Intelligent Drivesystems, Worldwide Services

GB

BU 0020

PROFIBUS DP

Supplementary manual options for NORD - Frequency Inverters

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 and initialisation and maintenance work must be carried out by qualified personnel (comply with IEC 364, CENELEC HD 384, DIN VDE 0100, IEC 664 and 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.

Drive power converters with the CE mark meet the requirements of the Low Voltage Directive 2006/95/EEC. The harmonized standards stated in the Declaration of Conformity are used for the drive power converters.

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 the safety functions which are described and for which they have been 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 connections

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 relevant 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:

Part No.: 607 02 02

Device series: **Profibus DP** for
SK 300E, SK 5xxE, SK 700E, SK 750E

Version list

Name previous versions	Software Version	Remarks
BU 0090 EN, February 2005	V. 3.4 R0	First version, prototype
BU 0020 EN, May 2006	V. 3.5 R1	Correction and inclusion of the frequency inverter series SK 500/520E and SK 750E, angled connector not possible for SK TU2-PBR-24V
BU 0020 EN, August 2006 Part No. 607 02 02 / 3806	V. 3.6 R0	Modification of SK 500/520/530E parameters, correction of recommended M8/M12 connector, SW2/3 and IW2/3 modification, correction of P513 = ...-0.1s
BU 0020 EN, May 2007 Part No. 607 02 02 / 2207	V. 3.6 R0	Small corrections, details of rotary coding switch SK TUx-PBR-24V
BU 0090 EN, February 2009 Part No. 607 02 02 / 0609	V. 3.6 R0	Supplementation of SK TU2-PBR-KL-ATEX, small corrections, updating of error messages, recommended connector components, vector mc description and options removed from the manual.
BU 0020 EN, June 2012 Part No. 607 02 02 / 2612	V. 3.6 R0	Supplementation of parameters for inverter variants: SK 54xE. Modifications of tables: control word and status word for SK 5xxE, slight error corrections, slight modifications of structure of document.

Table 1: Version list

Publisher

Getriebebau NORD GmbH & Co. KG

Rudolf-Diesel-Str. 1 • D-22941 Bargteheide • http://www.nord.com/

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

ATTENTION

This supplementary operating manual is only valid in conjunction with the operating manual supplied for the respective frequency inverter. This is an essential prerequisite for the availability of all the relevant information required for the safe commissioning of the frequency inverter.

Intended use of the frequency inverter

Compliance with the operating instructions is **necessary for fault-free** operation and the acceptance of any 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 described optional modules can only be used for the specifically defined frequency inverter series, use across series is only possible with the SK CU1-… module for SK 700E and SK 750E, or the SK TU2-... module with SK 300E and SK 750E. The use of these modules with other devices is not permitted and can lead to their destruction.

The described optional modules and the corresponding frequency inverters are, according to their type, devices for stationary installation in control cabinets or decentralised structures. All details regarding technical data and permissible conditions at the installation site must be complied with.

Commissioning (commencement of the intended use) is not permitted until it has been ensured that the machine complies with the EMC Directive 2004/108/EEC and that the conformity of the end product meets the Machinery Directive 2006/42/EEC (observe EN 60204).

Table of Contents

List of illustrations

List of tables

1. Introduction

1.1 General

This PROFIBUS DP documentation is valid for the NORD series trio SK 300E, SK 500E, SK 700E, SK 750E. For discontinued device series (e.g. vector mc) which are no longer supplies, the technical documentation for the Profibus description is available on request (older version of BU0020).

The respective basic devices are delivered with a blank cover for the technology unit slot. The basic models do not have any components for parameterisation and control.

In order to set up communication with Profibus DP, either a **Profibus customer unit** or a **Profibus technology unit** (according to the particular device series) must be installed and connected.

1.2 The bus system

Profibus allows the exchange of data between a wide range of automation devices. 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 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 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.

1.3 PROFIBUS DP with NORD frequency inverters

Features:

- Electrically isolated bus interface
- Standard transfer rate up to 1.5Mbit/s - according to version (with 24V supply) up to 12 MBit/s
- RS485 transfer
- Simple connection to the inverter via a 9-pin sub-D connector, M12 round plug connector, screw terminals (technology unit) or spring terminals (customer unit)
- Status indication with 2 LEDs (technology unit)
- Easy programming of all frequency inverter parameters
- Frequency inverter control via Profibus connection
- Transfer of setpoint positions with SK 2xxE/ 530E/ 700E/ 750E with PosiCon option
- Basic Profibus functionality as per DP-V0 for all frequency inverter series
- Transfer of the actual frequency inverter status during operation
- Up to 126 frequency inverters on a single bus

1.4 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.

1.5 Scope of supply

Technology unit	SK TU1-PBR(-…)	for SK 700E	IP20	or
	SK TU2-PBR(-…)	for SK 300E / SK 750E	IP55	or
	SK TU2-PBR(-…)-C	for SK 300E / SK 750E	IP66	or
	SK TU3-PBR(-…)	for SK 5xxE	IP20	or
Customer interface	SK CU1-PBR(-…)	for SK 700E / SK 750E	IP00	

The operating instructions for the above Profibus modules or the relevant frequency inverters as well as the NORDCON parameterisation software are available for download free of charge under www.nord.com. In addition, a documentation CD is provided with every frequency inverter (designation: EPD), on which the above data is also provided.

Note

The technology units SK TU1 and SK TU3 are also supplied with a flat connecting sleeve. This sleeve must be used to produce a correct PE connection of the technology unit via an appropriate cable (cross-section 1.5mm²).

Note

Standard SIMATIK modules are available for the series SK 2xxE and SK 5xxE. The modules can be downloaded under www.nord.com. A description of these modules can be found in Manual BU 0940.

1.6 Certifications

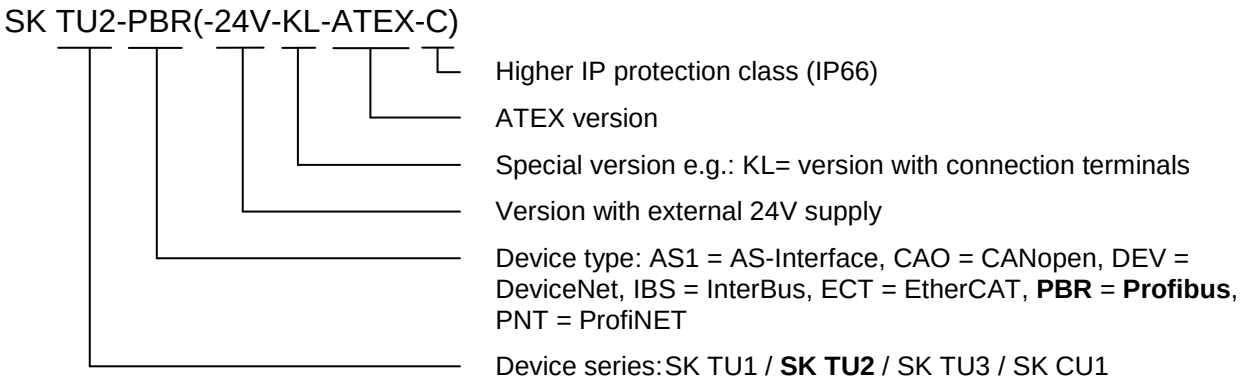
1.6.1 European EMC Directive

If the frequency inverter is installed according to the recommendations in this manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3.

1.6.2 RoHS compliant

The frequency inverters and optional modules are designed to be RoHS compliant according to Directive 2002/95/EU.

1.7 Type code


SK TU2-PBR(-24V-KL-ATEX-C)
Higher IP protection class (IP66)
ATEX version
Special version e.g.: KL= version with connection terminals
Version with external 24V supply
Device type: AS1 = AS-Interface, CAO = CANopen, DEV = DeviceNet, IBS = InterBus, ECT = EtherCAT, **PBR** = **Profibus**, PNT = ProfiNET
Device series: SK TU1 / **SK TU2** / SK TU3 / SK CU1

2. Modules

2.1 Modular assemblies SK 5xxE

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

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

The **Technology Unit (Technology Unit, SK TU1-...)** is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

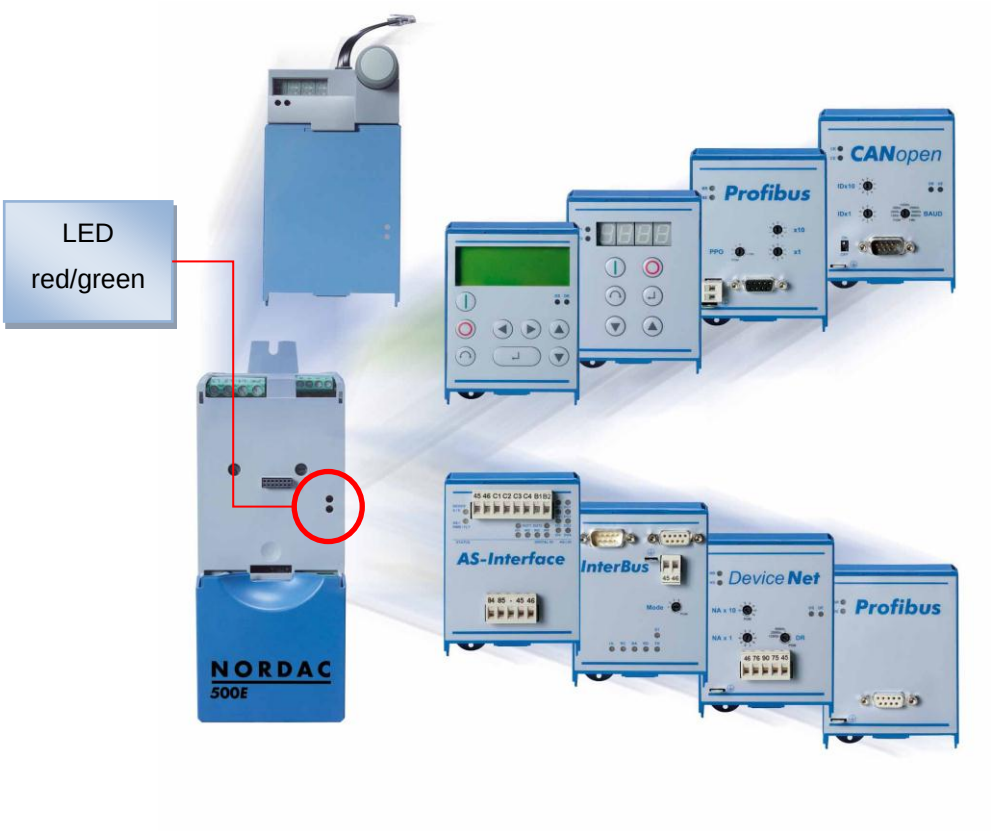


Fig. 1: Modular assemblies SK 5xxE

2.1.1 SK TU2 Profibus Module, Overview

The Profibus DP communication modules SK TU3-PBR and SK TU3-PBR-24V are used to connect drive units of the SK 500E series to higher level automation systems via Profibus DP.

Module	Description	Data
Profibus module **SK TU3-PBR**	This option enables control of the SK 5xxE via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud Connector: Sub-D9 Part No. 275900030
Profibus module **SK TU3-PBR-24V**	This option enables control of the SK 5xxE via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 12 MBaud Connector: Sub-D9 External 24V voltage supply, 2 pin connector Part No. 275900160

Table 2: SK TU3-PBR, Overview of Technology Units

Note

If several SK 500E frequency inverters are installed immediately adjacent to each other in a control cabinet, only SUB-D9 Profibus bus connectors with a 45° or 0° cable outlet should be used to connect the Profibus technology unit.

If necessary, in case of any vibration and contact problems, the Profibus cables should be fixed by means of SK 8 shield terminals and a shield bracket in the control cabinet.

Note

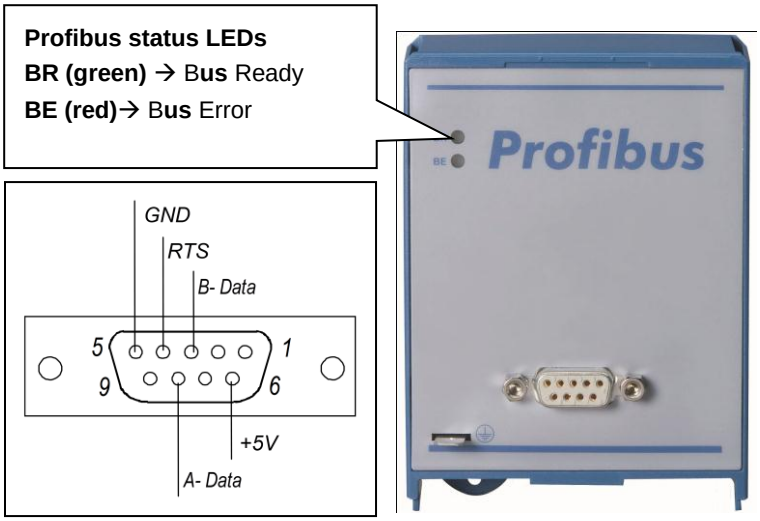
The cable shield must be connected to the functional earth[1] (usually the electrically conducting mounting plate) in order to avoid EMC interference in the device.

To achieve this, in the Profibus connector the shield must be connected to a large area of the D-SUB connector and the functional earth.

[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.

2.1.2 Profibus Module SK TU1-PBR

This Profibus module is internally supplied from the frequency inverter. Therefore, this Profibus participant is only detected by the master system if mains voltage is applied to the frequency inverter.



Termination resistor

The termination resistor for the last bus participant is located in the Profibus standard plug.

A transfer rate of up to 1.5Mbit/s can be used.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

2.1.3 Profibus module, SK TU3-PBR-24V

This Profibus module is supplied with voltage by an external 24V connection. The Profibus participant can therefore be identified by the master system even without a power supply to the frequency inverter. The data required for this purpose are set using a rotary coding switch. The data is read in when the 24V are applied.

A transfer rate of up to 12Mbit/s can be used.

Connection of the supply voltage

The supply voltage is 24V DC ±25% (Terminal 45 = 24V, terminal 46 = GND, approx. 100mA). Connection is via screw terminals with a maximum conductor cross-section of 2.5mm². Wire end sleeves must be used for flexible cables.

The assignment of the socket is identical to that for the option SK TU3-PBR.

Termination resistor

The termination resistor for the last bus participant is located in the SUB-D9 Profibus standard plug.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

Setting the PPO type

The 4 PPO types can be selected with the rotary coding switch for the **PPO** type (Section 7.2 and 7.2.1).

1 to 4 means the address range 00 to 99. With +100, the addresses from 100 to 126 can be set.

