting "S7 compatible") no data sets may be read with SFB 52 from the I/O modules in the application program, as the DP master would be addressed to the wrong slot (planned slot +3).

The SFB 52 "RDREC" is an asynchronous SFB, i.e. processing extends over several SFB call-ups.

Sequence

To read the parameter of the frequency inverter, the PROFIBUS DP master first sends a WRITE control command to the relevant DP slave (PROFIBUS DP technology unit), which confirms the query. A READ command triggers the transfer of the parameter data to the control unit.

The issue of a read command (SFB 52) without a previous write command (SFB 53), results in an error message (E009) by the relevant frequency inverter.

Writing parameters

Within the DPM2 master program, the system module SFB52 "WRREC" (write record) is used to write parameters. This system module writes (transfers) the data set of the addressed component (module) of a DP slave. Several interface settings in the DP master interface must be noted to ensure correct operation.

The SFB 53 "WRREC" is an asynchronous SFB, i.e. processing extends over several SFB call-ups.

Sequence

To change the parameter of the frequency inverter, the PROFIBUS DP master first sends a WRITE control command to the relevant DP slave (PROFIBUS DP technology unit), which confirms the query. If necessary, the transferred parameter changes can be checked by means of a READ command.

8.3.4.5 Device master data (GSD file)

All performance features of the NORDAC PROFIBUS DP module are collated in a device master file (electronic data sheet). The structure, content and coding of the device master file (GSD) are used (standardised in a readable ASCII text file) for simple PROFIBUS DP communication. The GSD file enables the convenient planning of NORDAC frequency inverters via tools from various control unit suppliers. In addition to general information, the GSD file also contains specifications for communication, which are specific to the manufacturer. These specifications are structured into three sections:

- **General Data** Details of the manufacturer and the device, software and hardware version numbers, supported transfer rates etc.
- **Master data** Specific parameter details for the master, upload and download facilities.
- **Slave data** Specific parameter details of the slave, number and type of I/O channels, diagnostic texts and module details for modular device structures.

The standardised GSD files are included in the scope of delivery of the devices (frequency inverters) (enclosed documentation CD (Electronic Product Documentation)) and are available for download free of charge from the Getriebebau NORD GmbH homepage under **www.nord.com**.

For the decentralised SK 200E device series with the associated technology units SK CU4-… or SK TU4-… the GSD file

NORD0BA8.GSD (SK 200E technology unit, incl. DP-V1, 12MBaud)

must be implemented.

This GSD file differs from the previous files provided by Getriebebau NORD GmbH, among other things in the extension of the DP-V1 functionality.

In the SIMATIC S7 Manager, the configuration data is stored under the **Slave_Family** (Code 1 = Drives), e.g. under the heading *Further field devices* under *Drive units* in the catalogue directory NORD@DPV1 of the hardware configuration manager. By means of parameterisation **Auto_Baud_supp** (Value = 1) the automatic baud rate detection is switched on. The function **Set_Slave_Add_supp** (Value = 0) is disabled, so that the slave address cannot be set from the DP master. The setting of several modules is supported by the setting **Modular_Station** (Value = 1). For further information, please refer to the above GSD file.

The PROFIBUS users´ organisation archives this information for all manufacturers and provides this in Internet.

8.3.4.6 Ident number

In order for the PROFIBUS DP master to uniquely identify the various DP devices, the slaves are labelled with an ident number which is specific to the manufacturer. On start-up of the PROFIBUS DP master, the ident numbers of the connected DP slaves are compared with the ident numbers in the specified planning data in the planning tool.

In order to rule out planning errors and malfunctions, the transfer of reference data only begins once the correct device types have been connected to the correct station addresses on the bus and have been recognised by the master.

The ident numbers for Profibus modules from Getriebebau NORD are as follows:

7531_{hex} all Profibus modules for the device series except for SK 200E → SK TU4-… and SK CU4-…

$0BA8_{hex}$ Technology units for the device series SK 200E → SK TU4-… and SK CU4-…

8.3.4.7 Consistent data transfer

A PLC can normally only consistently transfer double words by means of I/O memory access. For longer data formats (PKW channel always / PZD data with PPO2 or PPO4) system functions (e.g. SFC 14, consistent data reading / SFC15, consistent data writing) must be used.

8.3.4.8 I&M function

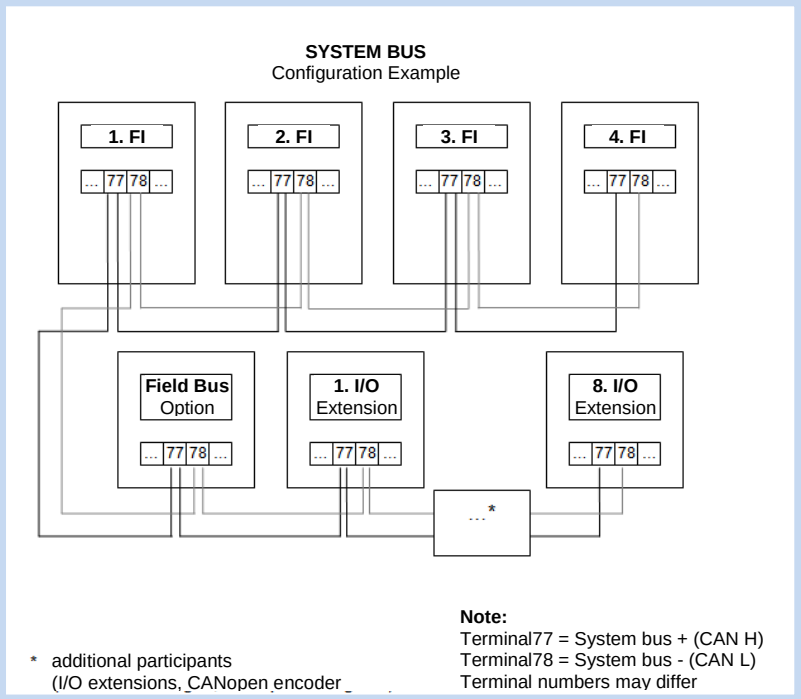
I&M functionality is only supported to a limited extent by Getriebebau NORD PROFIBUS technology units SK CU4-PBR and SK TU4-PBR (…-M12) via the acyclic communication channel (DP-V1). The I&M functions specify the manner of a unified representation of the data which describe PROFIBUS DP devices (electronic type plate). DPM2 masters, such as engineering tools can read and interpret the data of the electronic type plate via an allocation/encryption on the PNO Internet homepage. Among other things, information concerning the manufacturer´s designation, hardware and software version numbers and details of association with a particular profile are transferred.