When set to **PGM** the value from parameter P507 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

Setting the Profibus address

The Profibus address can be set in decimal from 0 to 99 with the rotary coding switches designated as "**x10**" and "**x1**".

When the PPO switch is set to **PGM** the value from parameter P508 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

Note

The settings made using the rotary coding switch are not transferred to the frequency inverter or saved.

Installing the technology unit

ATTENTION

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

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

The technology units must be **installed** as follows:

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

2.2 Modular units SK 700E (SK 750E)

By the use of various modules for display, control and parameterisation, the SK 700E can be easily adapted to various requirements.

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

The **Technology Unit (Technology Unit, SK TU1-...)** is connected externally to the front of the frequency inverter and is therefore easy to access and replace at any time.

In addition, further modules (customer interfaces and special extensions) can be used in the frequency inverter for the processing of digital and analogue signals and for speed control or positioning.

Fig. 2: Frequency inverter SK 700E and technology units

2.2.1 SK TU1 Profibus Module, Overview

The Profibus DP communication modules SK TU1-PBR or SK TU1-PBR-24V are used to connect drive units of the SK 700E series to higher level automation systems via Profibus DP.

Module	Description	Data
Profibus module **SK TU1-PBR**	This option enables control of the SK 700E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud Connector: Sub-D9 Part No. 278200060
Profibus module **SK TU1-PBR-24V**	This option enables control of the SK 700E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 12 MBaud Connector: Sub-D9 External 24V voltage supply, 2 pin connector Part No. 278200160

Table 3: SK TU1-PBR, Overview of Technology Units

Note

If several SK 700E frequency inverters are installed immediately adjacent to each other in a control cabinet, only SUB-D9 Profibus bus connectors with a 45° or 0° cable outlet should be used to connect the Profibus technology unit.

In general, Profibus bus connectors with a 90° cable outlet should not be used, as due to the contact of the bus connector housing with the cover of the frequency inverter, the Profibus technology unit may be tilted.

If necessary, in case of any vibration and contact problems, the Profibus cables should be fixed by means of SK 8 shield terminals and a shield bracket in the control cabinet.

Note

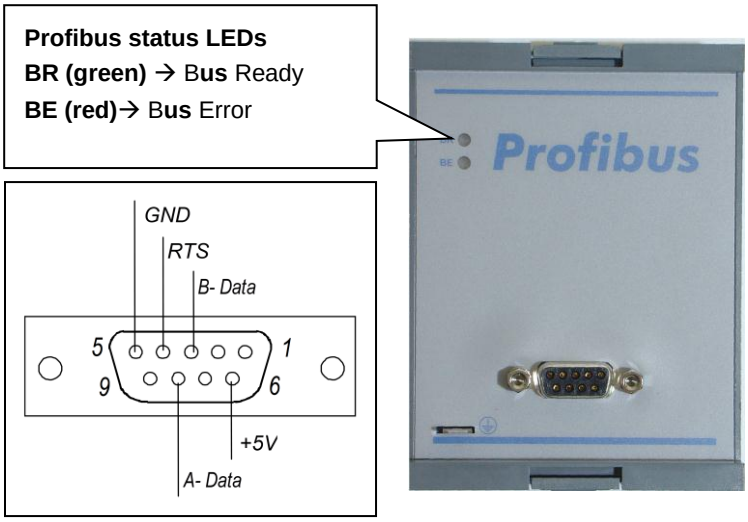
The cable shield must be connected to the functional earth[2] (usually the electrically conducting mounting plate) in order to avoid EMC interference in the device.

To achieve this, in the Profibus connector the shield must be connected to a large area of the D-SUB connector and the functional earth.

[2] 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 Profibus module SK TU1-PBR

This Profibus module is internally supplied from the frequency inverter. Therefore, this Profibus participant is only detected by the master system if mains voltage is applied to the frequency inverter.



Termination resistor

The termination resistor for the last bus participant is located in the Profibus standard plug.

A transfer rate of up to 1.5Mbit/s can be used.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

2.2.3 Profibus module SK TU1-PBR-24V

This Profibus module is supplied with voltage by an external 24V connection. The Profibus participant can therefore be identified by the master system even without a power supply to the frequency inverter. The data required for this purpose are set using a rotary coding switch. The data is read in when the 24V are applied.

A transfer rate of up to 12Mbit/s can be used.

Connection of the supply voltage

The supply voltage is 24V DC ±25% (Terminal 45 = 24V, terminal 46 = GND, approx. 100mA). Connection is via screw terminals with a maximum conductor cross-section of 2.5mm². Wire end sleeves must be used for flexible cables.

The assignment of the socket is identical to that for the option SK TU1-PBR.

Termination resistor

The termination resistor for the last bus participant is located in the SUB-D9 Profibus standard plug.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

Setting the PPO type

The 4 PPO types can be selected with the rotary coding switch for the **PPO** type (Section 7.2 and 7.2.1).

1 to 4 means the address range 00 to 99. With +100, the addresses from 100 to 126 can be set.

When set to **PGM** the value from parameter P507 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

Setting the Profibus address

The Profibus address can be set in decimal from 0 to 99 with the rotary coding switches designated as "**x10**" and "**x1**".

When the PPO switch is set to **PGM** the value from parameter P508 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

Note

The settings made using the rotary coding switch are not transferred to the frequency inverter or saved.

Note

Up to the end of 2005, "x16" hex rotary coding switches were used. This resulted in a different determination of the bus address.

2.2.4 Installation of the SK TU1 technology unit

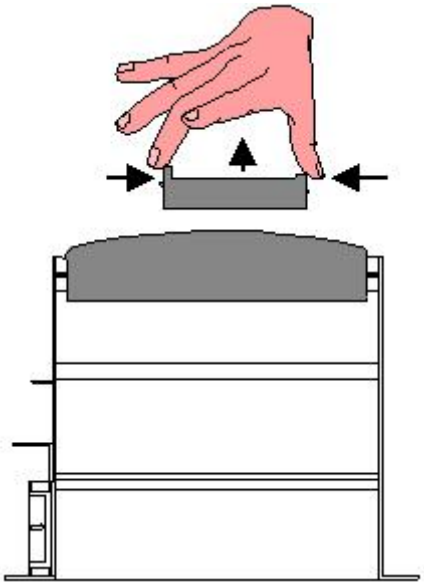
WARNING

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 remote from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

Failure to comply with this may result in an **electric shock**, which my cause serious injury and the destruction of the frequency inverter and the module.

Installation of the technology units must be carried out as follows:

1. Switch off the mains voltage, observe the waiting period.
2. Remove the dummy cover by actuating the unlocking device on the top and bottom edge.
3. Press the technology unit onto the mounting surface, until it audibly engages.



2.2.5 Profibus module, SK CU1-PBR (and SK 750E)

In addition to data connections, the Profibus customer units are also equipped with conventional digital inputs and outputs. The SK CU2-PBR can be used in both the SK 700E and the SK 750E series.

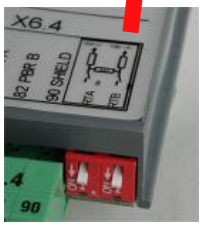
By means of a relay contact, brake control and even warnings to another system can be initiated.

Various digital functions can be programmed for the input. The digital input has a 2.5V switching threshold for the evaluation of the temperature sensor.

The bus termination resistor (R_{ab}) can be switched in. For this, both switches must be set to 'On'. A transfer rate of up to 1.5Mbit/s can be used.

Detail:

DIP switch



Profibus, SK CU1-PBR	Functions	Maximum cross-section
X6.1	Output relay	1.5 mm ^{2}
X6.2	Digital input	1.5 mm ^{2}
X6.3	Data cables	1.5 mm ^{2}
X6.4	Data cables, parallel	1.5 mm ^{2}

Assembly	Description	Data
Profibus module **SK CU1-PBR**	This option enables control of the SK 700E/750E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud 1 x digital input 1 x output relay Direct plugs, terminals and connectors Part No. 278200030

Table 4: SK CU1-PBR, overview of customer units

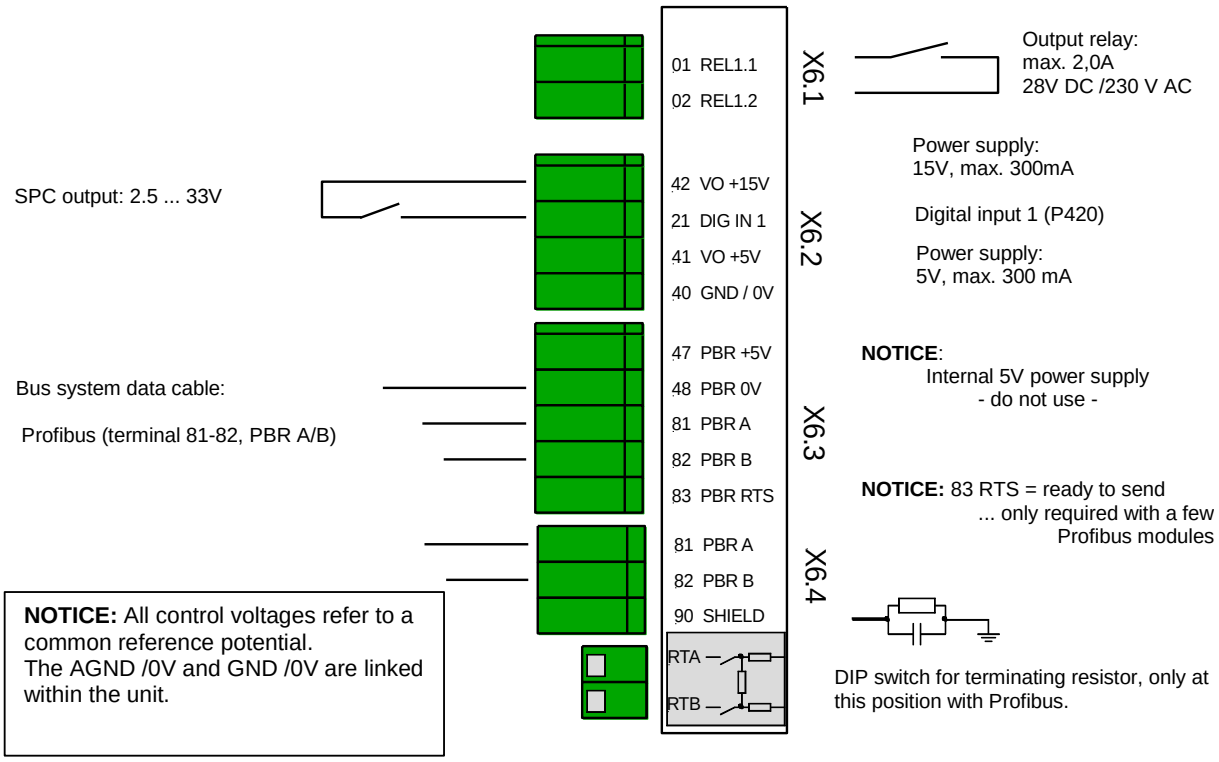
Note

The cable shield must be connected to the functional earth[3] (usually the electrically conducting mounting plate) in order to avoid EMC interference in the device.

With the two SK 8 shield terminals enclosed with option, the Profibus cables can be connected to the shield bracket of the frequency inverter.

[3] 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.

SK CU1-PBR terminal assignment



2.2.6 Installation of the SK CU1-PBR customer unit

WARNING

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 remote from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

Failure to comply with this may result in an **electric shock**, which my cause serious injury and the destruction of the frequency inverter and the module.

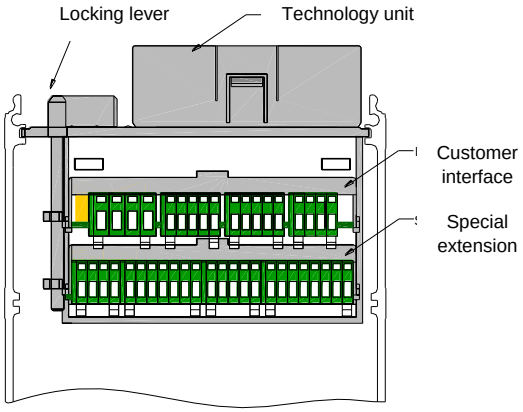
Note

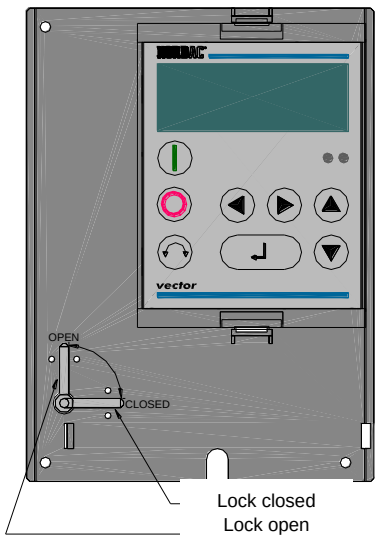
Following the insertion, replacement or removal of modules, and once the equipment has been switched on again, this procedure is indicated with the message E017 Customer unit changed.

This message can be directly reset by the usual measures.

Installing the customer unit

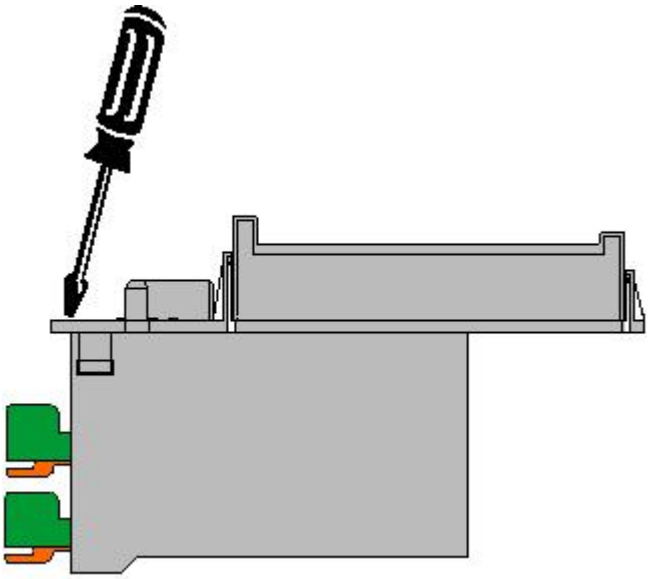
1. Switch off the mains voltage, observe the waiting period.
2. Remove the cover grille from the connection area by loosening the 2 screws and levering out the device cover (slot) or simply pull it out.
3. Locking lever in the "„**open**“ position.
4. Using light pressure push the customer unit into the upper guide rail until it engages.
5. Locking lever in the „**closed**“ position.
6. Remove the connector by pressing the releases then make the necessary connections. Then insert the connectors until they engage.
7. Replace all covers.

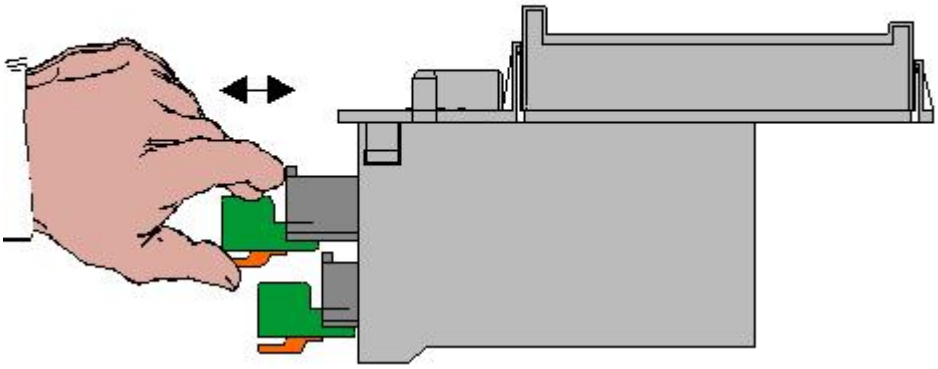




Removing the customer unit

1. Switch off the mains voltage, observe the waiting period.
2. Remove the cover grille from the connection area by loosening the 2 screws and levering out the device cover (slot) or simply pull it out.
3. Locking lever in the "„**open**“ position.
4. Using a screwdriver (as shown), lever the customer unit out of its engaged position and then remove it by hand.
5. Locking lever in the „**closed**“ position.
6. Replace all covers.

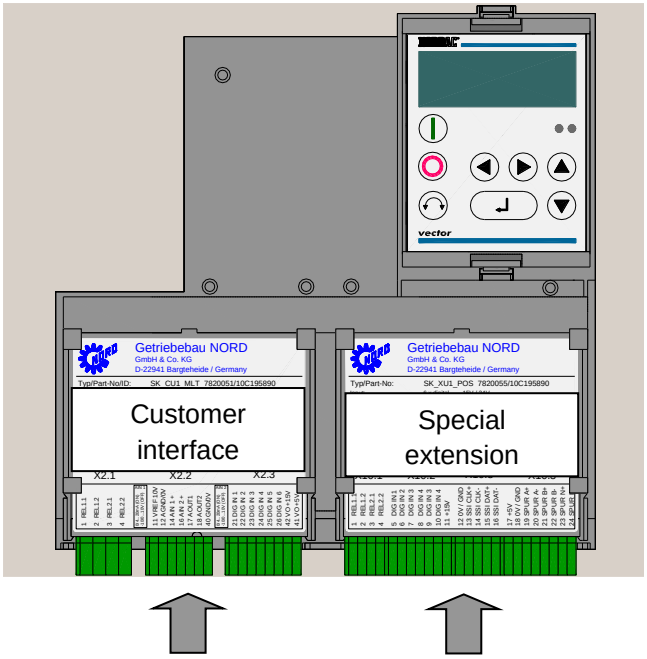




Deviating position of the customer unit for SK 700E above 30 kW and all SK 750E devices

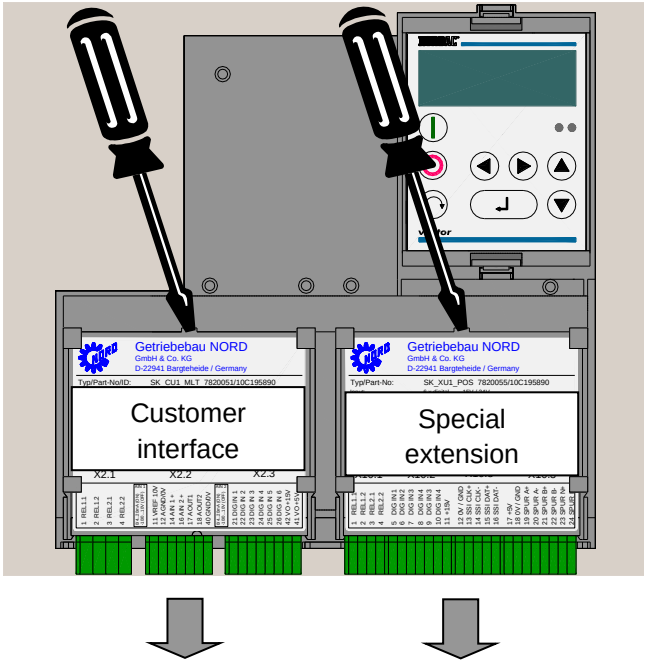
Installation

The procedure is as described above; however no locking lever is present. The modules engage on the front edge when they are inserted.



Dismantling

As shown, simply lever out from the upper edge. If this is difficult, simply unfasten the locking hook on the front edge.



2.3 Modular units *trio* SK 300E and SK 750E

Technology units are optional modules with which additional functions in the frequency inverter can be added depending on requirements. The high level of protection of the frequency inverter remains with all technology units.

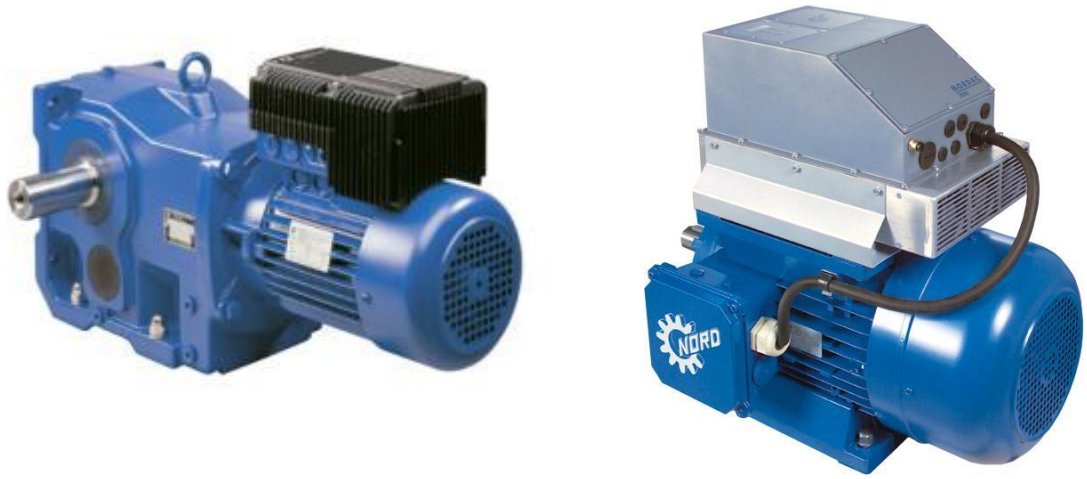


Fig. 3: Frequency inverters SK 300E and SK 750E

2.3.1 SK TU2 Profibus Module, Overview

The Profibus DP communication modules SK TU2-PBR, SK TU2-PBR-KL, SK TU2-PBR-KL-ATEX and SK TU2-PBR-24V are used to connect drives from the device series trio SK 300E and SK 750E to higher level automation systems via Profibus DP. Both the SK 300E frequency inverters and the external technology units are available in the protection classes IP55 (standard) and IP66 (optional). The type designation of the SK 300E and the modules in the protection class IP66 is given an additional code "-C" (coated → coated board) to differentiate the IP55 and IP66 protection classes. For SK 750E frequency inverters, the protection class is specified by the type of cooling. IP54 for air-cooled devices and IP65 for water-cooled SK 750E frequency inverters.

Module	Protection class	Description	Data
Profibus module **SK TU2-PBR**	IP55	This option enables control of the SK 300E / 750E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud 2 x 5-pin M12 system plug connector Part No. 275130070 (IP55) Part No. 275170070 (IP66)
Profibus module **SK TU2-PBR-C**	IP66		
Profibus module **SK TU2-PBR-24V**	IP55	This option enables control of the SK 300E / 750E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 12 MBaud 2 x 5-pin M12 system plug connector 1 power supply 24V/100mA, M8 round plug connector Part No. 275130110 (IP55) Part No. 275170110 (IP66)
Profibus module **SK TU2-PBR-24V-C**	IP66		
Profibus module **SK TU2-PBR-KL**	IP55	This option enables control of the SK 300E / 750E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud 8-pin WAGO terminal strip / SUB-D9 diagnostic connector Part No. 275130065 (IP55) Part No. 275170065 (IP66)
Profibus module **SK TU2-PBR-KL-C**	IP66		

Module	Protection class	Description	Data
Profibus module **SK TU2-PBR-KL-ATEX**	IP55	This option enables control of the SK 300E / 750E via the Profibus DP interface with the performance level DP-V0	Baud rate: up to 1.5 MBaud 8-pin WAGO terminal strip / SUB-D9 diagnostic connector Part No. 275130067 (IP55) Part No. 275170067 (IP66)
Profibus module **SK TU2-PBR-KL-ATEX-C**	IP66		

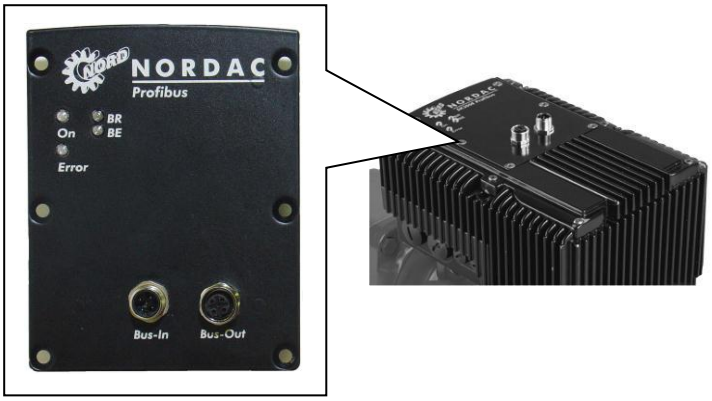
Table 5: SK TU2-PBR, Overview of Technology Units

Note

Modules of the IP66 version have an additional "C" in the type code and are modified with several **special measures** (see Manual SK 300E or SK 750E).

2.3.2 Profibus module SK TU2-PBR

- 2x 5 pin M12 connectors
- No additional supply voltage
- Transfer rate of up to 1.5Mbit/s



External M12 round plug connector BUS connection

To connect an SK 300E / 750E with Profibus option to an existing Profibus network, special connection accessories are required (Section 3). M12 connectors are used, which enable compliance with the high protection class IP55/66. The following recommended M12 components are specially designed for Profibus applications. Shielding is provided and the coding (B coding) complies with the Profibus standard. When selecting the connectors, care must be taken that conventional M12 components with A coding are not used.

Standard assignment	
M12 pin	**Signal**
1	+ 5V
2	A Data
3	GND
4	B Data
5	n.c.

Termination resistor

The termination resistor for the last bus participant can be screwed to the Bus-out socket of the of the final frequency inverter or bus participant as the termination connector.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

Note

If older SK TU2-PBR modules are used, only normal, straight M12 plug connectors and sockets can be used. However, angled connectors can be used with the new hardware version (from May 2007).

2.3.3 Profibus module SK TU2-PBR-24V

The power supply for this Profibus option is via an external 24V connection (M8 round plug connector). The Profibus participant can therefore be identified by the master system even without a voltage supply to the frequency inverter.

- 2x 5 pin M12 connectors
- Additional 24V supply voltage (3-pin M8 socket)
- Transfer rate of up to 12Mbit/s
- Rotary coding switch for setting the PPO type
- Rotary coding switch for address setting

The data required for this purpose are set using the three rotary coding switches. The data is read in when the 24V (approx. 100mA) are applied.

External M8 round plug connector for 24V supply voltage connection

To connect an SK 300E / 750E with Profibus 24V option to an existing Profibus network, special connection accessories are required for the separate voltage supply (Section 3). An M8 socket is used, which enables compliance with the high protection class IP55/66. The following recommended M8 components must be used for Profibus applications.

24Vdc connection assignments	
M8 pin	**Signal**
1	24 VDC ± 25%
3	GND
4	n.c.

Connection of the 24V supply voltage

The supply voltage is 24V DC ±25% (Pin 1 = 24V, Pin 3 = GND, approx. 100mA). A normal M8 cable socket is used for the 24V connection.

External M12 round plug connector BUS connection

To connect an SK 300E / 750E with Profibus option to an existing Profibus network, special connection accessories are required (Section 3). M12 connectors are used, which enable compliance with the high protection class IP55/66. The following recommended M12 components are specially designed for Profibus applications. Shielding is provided and the coding (B coding) complies with the Profibus standard. When selecting the connectors, care must be taken that conventional M12 components with A coding are not used.

Standard assignment	
M12 pin	**Signal**
1	+ 5V
2	A Data
3	GND
4	B Data
5	n.c.

Termination resistor

The termination resistor for the last bus participant can be screwed to the Bus-out socket of the of the final frequency inverter or bus participant as the termination connector.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

Rotary coding switches

The rotary coding switches are located under the respective screw covers at the front. After setting of the rotary coding switches is complete, the screw covers must be correctly replaced in order to maintain the protection class.

Setting the PPO type

The 4 PPO types can be selected with the rotary coding switch for the **PPO** type (Section 7.2 and 7.2.1). 1 to 4 means the address range 00 to 99. With +100, the addresses from 100 to 126 can be set.

When set to **PGM** the value from parameter P507 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

Setting the Profibus address

With the rotary coding switches, designated as "**x10**" (10s place) and "**x1**" (units place), the Profibus address can be set in decimal from 00 to 99. With +100 the addresses from 100 to 126 can be set. When set to **PGM** the value from parameter P508 of the frequency inverter is used. For this, the frequency inverter must be supplied with mains voltage.

E.g. Profibus adress = 30_{dez} = x10=3, x1=0

Note

The settings made using the rotary coding switch are not transferred to the frequency inverter or saved.

Note

Up to the end of 2005, "x16" hex rotary coding switches were used. This resulted in a different determination of the bus address. If older SK TU2-PBR 24V modules are used, only normal, straight M12 plug connectors and sockets can be used. However, angled connectors can be used with the new hardware version (from January 2007).

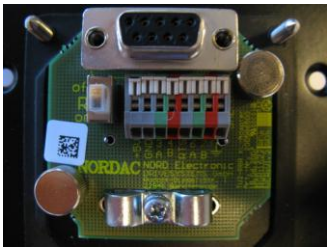
2.3.4 Profibus module SK TU2-PBR-KL

- WAGO terminal block, type 218, 8-pin
- Network termination resistor (220Ω) can be switched in
- SUB-D 9 test connector for production, testing and bus signal analysis

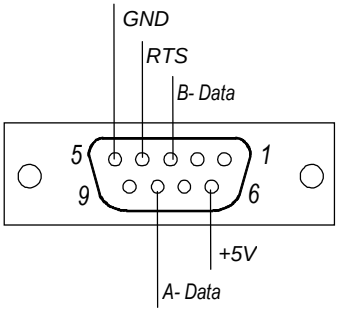
Wiring should be via 2x M16 cable glands. The Profibus option is supplied with two M16 dummy cable glands. There are therefore no plug connection contacts outside of the housing. With this option, normal and coloured 8-pin WAGO series terminal blocks, type 218 are used. In combination with the cover, the high protection class IP55/66 is implemented.