The Getriebebau NORD Manufacturer ID is:	**393_{dec}.**
The company name is:	**NORD Electronic DRIVESYSTEMS GmbH**.

8.4 System bus

SK 2xxE series frequency inverters and components communicate with each other via the system bus. This bus system is a CAN bus with CANopen protocol. Up to four frequency inverters and their associated components (field bus module, absolute encoder, I/O modules etc.) can be connected to the system bus. Integration of the components into the system bus does not require any specific knowledge of the bus on the part of the user.

Only the proper physical configuration of the bus system and if necessary the correct addressing of the participants need to be taken into account by the user.



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

For detailed information regarding the system bus (physical structure, integration and addressing of further components) please refer to the inverter manual BU0200.

8.5 Repairs

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

NORD Electronic DRIVESYSTEMS GmbH
Tjüchkampstr. 37
26605 Aurich, Germany

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG
Telephone: 04532 / 401-515
Fax: 04532 / 401-555

If a frequency inverter or accessories are sent in for repair, no liability can be accepted for any added components, e.g. such as line cables, potentiometer, external displays, etc.!

Please remove all non-original parts from the frequency inverter.

NOTE

If possible, the reason for returning the component/device should be stated. If necessary, at least one contact for queries should be stated.

This is important in order to keep repair times as short and efficient as possible.

On request you can obtain a suitable goods return voucher from Getriebebau NORD GmbH.

9 Index

Keyword Index:

Address	Assigned or specified designation of a DP slave.
ASIC	Integrated circuit specific to the application
Baud rate	The transmission rate for serial interfaces in bits per second
Binary code	The designation for a code in which messages are communicated by "0" and "1" signals.
Bit / Byte	A bit (binary digit) is the smallest unit of information in the binary system. A byte has 8 bits.
Broadcast	In a network, all slave participants are addressed simultaneously by the master.
DPM1	DP masters Class 1 implement the reference data traffic to the DP slaves. The DPM1 is the central automation device for PROFIBUS DP.
DPM2	In addition to reference data traffic, Class 2 DP masters enable further event-controlled functions such as control, commissioning and planning tasks. The DPM2 is a planning or configuration device for PROFIBUS DP.
DP	Protocol for decentralised peripherals. With PROFIBUS DP this describes the connection between the automation device and the bus participants and is a standardised specification.
DP-V0	The central control unit (bus master)cyclically reads the incoming information (e.g. actual values and status word) from the slaves and writes the outgoing information (e.g. control word and setpoints) to the slaves.
DP-V1	In addition to DP-V1 an acyclic data traffic between the central control unit (bus master) and the connected slaves can be carried out. Transfer of acyclic data is carried out in parallel to the cyclic data traffic between the bus participants.
GSD	Device master data Electronic data sheet
ISO	The International Standards Organisation is the international association of standardisation organisations and produces international standards in all fields, with the exception of electricity and electronics.
I&M	I&M stands for "Identification & Maintenance Functions" and is a functionality of the PNO for all PROFIBUS devices which support acyclic data traffic.
OSI layer model	The Open Systems Interconnection Reference Model defines the elements, structures and tasks necessary for data communication and assigns these to the times for the communication process in seven consecutive layers.
PROFIBUS DP	PROFIBUS DP is a field bus variant for production automation. RS485 interfaces are used for transfer. The DP communication protocol differs in its performance levels and various application profiles.

Abbreviations used:

BE	Bus error (fault)
BR	Bus ready
BS	BUS state (status)
CU	Customer Unit (customer interface - internal technology unit)
D, DI, DIN	Digital IN
EN	DEVICE error (fault)
DO, DOUT	Digital OUT
DP	Decentralized peripheral
DS	DEVICE state (status)
EMC	Electromagnetic compatibility
FI	Frequency inverters
GND	Earth
HW	Hardware
IND	Index
I/O	IN / OUT, input and output
IW	Actual value
I&M	Identification & Maintenance Functions
P	parameter which depends on a parameter set
PKE	Parameter identifier
PKW	Parameter identifier Value
PNO	PROFIBUS users´ organisation
PPO	Parameter Process data Object
PWE	Parameter Value
PZD	Process data
STW	Control word
SW	Software / Setpoint
TU	Technologie Unit (external technology unit)
ZSW	Status word

10 Keyword index

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Part. No. 607 2202 / 0912