The Bus data cables are in parallel on terminals 3 and 6 (A data, green terminals) as well as 4 and 7 (B data, red terminals). It is therefore very easy to differentiate between incoming and outgoing cables. An additional 24V supply is not required, the power supply is provided by the frequency inverter.

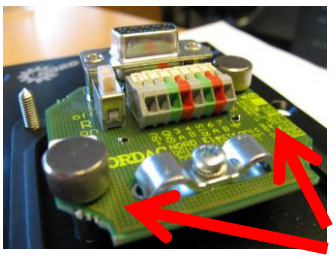
Strain relief, as well as the shield contact of the Profibus cables, is via the double shield terminal on the PCB.



For analysis and test purposes, a 9-pin SUB D socket is available to users for the connection of Profibus analysis tools.



By loosening the two M3 knurled screws, the connection board of the Profibus option can be removed in order to facilitate connection of the Profibus cables.

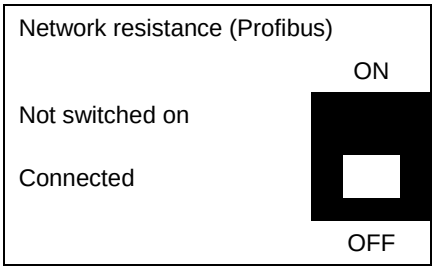


A termination resistor (220Ω) and pull-up/pull-down resistors (390Ω) for the last Bus participant can be switched in with the micro-switches (ON position) located on the left of the WAGO terminal block on the connection board of the last Profibus participant.

A transfer rate of up to 1.5Mbit/s can be used.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.



WAGO terminal block (new design):

Single conductor terminal strip, 8-pin with actuating slide; grid dimension 2.5 mm / 0.098 inch for angled wiring.

Terminal	Signal
1	+5V
2	GND
3	A Data
4	B Data
5	RTS
6	A Data
7	B Data
8	Shield

Cross-section
from 0.08 mm² (28 AWG)
to 0.50 mm² (14 AWG)

Note

Up to hardware version V3.2 R0, the hardware for the Profibus option SK TU2 PBR KL is provided with 8 x 2.5mm² screw terminals. More recent and current Profibus SK TU2-PBR-KL options as well as the ATEX variants are equipped with WAGO terminals.

2.3.5 Profibus module SK TU2-PBR-KL-ATEX

Due to its special design, the Profibus option SK TU2-PBR-KL-ATEX is approved for the ATEX explosion zone 22. This only differs from the option SK TU2-PBR-KL by the lack of the four status LEDs.

- 8 x 2.5mm^2 screw terminals
- Network termination resistor (220Ω) can be switched in
- SUB-D 9 test connector for production testing

The *trio* SK 300E can be used in hazardous areas with a suitable modification. For this it is important that all the safety information in the operating instructions is strictly complied with for the prevention of personal injury and material damage. This is essential to prevent injury and damage.

Profibus LED display

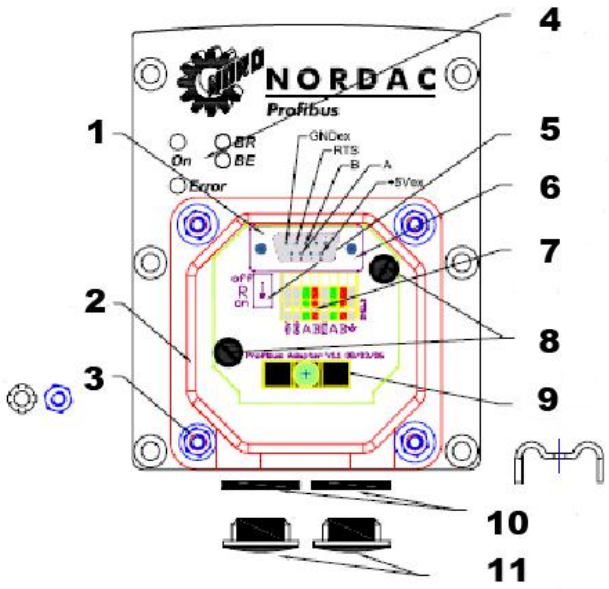
The status LEDs and the two frequency inverter LEDs are not present in the ATEX version.

For all further information, see Section 2.3.4.

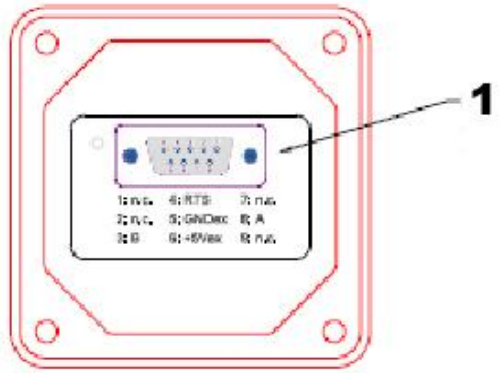
2.3.6 SK TU2-PBR-KL-(ATEX) connection and installation instructions

When connecting the Profibus cables and installing the Profibus option, qualified personnel must ensure that the connection work and installation is carried out correctly.

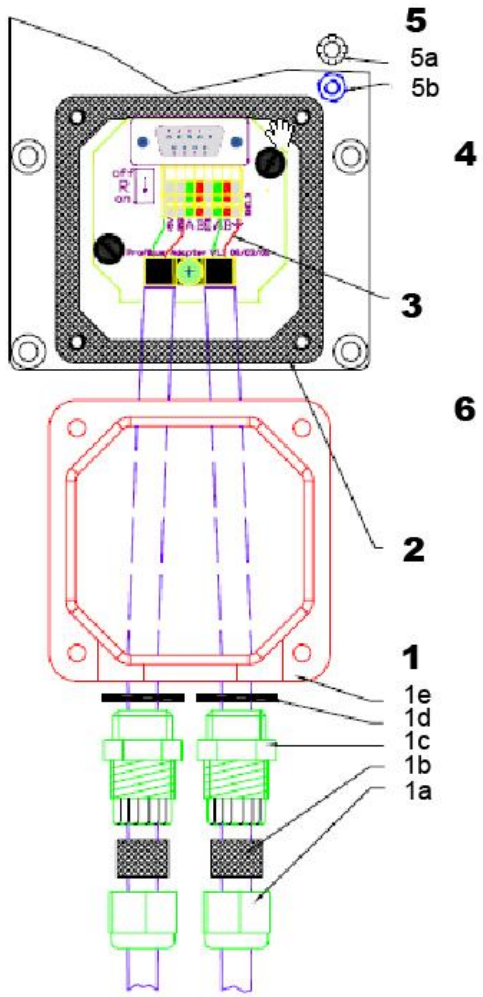
By loosening the two M3 knurled screws, the connection board of the Profibus option can be removed in order to facilitate insertion into the cable glands and connection of the Profibus cables. The individual installation steps and tightening torques for the fastening screws are described below.



No	meaning
1	Test connector
2	Cover
3	4x contact washers (M4) and M4 nuts
4	Optic fibre 4x – Not used for ATEX version
5	Switch for terminating resistor
6	Test socket, D-SUB, 9-pin
7	Terminals: 8x WAGO 218 (RM2.5 / coloured)
8	M3 fastening screws - Knurled screw
9	Double shield -Terminal
10	Flat seals
11	Blank screw caps



No	meaning
1	Assignment of test sockets in the cover



No	meaning
1	**Assembly step 1**
1a	Push on the screw cap
1b	Sealing plugs
1c	Cable gland
1d	Sealing ring (flat)
1e	Cover
2	**Assembly step 2**
	Put on the flat seal for the cover
3	**Assembly step 3**
	• Connect the cable shield • Connect the conductors
4	**Assembly step 4**
	Push on the cover and place it on the M4 threaded studs
5	**Assembly step 5**
5a	Screw on the cover with 4 contact washers
5b	and 4x M4 nuts Torque 2.5 Nm ± 20%!
6	**Assembly step 6**
	• Screw in the cable gland Torque 2 Nm ± 20% • Press in the sealing plugs (if present) • Screw on the protective cap • Torque 1.5 Nm± 20%

2.3.7 Installation of the SK TU2 technology unit

WARNING

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 remote from the frequency inverter is not possible. It must be connected directly to the frequency inverter.

Failure to comply with this may result in an **electric shock**, which my cause serious injury and the destruction of the frequency inverter and the module.

Installing the technology unit

1. Switch off the mains voltage, observe the waiting period.
2. Unscrew the 6 fastening screws of the **blind plate** land remove the blind plate (Fig.1).
3. Attach the PE connection on the inside of the technology unit which is being installed (Fig. 2). Fit the seal together with the **technology unit** on the surface of the frequency inverter. Ensure that the connector strip makes full contact.
4. Lightly tighten all 6 fastening screws.
5. Now tighten the 6 fastening screws in the specified sequence from 1 to 6 (see Fig. 1) and with the torque stated in the table.

Screw 4 Screw 3

Screw 2 Screw 1

Screw 6 Screw 5

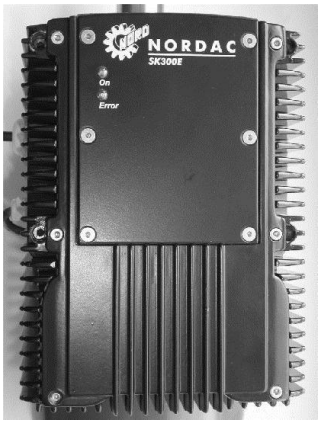


Fig. 1

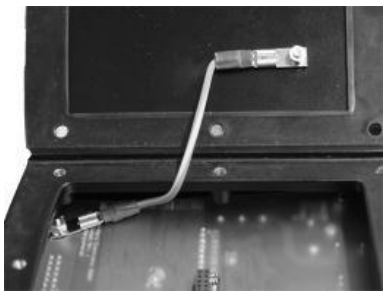


Fig. 2

Frequency inverter size	Screw size	Tightening torque
Size 1	M4 x 8	1.5Nm ± 20%
Size 2		

ATTENTION

Note the earthing cable!

Make sure the earthing line is plugged into the plate of the standard device and each technology unit. This cable must be connected when installing the technology unit to ensure it is fully earthed. Operation is not permitted if there is no secure PE connection to the frequency inverter and to the technology unit!

ATTENTION

During installation, attention must be paid to **proper sealing** (do not forget the rubber seal!), to prevent the entry of moisture.

With IP66 versions, care must also be taken that the cables and cable glands at least comply with protection class IP66, so that compliance with protection class IP66 is ensured on the frequency inverter.

2.3.8 Status messages from the SK TU2-PBR-... modules

For the purpose of rapid indication, the communication status of the Profibus module is indicated with two LEDs. By means of their colour and flashing frequency, these indicate the status of the module or communication.

Profibus LED display

Further information regarding the status LED displays is listed in Section 8.2.

Profibus status LEDs		Description
	Green LED [ON]	Indicates that the Profibus is operating (BUS ready).
	Red LED [ERROR]	Indicates the presence of an error by flashing (BUS error).

Frequency inverter LEDs		Description
	Green LED [ON]	Signals that mains voltage is present.
	Red LED [ERROR]	Signals actual error by flashing according to the number code of the error.

3. Recommended connector and accessory components

Note

The components listed below or in this section should only be regarded as recommendations.

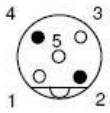
For further information please refer to the particular manufacturer's information and data sheets.

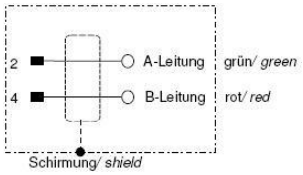
Please observe the manufacturer's information regarding installation and the corresponding installation guidelines.

3.1 M12 round plug connectors

M12 connector

B coded

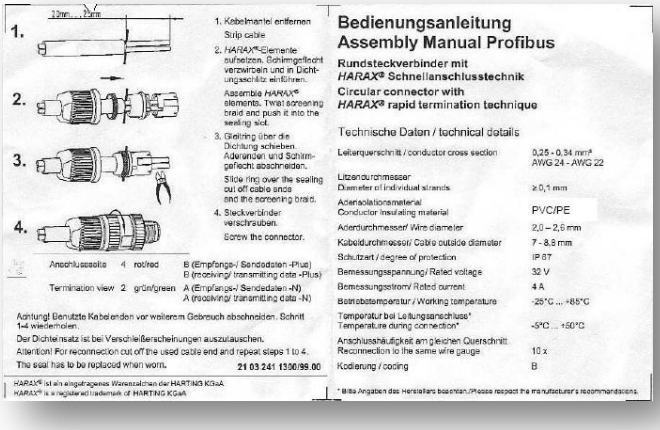




Supplier	Name	Article No. / Part No.	
		straight	angled
MURR Elektronik	M12 plug, 7…8.8mm, 3-pin, cutting type, IP67, shielded	7000-14201-0000000 / 275130073	---
MURR Elektronik	M12 plug, 6...8mm, 2-pin, screwed, IP67, shielded	7000-14005-0000000	---
Franz Binder GmbH	M12 plug, 6...8mm, 5-pin, screwed,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

Note

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

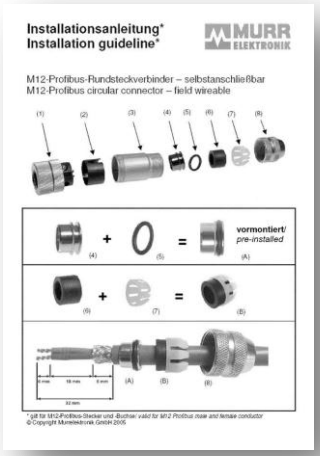


Bedienungsanleitung
Assembly Manual Profibus

Rundsteckverbinder mit
***HARAX*® Schnellanschlusstechnik**
Circular connector with
***HARAX*® rapid termination technique**

Technische Daten / technical details

Leiterquerschnitt / conductor cross section	0,25 - 0,34 mm² AWG 24 - AWG 22
Litzendurchmesser Diameter of individual strands	≥ 0,1 mm
Adernisolationsmaterial Conductor insulating material	PVC/PE
Aderdurchmesser/ Wire diameter	2,0 – 2,6 mm
Kabeldurchmesser/ Cable outside diameter	7 - 8,8 mm
Schutzart / degree of protection	IP 67
Bemessungsspannung/ Rated voltage	32 V
Bemessungsstrom/ Rated current	4 A
Betriebstemperatur / Working temperature	-25°C ... +85°C
Temperatur bei Leitungsanschluss* Temperature during connection*	-5°C ... +50°C
Anschlusshäufigkeit am gleichen Querschnitt Reconnection to the same wire gauge	10 x
Kodierung / coding	B

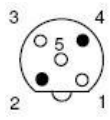


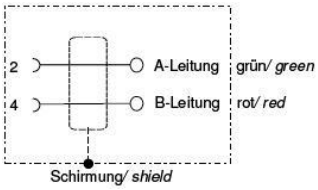
Note

For preference, pre-assembled Profibus cables and connection components should be used for the connection of Profibus cables to technology units. For the selection of M12 round plug connectors, connectors and sockets with hexagonal threaded rings should preferably be selected and used. By the use of a special torque wrench, the round plug connectors can be installed or tightened with a defined tightening torque- even in inaccessible installation locations.

M12 socket

B coded

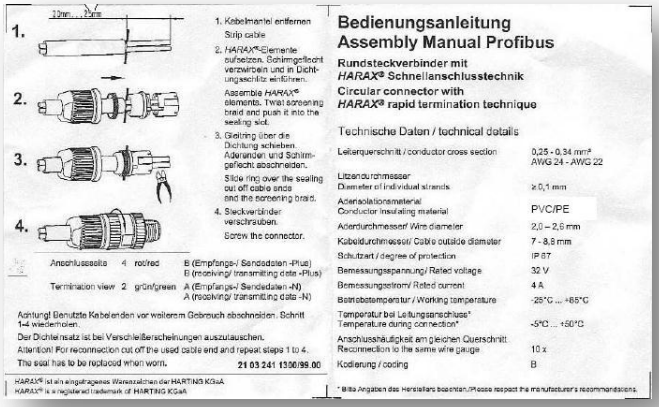


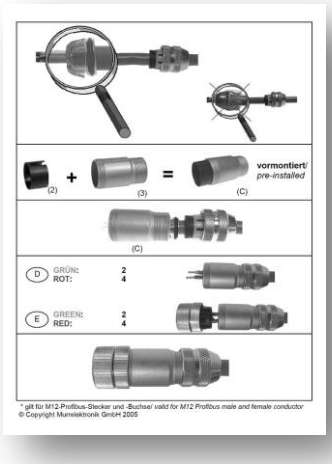


Supplier	Name	Article No. / Part No.	
		straight	angled
MURR Elektronik	M12 plug, 7…8.8mm, 3-pin, cutting type, IP67, shielded	7000-14221-0000000 / 275130075	---
MURR Elektronik	M12 plug, 6...8mm, 2-pin, screwed, IP67, shielded	7000-14025-0000000	---
Franz Binder GmbH	M12 plug, 6...8mm, 5-pin, screwed,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

Note

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



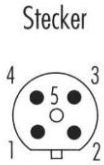


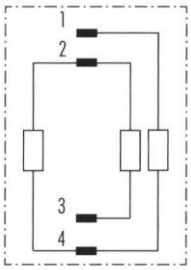
Note

For certain applications the use of vibration-proof round plug connectors is advisable. If, e.g. ESCHA S12x1 quick connecting round plug connectors are used, the installation time is reduced and at the same time a vibration-proof plug connection is ensured, which prevents contact faults and Profibus interruptions due to vibrations.

M12 termination resistor

B coded





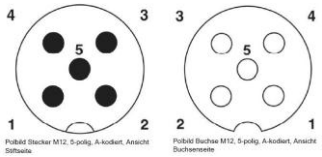
Supplier	Name	Article No. / Part No.
MURR Elektronik	Termination resistor, plug connector M12, 4-pin, straight	7000-14041-0000000 / 275130076
Franz Binder GmbH	Profibus termination resistor, plug connector M12, 4-pin, IP67	0979 PTX 101

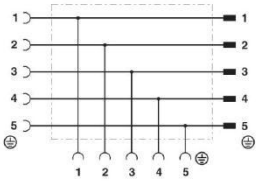
Note

The resistance to the Profibus connection is 220Ω.

M12- T connectors

A coded



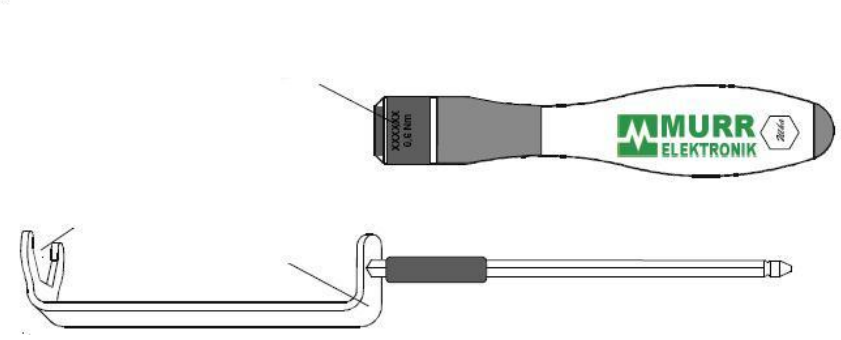


Supplier	Name	Article No. / Part No.
MURR Elektronik		7000-XXXXX-0000000 / 27513XXXX
Phoenix Contact GmbH & Co. KG	Sensor / Actuator T-connector, 5-pin, parallel distributor, M12 socket to M12 plug connector and M12 socket SAC-5P-M12T/2XM12 VP	1541186
ESCHA components	Profibus termination resistor, plug connector M12, 4-pin, IP67	0979 PTX 101

3.2 Installation tools for M12 round plug connectors

Torque wrench for assembly of M12 plug connectors

The M12 torque wrench set is used to check the optimum tightening torque of M12 round connectors. The torque wrench is calibrated to the optimum tightening torque is 0.6Nm.



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	Article No. / 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

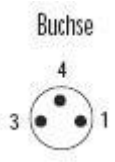
Note

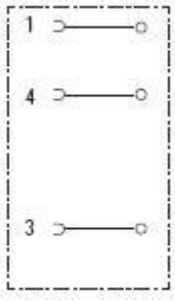
In order to ensure a secure, sealed and vibration-proof connection, connecting components with hexagonal fittings should be used.

By means of the corresponding installation tools, after completion of installation work, all M12 round connectors should be tightened to a torque of 0.6Nm with an M12 wrench.

3.3 M8 round plug connectors for power supply

M8 socket - 24V supply voltage





Supplier	Name	Article No. / Part No.
LUMBERG Automation	M8 coupling with screw connector, assembly with screw terminals, 3-pin, IP67	RKMCK 3 / 275130078
Franz Binder GmbH	Sensor plug connector, series 768 (M8x1), screw terminals, 3-pin, IP67	99-3400-100-03
Franz Binder GmbH	Encapsulated cable socket, screw-locking, 3-pin, 3m, IP67	79 3406 42 03

24Vdc connection assignments	
M8 pin	**Signal**
1	24 VDC ± 25%
3	GND
4	n.c.

Note

If required, ready-made profibus cables of various lengths can be obtained from the manufacturers listed here. For quicker installation, ESCHA also supplies 3-pin, snap-on round plug connector couplings in straight and angled versions (Article designation: KP3 and WKP3) with various cable lengths.

Note

For preference, pre-assembled Profibus cables and connection components should be used for the connection of Profibus cables to technology units. For the selection of M12 round plug connectors, connectors and sockets with hexagonal threaded rings should preferably be selected and used. By the use of a special torque wrench, the round plug connectors can be installed or tightened with a defined tightening torque- even in inaccessible installation locations.

4. Bus Configuration

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.

Optic fibre cables should be used for applications with a high potential for electromagnetic interference and long distances.

4.1 Laying the bus cables

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.

Installation information and recommendations for laying are given in Section 4.4.

4.2 Cable material

The frequency inverter is usually connected to the PROFIBUS 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 lengths of a bus segment 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

Table 6: Transfer speeds versus cable length

4.3 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 qualities can be achieved with the following measures:

- Do not make cable connections shorter than 1m between bus participants
- Avoid long connections between bus participants
- Shield the bus cable *at 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:

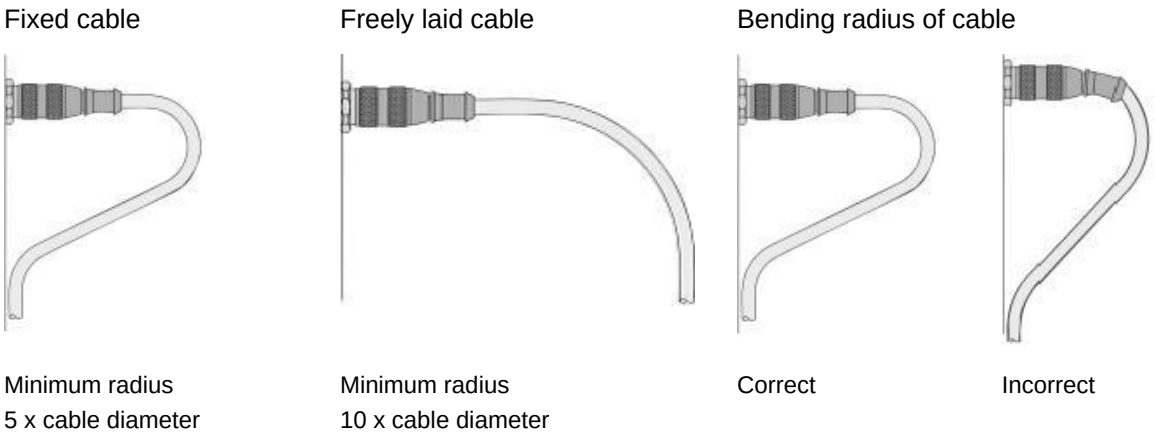


Fig. 4: Installation and cable laying information

ATTENTION

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.

4.4 Recommendations of the PROFIBUS users´ association

Please take special note of the information from the Profibus "Technical Guidelines":

- "Installation guidelines for PROFIBUS-DP/FMS", September 1998, Order No. 2.111
- **Assembly guideline**, Version 1.06, Order Number 8.021/8.022
- **Commissioning guideline**, Version, 1.02, Order Number 8.031/8.032
- Planning recommendations, in preparation

This technical information can be found on the Internet site www.profibus.com/pb/ in the download section. The appropriate pdf files can be found under the heading "Installation Guide" ... "Handbook PROFIBUS Installation Guideline".

5. PROFIBUS 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 was developed by SIEMENS and the Profibus users' organisation and was standardised in the international standard IEC 61158. Profibus 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 range of field devices can be networked without problems, and in case of failure of individual field devices, data transfer to the remaining bus participants continues without interruption.

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

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

Table 7: ISO/OSI Layer model

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.

5.2 PROFIBUS DP 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 master and the assigned PROFIBUS 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 participants (master ↔ slaves). The DP communication protocol is categorised into three basic functions or performance levels, DP-V0, DP-V1 and DP-V2.

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

Device class	Description
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.
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.

Table 8: Device classes

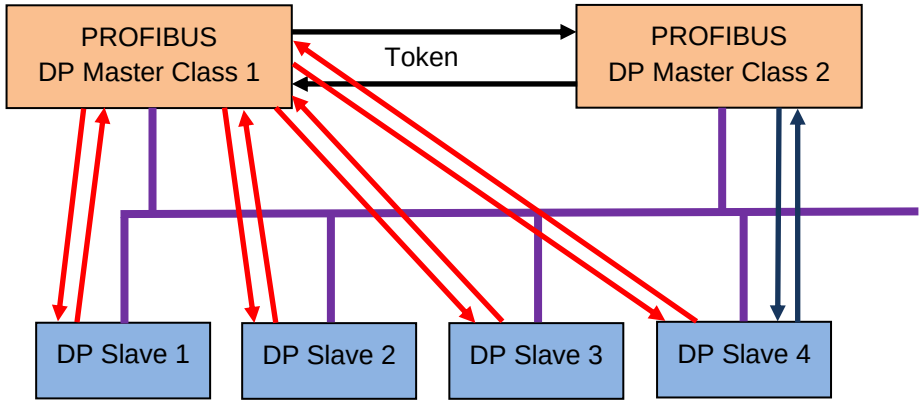


Fig. 5: Communication, device classes

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. Some of the fundamentals of PROFIBUS DP and its further technical developments (performance levels) are briefly summarised below.

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.

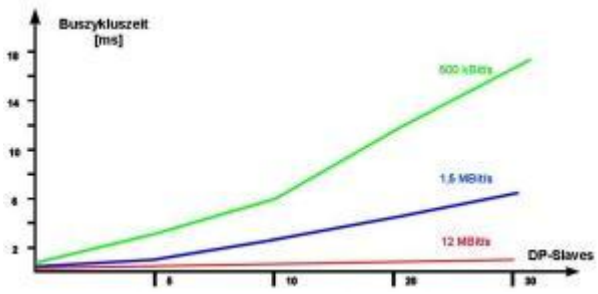


Fig. 6: Diagram of bus cycle time

A DP master Class 1 sends its status state 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.

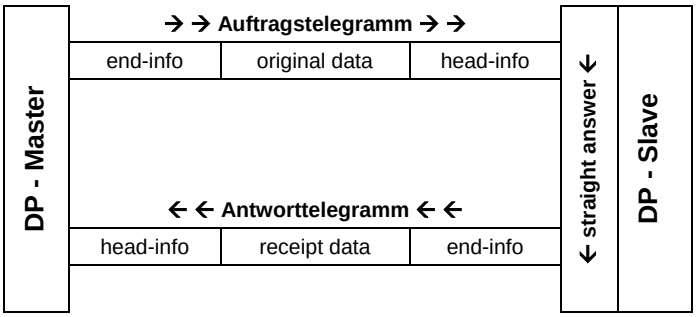


Fig. 7: Diagram of telegram sequence

5.2.1 PROFIBUS DP performance level DP-V0

The basic DP function DP-V0 describes and stands for the basic functionality of the DP communication protocol, i.e.:

- Cyclic exchange of process data / transfer of reference data
- Diagnosis specific to the station, module and channel

The PROFIBUS master cyclically reads the input information from the slaves and cyclically writes the output information to the slaves. It must be noted that the bus cycle time is shorter than the program cycle time of the central automation device. Components from all three device classes, DPM1, DPM2 and slaves may be used.

The PPO types 1 to 4 are available as possible telegrams. For a parameter query (reading access) about 30 ms should be allocated, and for a parameter change (writing access), about 50ms. This is regardless of whether one, or up to four frequency inverters communicate with the PROFIBUS master via a PROFIBUS technology unit. Data traffic between the DPM1 and the slaves is structured into the parameterisation, configuration and data transfer phases.

5.2.2 PROFIBUS DP performance level DP-V1

The basic DP function DP-V1 includes extensions 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
- DP Master-Master communication

As the NORD components /PROFIBUS technology units described in this manual do not support DP-V1 functions, their functionality is not described in further detail in this section.

5.2.3 PROFIBUS DP performance level DP-V2

The basic DP function DP-V2 includes further extensions for the requirements of drive technology, in particular transfer of data between slaves.

- Isochronous slave operation and cross transfer between slaves (Data Exchange Broadcast)
- Drive bus for the control of rapid sequences of movements of drive axes.

As the NORD components /PROFIBUS technology units described in this manual do not support DP-V2 functions, their functionality is not described in further detail in this section.

5.3 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.

Control command FREEZE

The PROFIBUS master sends a FREEZE control command to one or a group of DP slaves (PROFIBUS technology unit), which in turn commence the FREEZE mode. On receipt of the FREEZE command, the actual value (actual status) of all addressed technology units (DP slaves) is "frozen". In the next Profibus cycle, the "frozen" data are cyclically transferred to the PROFIBUS master. After each further FREEZE control command sent from the master, the DP slaves once again "freeze" their statuses. The input data is only updated if the master has sent the next FREEZE control command. The actual values are enabled again via an UNFREEZE command sent from the master and from the DP slaves to the PROFIBUS master, so that changes can be transferred in each cycle and FREEZE mode terminated.

Control command SYNC

The PROFIBUS master sends a SYNC control command to one or a group of DP slaves (PROFIBUS technology unit), which in turn commence the SYNC mode. On receipt of the SYNC command, the setpoint values of all addressed technology units (DP slaves) is "frozen". With the following transfer of reference data the output data in the DP slaves is saved, but the output statuses remain unchanged. The saved output data is only switched to the outputs on receipt of the next SYNC control command. In the following cycle, the master sends an UNSYNC command and the setpoint values are adopted simultaneously by all the bus participants which are addressed and SYNC mode is terminated.

5.4 Protection mechanisms

For safety reasons, PROFIBUS DP is equipped with effective protective functions against failure of the transfer devices and incorrect parameterisation. Monitoring mechanisms are implemented in both the DP master and the DP slaves in the form of time monitoring, by means of access monitoring intervals (times), which can be specified during planning.

Access monitoring

If there is no communication with a DP slave via the PROFIBUS master (DP standard protocol) within a time interval which can be parameterised, all the outputs of the affected technology unit are set to "0" and all connected frequency inverters are set to error status. This is also known as the so-called safe condition, which is automatically adopted by each DP slave if there is no transfer of data within the access monitoring interval. Parallel to this, the user is informed of the fault status of the data communication via a diagnostic alarm or the LED status indicator. 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.

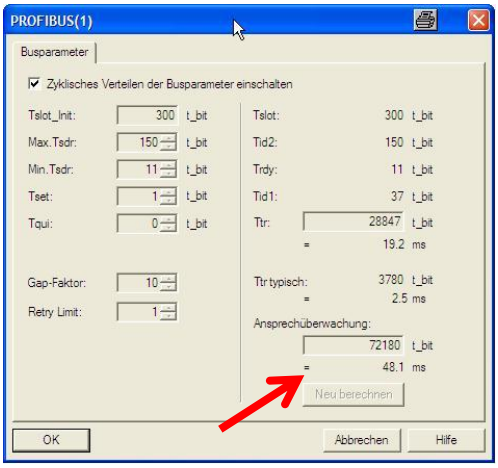


Fig. 8: DP slave properties (left)

Fig. 9: Access monitoring setting (right)

Note

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

During system planning, the access monitoring time is automatically calculated for the entire PROFIBUS network by the software tool STEP 7. Access monitoring should not be confused with the Timeout function in parameter P513. These are different functionalities.

5.5 PROFIBUS master

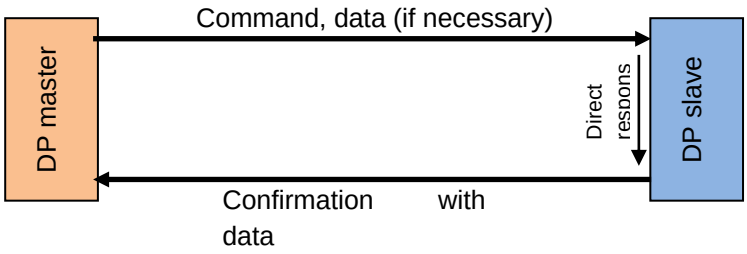
PROFIBUS masters are field devices, which take the initiative for the exchange of data with field devices which operate as slaves. A master has the sole access right to slaves on the bus and determines the data transfer on the bus. The master may send out messages without request if it has an access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

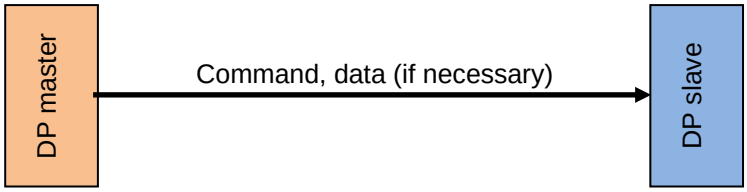
The main tasks of a master are:

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

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 modules with integrated PLC
- standard PC modules
- Stand-alone-boards

5.6 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 DeviceMasterFile (→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.

6. Parameterisation

To operate the inverter with the Profibus protocol, the bus must be connected to the master and some settings must made on the frequency inverter.

With the Profibus 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 → P1508).

In order to access the frequency inverter via Profibus, the Profibus address must be set in P508 and the PPO type must be set in P507 or with the rotary coding switches on the SK TUx-PBR-24V module according to the control configuration.

The frequency inverter can always be parameterised. The control source can be selected with parameter P509 (control word) and parameter P510 (setpoint source). The telegram down time P513 can be selected depending on the bus system.

Note

According to the type or equipment of the frequency inverter, individual parameters may be different or restricted.

Note

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

6.1 BUS parameter data for SK 300E/700E/750E

6.1.1 Control terminals

Parameter {factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P480	**[-01] ... [-08] Function BusIO In Bits** *(Function Bus I/O In Bits)*		**S**	
0 ... 62 { all 0 }	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420...425). In order to use this function, one of the bus setpoints (P546, P547, P548) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit. **[-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** The possible functions for the Bus In Bits can be found in the table of functions for the digital inputs P420...425. **Note** SK 300E: Only the value of the first array can be accessed with the ControlBox. A ParameterBox or the NORDCON software is required to access the other arrays.			
P481	**[-01] ... [-08] Function BusIO Out Bits** *(Function Bus I/O Out Bits)*		**S**	
0 ... 38 { all 0 }	The bus I/O Out bits are perceived as digital outputs. These can be set to the same functions as P434 … P443; P624 … P629 (only SK 7x0E with POSICON). In order to use this function, one of the bus setpoints (P543, P544, P545) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit. **[-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] = Bus I/O Out Bit 6** **[-08] = Bus I/O Out Bit 7** The possible functions for the Bus Out Bits can be found in the table of functions for the digital outputs or the relays P434. **Note** SK 300E: Only the value of the first array can be accessed with the ControlBox. A ParameterBox or the NORDCON software is required to access the other arrays.			

P482	[-01] ... [-08]	**Norm. BusIO Out Bits** *(Standardisation of bus I/O Out bits)*		S	
-400 … 400 % { all 100 }		Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative. When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens. The assignment of the arrays correspond to those of parameter (P481).			

P483	[-01] ... [-08]	**Hyst. BusIO Out Bits** *(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. The assignment of the arrays correspond to those of parameter (P481).			

6.1.2 Extra functions

Parameter {factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P507	**PPO-Type** *(PPO-Type)*			
1 ... 4 { 1 }	This parameter can only be used with the technology unit Profibus, DeviceNet or InterBus. See also the relevant section of the corresponding supplementary BUS manual.			
P508	**Profibus address** *(Profibus address)*			
1 ... 126 { 1 }	Profibus address, only with the technology unit Profibus See also the additional description for the Profibus control BU 0020			

P509	Interface *(Interface)*			
0 ... 21 { 0 }	Selection of the interface via which the FI is controlled. **0 =** **Control terminals or keyboard control** ** with the ControlBox (if P510=0), the ParameterBox (not ext. P-box) or via BUS I/O Bits. **1 =** **Only control terminals** , the FI can only be controlled via the digital and analog inputs or via the bus I/O Bits. **8 =** **Profibus setpoint**, the frequency setpoint is transferred via Profibus. Control via the digital inputs is still active. **9 =** **Profibus control word**, the control signals (enable, direction of rotation, ...) are transferred via Profibus, the setpoint via the analog input or the fixed frequencies. **10 =** **Profibus,** all control data is transferred via Profibus. The analog input and the digital inputs have no function (except safety functions) *) Keyboard control (ControlBox, ParameterBox, PotentiometerBox) is blocked, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will block without an error message.			

P510	Bus interface auxiliary setpoint *(Bus interface auxiliary setpoints)*	SK 700E/ SK750E	S	
0 ... 8 { all 0 }	Selection of the interface via which the FI is controlled. **0 =** **Auto (=P509):** The source of the auxiliary setpoint is automatically derived from the setting in the parameter P509 >Interface< **1 =** **USS** **2 =** **CANbus** **3 =** **Profibus** **4 =** **InterBus** **5 =** **CANopen** **6 =** **DeviceNet** **7 =** Reserved **8 =** **CAN Broadcast**			

P513	Telegram time-out *(Telegram time out)*		S	
-0.1 / 0.0 / 0.1 ... 1000 s { 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.			

P543	Bus actual value 1 *(Actual bus value 1)*	SK 300E / SK 7x0E	S	P
0 ... 12 { 1 }	The return value 1 can be selected for bus actuation in this parameter.			

0 =	Off	**6 =**	Actual position *(only with POSICON, SK 7x0E)*
1 =	Actual frequency	**7 =**	Setpoint position *(only with POSICON, SK 7x0E)*
2 =	Actual speed	**8 =**	Setpoint frequency
3 =	Current	**9 =**	Error number
4 =	Torque current (100% = P112)	**10 =**	Actual position increment *(only with POSICON, SK 7x0E)*[4]
5 =	Digital IO status [5]	**11 =**	Setpoint position increment *(only with POSICON, SK 7x0E)*[4]
		12 =	BusIO Out Bits 0...7

P544	Bus actual value 2 *(Actual bus value 2)*	SK 300E / SK 7x0E	S	P
0 ... 12	This parameter is identical to P543.			
{ 0 }	The condition is PPO 2 or PPO 4 type (P507 or rotary encoding switch on technology unit option SK TUx-PBR-24V).			

P545	Bus actual value 3 *(Actual bus value 3)*	SK 300E / SK 7x0E	S	P
0 ... 12	This parameter is identical to P543.			
{ 0 }	The condition is PPO 2 or PPO 4 type (P507 or rotary encoding switch on technology unit option SK TUx-PBR-24V).			

[4] Setpoint/actual position corresponding to an 8192 increment encoder.

[5] The assignment of the digital inputs in P543/ 544/ 545 = 5 for SK 700E/ SK 750E

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = DigIn 5	Bit 5 = DigIn 6	Bit 6 = DigIn 7 (POS or ENC)	Bit 7 = DigIn 8 (POS)
Bit 8 = DigIn 9 (POS)	Bit 9 = DigIn 10 (POS)	Bit 10 = DigIn 11 (POS)	Bit 11 = DigIn 12 (POS)
Bit 12 = REL 1	Bit 13 = REL 2	Bit 14 = REL 3 (POS)	Bit 15 = REL 4 (POS)

P546	Bus setpoint 1 *(Bus setpoint 1)*	SK 300E / SK 7x0E	S	P

0 ... 7
{ 1 }

In this parameter, a function is allocated to the output setpoint 1 during bus actuation. The settings 2 to 6 are only relevant for type SK 700E and SK 750E inverters in combination with the POSICON option.

- **0 =** Off
- **1 =** Setpoint frequency (16 bit)
- **2 =** 16 Bit setpoint position
- **3 =** 32 Bit Bit setpoint position *(PPO type 2 or 4)*
- **4 =** POSICON control terminals *(16 Bit)*[6]
- **5 =** Setpoint position (16 Bit)
- **6 =** Setpoint position (32 Bit) increment
- **7 =** Bus I/O In Bits 0-7

P547	Bus setpoint 2 *(Bus setpoint 2)*	SK 300E / SK 7x0E	S	P

0 ... 20
{ 0 }

In this parameter, a function is allocated to the setpoint 2 which is output during bus actuation.

- **0 =** Off
- **1 =** Setpoint frequency
- **2 =** Torque current limit *(P112)*
- **3 =** Actual frequency PID
- **4 =** Frequency addition
- **5 =** Frequency subtraction
- **6 =** Current limit *(only SK 7x0E) (P536)*
- **7 =** Maximum frequency *(only SK 7x0E) (P105)*
- **8 =** Actual PID frequency limited
- **9 =** Actual PID frequency monitored
- **10 =** Torque
- **11 =** Torque precontrol *(only SK 7x0E) (P214)*
- **12 =** POSICON control terminals *(only SK 7x0E)*
- **13 =** Multiplication *(only SK 7x0E)*
- **14 =** Process controller actual value
- **15 =** Process controller setpoint
- **16 =** Process controller lead
- **17 =** BusIO In Bits 0...7
- **18 =** Curve travel calculator *(only SK 7x0E)*
- **19 =** Set relays *(P541)*
- **20 =** Set analog output *(P542)*

P548	Bus setpoint 3 *(Bus setpoint 3)*	SK 300E / SK 7x0E	S	P

0 ... 20
{ 0 }

In this parameter, a function is assigned to the delivered setpoint 3 (SW3) for bus control. This is identical to parameter P547 and is only present if P546 ≠ 3 and 6.

[6] The *"reference run", "teach-in"* and *"reset position* can be controlled via the other bits:

Bit 0: Position array / Position increment Bit 1: Position array / Position increment Bit 2: Position array / Position increment

Bit 3: Position array / Position increment Bit 4: Position array / Position increment Bit 5: Position array / Position increment

Bit 6: Approach reference point Bit 7: Reference point Bit 8: Teach- In Bit 9: Quit Teach- In Bit 10: Reset position

6.1.3 Information

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P740 **[-01] ... [-06]** **Process data Bus In** *(Process data bus in)*		**SK 300E / SK 7x0E**	**S**	
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems. For display, a BUS system must be selected in P509	**Series SK 300E:** **[-01] =** Control word **[-02] =** setpoint value 1 **[-03] =** setpoint value 2 **[-04] =** setpoint value 3 **[-05] =** Bus I/O In Bits (P480)	**Series SK 7x0E:** **[-01] =** Control word **[-02] =** setpoint value 1 **[-03] =** Setpoint value 1 High byte **[-04] =** setpoint value 2 **[-05] =** setpoint value 3 **[-06] =** Bus I/O In Bits (P480)	
P741 **[-01] ... [-06]** **Process data Bus Out** *(Process data bus out)*		**SK 300E / SK 7x0E**	**S**	
0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.	**Series SK 300E** **[-01] =** Status word **[-02] =** Actual value 1 **[-03] =** Actual value 2 **[-04] =** Actual value 3 **[-05] =** Bus I/O Out Bit (P481)	**Series SK 7x0E** **[-01] =** Status word **[-02] =** Actual value 1 **[-03] =** Actual value 1 High byte **[-04] =** Actual value 2 **[-05] =** Actual value 3 **[-06] =** Bus I/O Out Bit (P481)	
P745 **Module version** *(Module version)*		**SK 300E**		
0.0 ... 3276.7	Version status (software version) of the technology unit (SK TU2-xxx), but only when own processor is present, i.e. not for SK TU2-CTR. Have this data available if you have a technical query.			
P745 **[-01] ... [-03]** **Module version** *(Module version)*		**SK 7x0E**	**S**	
0000 ... FFFF (hex)	Version status (software version) of the installed option module(s) but only when own processor is present, i.e. not for SK TU1-CTR. Have this data available if you have a technical query.	**[-01] =** Technology unit **[-02] =** Customer unit **[-03] =** Special extension unit		

P746	Module status *(Module status)*	SK 300E	S	
0000 ... FFFF (hex)	Shows the actual status (readiness, error, communication) of the technology unit (SK TU2-xxx), but only when own processor is present, i.e. not for SK TU2-CTR. Example: 0603_{hex} High byte = 06_{hex} → Profibus Low byte = 03_{hex} → Module ready + connection to master Details of the codes specific to the bus can be found in the section "Error monitoring" of the relevant supplementary instructions.			

P746 [-01] ... [-03]	Module status *(Module status)*	SK 7x0E	S	
0000 ... FFFF (hex)	Shows the actual status (readiness, error, communication) of the installed technology unit(s) (if active), but only when own processor is present, i.e. not for SK TU1-CTR. Example: 0603_{hex} High byte = 06_{hex} → Profibus Low byte = 03_{hex} → Module ready + connection to master Details of the codes specific to the bus can be found in the section "Error monitoring" of the relevant supplementary instructions.		**[-01] =** Technology unit **[-02] =** Customer unit **[-03] =** Special extension unit	

6.2 BUS Parameters SK 5xxE

Note

The SK 54xE frequency inverter can administer 5 setpoint or actual values. However, the Profibus bus system can only process setpoint or actual values 1 ... 3 (PPO1 ... PPO4).

6.2.1 Control terminals

Parameter {factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P480 **[-01] ... [-12]**	**Function BusIO In Bits** *(Function Bus I/O In Bits)*		**S**	
0 ... 74 { all 0 }	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420...425). In order to use this function, one of the bus setpoints (P546, P547, P548) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit. With the SK 54xE in association with IO extension modules (e.g. SK TU4-IOE) these I/O bits can also process their input signals. **[-01] = Bus I/O In Bit 0** (or SK54xE and above: + **DI1** of the **second** SK xU4-**IOE**) **[-02] = Bus I/O In Bit 1** (or SK54xE and above: + **DI2** of the **second** SK xU4-**IOE**) **[-03] = Bus I/O In Bit 2** (or SK54xE and above: + **DI3** of the **second** SK xU4-**IOE**) **[-04] = Bus I/O In Bit 3** (or SK54xE and above: + **DI4** of the **second** SK xU4-**IOE**) **[-05] = Bus I/O In Bit 4** (or SK54xE and above: + **DI1** of the **first** SK xU4-**IOE**) **[-06] = Bus I/O In Bit 5** (or SK54xE and above: + **DI2** of the **first** SK xU4-**IOE**) **[-07] = Bus I/O In Bit 6** (or SK54xE and above: + **DI3** of the **first** SK xU4-**IOE**) **[-08] = Bus I/O In Bit 7** (or SK54xE and above: + **DI4** of the **first** SK xU4-**IOE**) **[-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 P420...425. For further details, please refer to the manual for the AS interface, BU 0090.			

P481	[-01] ... [-10]	**Function BusIO Out Bits** *(Function Bus I/O Out Bits)*		S	

0 ... 39
{ all 0 }

The bus I/O Out bits are perceived as digital outputs. They can be set to the same functions (P434; P441; P450; P455).

In order to use this function, one of the bus setpoints (P543, P544, P545) must be set to >Bus I/O In Bits 0-7 <. The required function must then be assigned to the relevant bit.

With the SK 54xE these I/O bits in association with IO extension modules (e.g. SK TU4-IOE) can also control their digital outputs.

[-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 (or SK54xE and above: + **DO1** of the **first** SK xU4-**IOE**)

[-06] = Bus I/O Out Bit 5 (or SK54xE and above: + **DO2** of the **first** SK xU4-**IOE**)

[-07] = Bus I/O Out Bit 6 / Flag 1 (or SK54xE and above: + **DO1** of the **second** SK xU4-**IOE**)

[-08] = Bus I/O Out Bit 7 / Flag 2 (or SK54xE and above: + **DO2** of the **second** SK xU4-**IOE**)

[-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 digital outputs or the relays P434.

For further details, please refer to the manual for the AS interface, BU 0090.

P482	[-01] ... [-10]	**Norm. BusIO Out Bits** *(Scaling of bus I/O Out bits)*		S	

-400…400 %
{ all 100 }

Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative.

When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens.

The assignment of the arrays correspond to those of parameter (P481).

P483	[-01] ... [-10]	**Hyst. BusIO Out Bits** *(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.

The assignment of the arrays correspond to those of parameter (P481).

6.2.2 Extra functions

Parameter {factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P507	**PPO-Type** *(PPO-Type)*			
1 ... 4 { 1 }	This parameter can only be used with the technology unit Profibus, DeviceNet or InterBus. See also the relevant section of the corresponding supplementary BUS manual.			
P508	**Profibus address** *(Profibus address)*			
1 ... 126 { 1 }	Profibus address, only with the technology unit Profibus See also the additional description for the Profibus control BU 0020			
P509	**Source Control Word** *(Source control word)*			
0 ... 10 { 0 }	Selection of the interface via which the FI is controlled. **0 =** **Control terminals or keyboard control** ** with the ControlBox (if P510=0), the ParameterBox (not ext. p-box) or via BUS I/O Bits. **1 =** **Only control terminals** , the FI can only be controlled via the digital and analog inputs or via the bus I/O Bits. **2 =** **USS** control word *, the control signals (enable, direction of rotation, ...) are transferred via the RS485 interface. The setpoint is transferred via the analog input or the fixed frequencies. Above SK 540E this setting should also be selected if communication via Modbus RTU is intended. The frequency inverter automatically detects whether this is a USS protocol or a Modbus protocol. **3 =** **CAN** control word * **4 =** **Profibus** control word * **5 =** **InterBus** control word * **6 =** **CANopen** control word * **7 =** **DeviceNet** control word * **8 =** **Ethernet TU*** ** control word* **9 =** **CAN Broadcast** * **10 =** **CANopen Broadcast ***			

NOTE:

For details about the respective Bus systems please refer to the respective Options descriptions.

BU 0020 = Profibus	BU 0050 = USS, Modbus RTU
BU 0060 = CAN/CANopen	BU 0070 = InterBus
BU 0080 = DeviceNet	BU 0090 = AS-Interface
BU 0570 = EtherCAT	BU 0590 = ProfiNet

*) Keyboard control (ControlBox, ParameterBox, PotentiometerBox) is blocked, parameterisation is still possible.

**) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will block without an error message.

***) The **Ethernet TU** setting must be used for all NORD Ethernet-based bus systems (e.g.: EtherCAT: SK TU3-ECT, PROFINET: SK TU3-PNT).

Note: Parameterisation of a frequency inverter via a field bus connection requires parameter (P509) "Control Terminals" to be set to the appropriate bus system

P510	[-01] [-02]	Setpoint source *(Setpoint source)*		S	

0 ... 10
{ all 0 }

Selection of the setpoint source to be parameterised.

[-01] = Main **setpoint source** **[-02] =** Auxiliary **setpoint source**

Selection of the interface via which the FI receives the setpoint.

- **0 = Auto (=P509):** The source of the auxiliary setpoint is automatically derived from the setting in the parameter P509 >Interface<
- **1 = Control terminals**, digital and analog inputs control the frequency, including fixed frequencies
- **2 = USS (**or Modbus RTU SK 540E and above**)**
- **3 = CAN**
- **4 = Profibus**
- **5 = InterBus**
- **6 = CANopen**
- **7 = DeviceNet**
- **8 = Ethernet TU**
- **9 = CAN Broadcast**
- **10 = CANopen Broadcast**

P513	Telegram time-out *(Telegram time out)*		S	

-0.1 / 0.0 / 0.1 ... 1000 s
{ 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.

P543	Bus actual value 1 *(Actual bus value 1)*	up to SK 535E	S	P

0 ... 24
{ 1 }

The return value 1 can be selected for bus actuation in this parameter.

The possible analog functions can be found in the following table.

NOTE: Further details can be found in the respective BUS operating instructions or in the description of P418.

P543	[-01] ... [-05]	Bus actual value *(Actual bus values)*	SK 540E and above	S	P

0 ... 57
{ [-01] = 1 }
{ [-02] = 4 }
{ [-03] = 9 }
{ [-04] = 0 }
{ [-05] = 0 }

In this parameter the return value for bus actuation can be selected.

NOTE: The actual values 4 and 5 must be supported by the relevant bus module. Further details can be found in the respective BUS operating instructions or in the description of P418.

[-01] = Bus - Actual value 1 **[-02] =** Bus - Actual value 2 **[-03] =** Bus - Actual value 3

[-04] = Bus - Actual value 4 **[-05] =** Bus - Actual value 5

0 =	Off	**13 =**	... 16 Reserved
1 =	Actual frequency	**17 =**	Value analog input 1
2 =	Actual speed	**18 =**	Value analog input 2
3 =	Current	**19 =**	Setpoint frequency master value*(P503)*
4 =	Torque current (100% = P112)	**20 =**	Setpoint frequency master value after ramp *"Setpoint frequency master value after ramp"*
5 =	Digital IO status [7]	**21 =**	Act. freq. without slip master value *"Actual frequency without slip master value"*
6 =	... 7 Reserved	**22 =**	Speed encoder *(only possible with SK 520E and encoder feedback)*
8 =	Setpoint frequency	**23 =**	Actual frequency with slip, *"Actual frequency with slip"* *(SW V2.0 and above)*
9 =	Error number	**24 =**	Master value, actual freq. with slip, *"Master value, actual freq. with slip"* *(SW V2.0 and above)*
10 =	... 11 Reserved	**53 =**	*... 57 Reserved*
12 =	BusIO Out Bits 0...7		

Further functions are listed in the corresponding supplementary instructions (BU0510 for POSICON, BU550 for PLC).

P544	**Bus actual value 2** *(Actual bus value 2)*	**up to SK 535E**	**S**	**P**
0 ... 24	This parameter is identical to P543.			
{ 0 }	Condition is PPO 2 or PPO 4 type (P507).			

P545	**Bus actual value 3** *(Actual bus value 3)*	**up to SK 535E**	**S**	**P**
0 ... 24	This parameter is identical to P543.			
{ 0 }	Condition is PPO 2 or PPO 4 type (P507).			

P546	**Func. bus-set point 1** *(Function of bus - setpoint 1)*	**up to SK 535E**	**S**	**P**
0 ... 55	In this parameter, a function is allocated to the output setpoint 1 during bus actuation.			
{ 1 }	The possible analog functions can be found in the following table.			
	NOTE: Further details can be found in the respective BUS operating instructions or in the description of P400.			

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

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

P546	[-01] ... [-05]	Function Bus setpoint *(Function bus - setpoints)*	SK 540E and above	S	P

0 ... 57
{ [-01] = 1 }
all other { 0 }

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

NOTE: The setpoints 4 and 5 must be supported by the relevant bus module. Further details can be found in the respective BUS operating instructions or in the description of P400.

[-01] = Bus setpoint 1 **[-02] =** Bus setpoint 2 **[-03] =** Bus setpoint 3

[-04] = Bus setpoint 4 **[-05] =** Bus setpoint 5

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

Further functions are listed in the corresponding supplementary instructions (BU0510 for POSICON, BU550 for PLC).

P547	Func. bus-set point 2 *(Function of bus - setpoint 2)*	up to SK 535E	S	P

0 ... 55
{ 0 }

This parameter is identical to P546.

P548	Func. bus-set point 3 *(Function of bus - setpoint 3)*	up to SK 535E	S	P

0 ... 55
{ 0 }

This parameter is identical to P546.

6.2.3 Information

Parameter	Setting value / Description / Note		Device	Supervisor	Parameter set
P740 **[-01] ... [-13]**	**PZD bus in** *(Process data bus in)*		**up to SK 535E**	**S**	
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems. For display, a BUS system must be selected in P509	**[-01] =** Control word		Control word, source from P509.	
		[-02] = setpoint value 1 **[-03] =** setpoint value 2 **[-04] =** setpoint value 3		Setpoint data from main setpoint (P510 [-01]).	
		[-05] = Bus I/O In Bits (P480)		The displayed value depicts all Bus In bit sources linked with OR.	
		[-06] = Parameter data In 1 **[-07] =** Parameter data In 2 **[-08] =** Parameter data In 3 **[-09] =** Parameter data In 4 **[-10] =** Parameter data In 5		Data during parameter transfer: Order label (AK), Parameter number (PNU), Index (IND), Parameter value (PWE 1/2)	
		[-11] = setpoint value 1 **[-12] =** setpoint value 2 **[-13] =** setpoint value 3		Setpoint data from the master function value (Broadcast), if P509 = 9/10(P510 [-02])	

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

P741	[-01] ... [-13]	PZD bus out *(Process data bus out)*	up to SK 535E	S	

0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.	**[-01] =** Status word	Status word, source from P509.
		[-02] = Actual value 1 (P543) **[-03] =** Actual value 2 (P544) **[-04] =** Actual value 3 (P545)	
		[-05] = Bus I/O Out Bit (P481)	The displayed value depicts all Bus In bit sources linked with OR.
		[-06] = Parameter data Out 1 **[-07] =** Parameter data Out 2 **[-08] =** Parameter data Out 3 **[-09] =** Parameter data Out 4 **[-10] =** Parameter data Out 5	Data during parameter transfer.
		[-11] = Actual value 1 leading function **[-12] =** Actual value 2 leading function **[-13] =** Actual value 3 leading function	Actual value of leading function P502/P503.

P741	[-01] ... [-23]	PZD bus out *(Process data bus out)*	SK 540E and above	S	

0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.	**[-01] =** Status word	Status word, source from P509.
		[-02] = Actual value 1 (P543 [-01]) **[-03] =** Actual value 2 (P543 [-02]) **[-04] =** Actual value 3 (P543 [-03]) **[-05] =** Actual value 4 (P543 [-04]) **[-06] =** Actual value 5 (P543 [-05])	
		[-07] = Bus I/O Out Bit (P481)	The displayed value depicts all Bus In bit sources linked with OR.
		[-08] = Parameter data Out 1 **[-09] =** Parameter data Out 2 **[-10] =** Parameter data Out 3 **[-11] =** Parameter data Out 4 **[-12] =** Parameter data Out 5	Data during parameter transfer.
		[-13] = Actual value 1 leading function **[-14] =** Actual value 2 leading function **[-15] =** Actual value 3 leading function **[-16] =** Actual value 4 leading function **[-17] =** Actual value 5 leading function	Actual value of leading function P502/P503.
		[-18] = PLC status word	Status word via PLC
		[-19] = Actual value 1 PLC **[-20] =** Actual value 2 PLC **[-21] =** Actual value 3 PLC **[-22] =** Actual value 4 PLC **[-23] =** Actual value 5 PLC	Actual value data via PLC

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

P746	Module status *(Module status)*		S	
0000 ... FFFF (hex)	Shows the actual status (readiness, error, communication) of the technology unit (SK TU3-xxx), but only when own processor is present, i.e. not for SK TU3-CTR. Example: 0603_{hex} High byte = 06_{hex} → Profibus Low byte = 03_{hex} → Module ready + connection to master Details of the codes specific to the bus can be found in the section "Error monitoring" of the relevant supplementary instructions.			

7. Data transmission

7.1 Structure of reference data

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

The reference data is divided into two sections:

- PKW section (Parameterisation; **P**arameter **I**dentification- **V**alue)
- PZD section (**P**ro**c**es**s**data)

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.

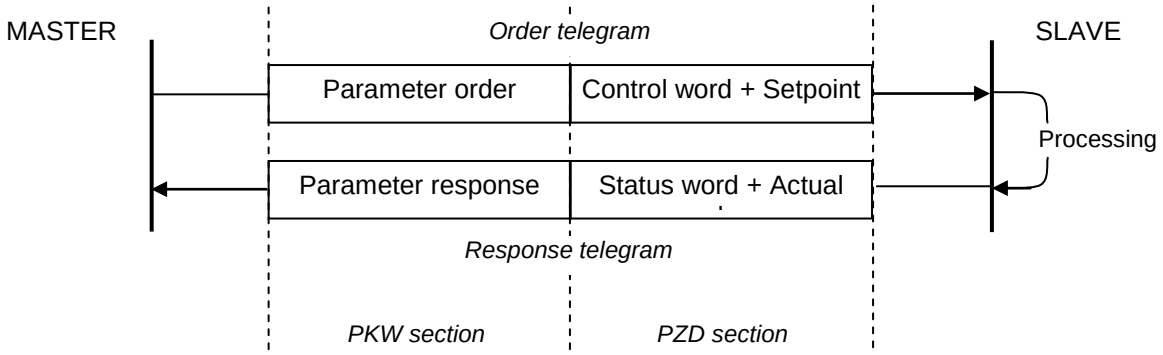


Fig. 10: Telegram traffic / structure of reference data area

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 PPO types

For cyclic data traffic, the Parameter- Process data Object (PPO) with which the process data (PZD) and parameters (PKW) are transferred from the 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.

Abbreviations used

PPO	Parameter Process data Object
PKW	Parameter identifier value
PZD	Process data
PKE	Parameter identifier
IND	Index
PWE	Parameter value

STW	Control word
ZSW	Status word
SW1..3	Setpoints 1-3
IW1..3	Actual values 1-3

Note

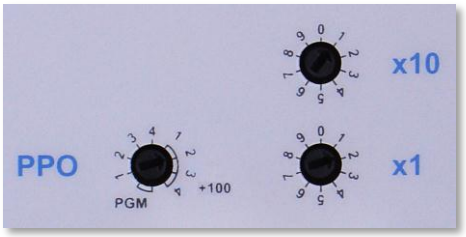
A PLC can normally only consistently transfer double words by means of I/O memory access. For longer data formats (PKW channel always / PZD data with PPO2 or PPO4) system functions (e.g. SFC 14, consistent data reading / SFC15, consistent data writing) must be used.

Note

Because of the protocol specification, for PPO types 2 and 4, 6 words must be reserved for the address area of the process data (PZD). The two last words are not used for the process data telegrams and are therefore merely reserve areas.

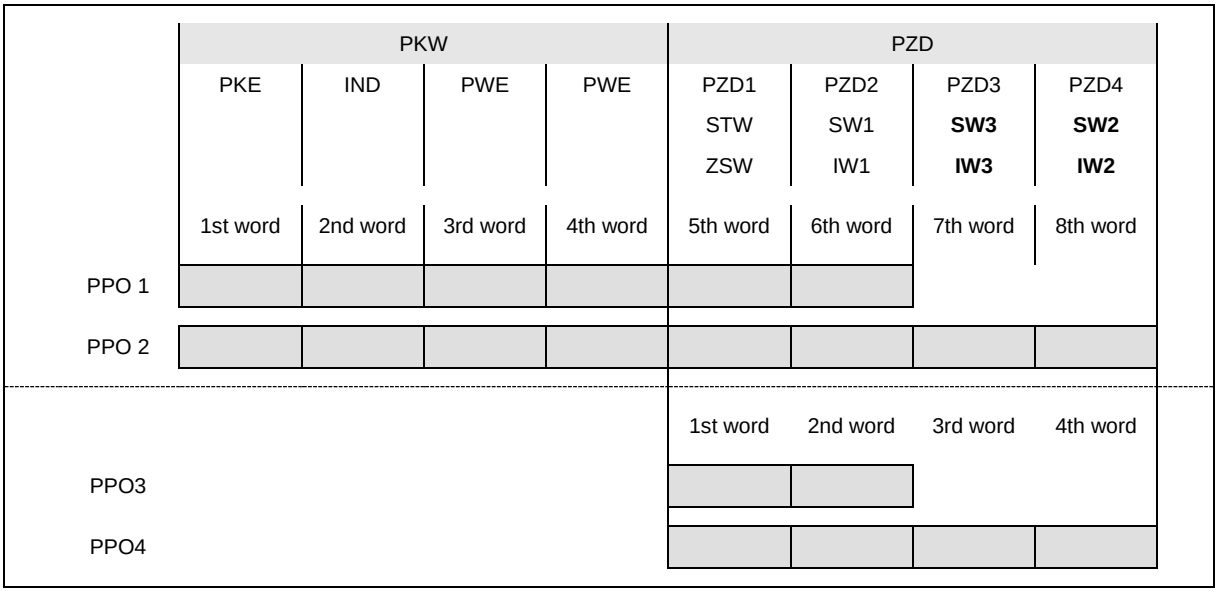
7.2.1 Rotary coding switch for SK TUx-PBR-24V

- PPO 1…4: PPO type, address range 00-99
- PPO 1…4 +100: PPO type, address range 100-126
- PPO PGM: PPO type = P507, BUS address = P508
- x1: Address of units position
- x10: Address of 10's position



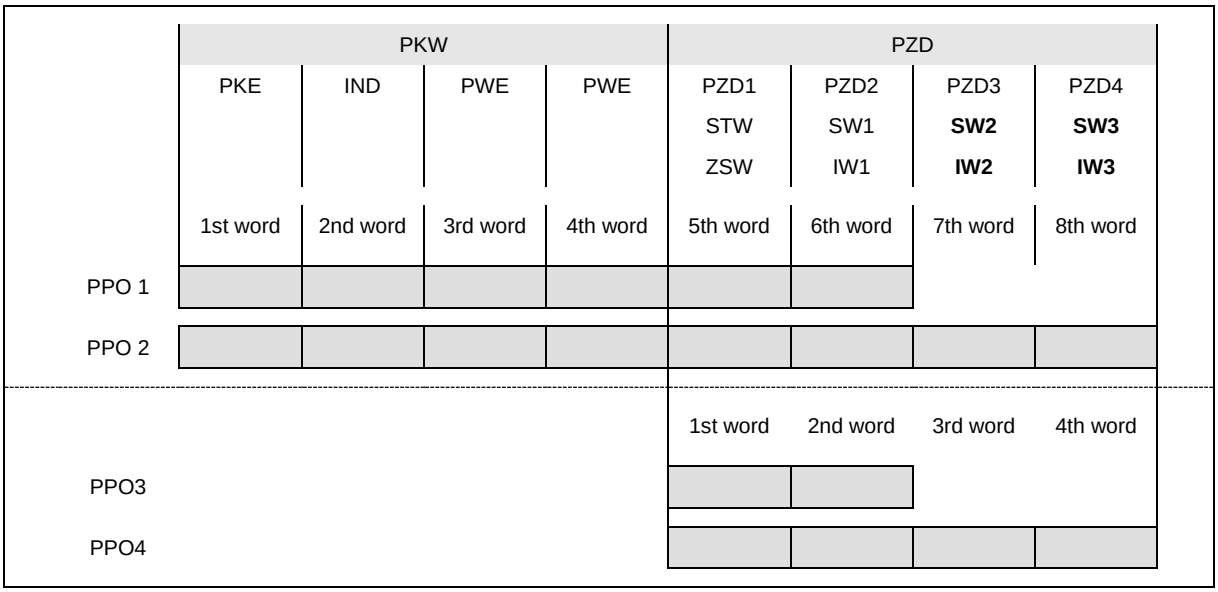
7.2.2 PPO types SK 300E/700E/750E

The following diagram shows an overview of the supported PPO types.



7.2.3 PPO types, SK 5xxE

The following diagram shows an overview of the supported PPO types. Please note the arrangement of SW2/SW3 and IW2/IW3



7.3 Process data (PZD)

In the process data area (PZD), control words and setpoints are transferred from the master to the frequency inverter and in return, status words and actual values are sent from the inverter 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	**C**ontrol**w**ord; length 16Bit, order telegram contains control bits (e.g. Enable, Emergency Stop, Error Acknowledgement)
ZSW	**Z**tatus**w**ord; length 16Bit, response telegram contains status bits (e.g. FI running, Error)
SW 1 … 3	**S**etpoint**v**alues; maximum of 3 possible, 16 or 32Bit, order telegram e.g. frequency setpoint, position setpoint, torque setpoint
IW 1 … 3	**A**ctual **wv**alues; maximum of 3 possible, 16 or 32Bit, response telegram e.g. frequency actual value, position actual value, torque actual value

Note

The SK 54xE frequency inverter can administer 5 setpoint or actual values. However, the Profibus bus system can only process setpoint or actual values 1 ... 3 (PPO1 ... PPO4).

7.3.1 Process data, SK 300E / 700E / 750E

	1st word	2nd word	3rd word	4th 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	**SW3** **IW3**	**SW2** **IW2**	PP0 type 2,4
PZD area with 1x 32-Bit setpoint and 1x 16-Bit	STW ZSW	SW1 IW1		SW2 IW2	PP0 type 2,4

7.3.2 Process data, SK 5xxE

	1st word	2nd word	3rd word	4th 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).

Note

The SK 54xE frequency inverter can administer 5 setpoint or actual values. However, the Profibus bus system can only process setpoint or actual values 1 ... 3 (PPO1 ... PPO4).

7.3.3 Control word (STW)

The control word (STW) is the first word transferred to the frequency inverter in the process data area in an order telegram. For example, a control word "Ready for switch-on" corresponds to 047E$_{(hex)}$. In general the command "Standby" should be the first command which is transferred to the inverter.

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: If a digital input has been programmed for the "ack.fault" function, this bit must not permanently be set to 1 via the bus (otherwise, flank evaluation would be prevented).	
8	0			
	1	Bit 8 active	Bus bit 8 from the control word is set. Only for SK 2xxE and SK 5xxE. For further details of the function please refer to parameter P480.	
9	0			
	1	Bit 9 active	Bus bit 9 from the control word is set. Only for SK 2xxE and SK 5xxE. For further details of the function please refer to parameter P480.	
10	0	PZD invalid	The transmitted process data is invalid.	
	1	PZD valid	Valid process data is transferred from the master. **Note:** In order for the transmitted setpoint to be valid, this bit must also be set (setting: interface), even if only setpoint values are transmitted via the bus.	
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

7.3.4 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. The meaning of the individual bits deviate for some types of devices.

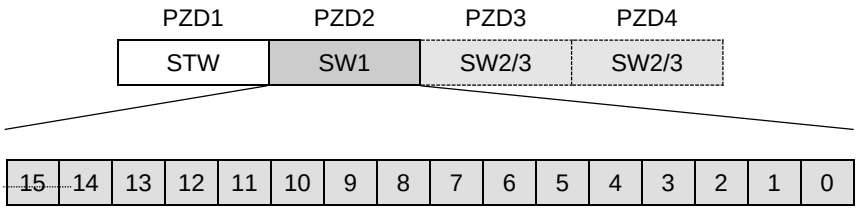
Bit	Value	Meaning	Remarks	
0	0	Not ready to start		
	1	Ready to start	Initialisation completed, charging relay ON, output voltage disabled	
1	0	Not ready for operation	Causes: No command has been activated, fault is signaled, OFF2 or OFF3 activated, starting disabled state activated	
	1	Ready for operation	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	*SK 5xxE:* Bit 10 active	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481.	
		SK 300E / 7x0E: MFR 1 reference value reached	Programmed function of the MFR 1 is fulfilled, or Actual value ≥ programmed reference value	
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	*SK 5xxE:* Bit 13 active	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481.	
		SK 7x5E: MFR 4 reference value reached	Only with Posicon extension: Status MFR 4 = 1	
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		

7.3.5 Setpoint 1 (SW1)

The function of the 1st setpoint is set in parameter P546. The following options are available:

Setpoint frequency (16 bit)

The setpoint frequency in setpoint 1 is transferred as a 16 Bit value as standard. Setpoint 1 is transferred to the inverter as the second word in the process data area of the order telegram.



The setpoint is transferred as a whole number with a value range of -32768 to 32767 (8000 hex to 7FFF hex). The value 16384 (4000 hex) is equal to 100%. The value C000 HEX corresponds to -100%. A setpoint of 100% corresponds to the parameter **maximum frequency** (parameter P105) set in the same parameter set.

Setpoint position (16 or 32 Bit)

Using the posicon special extension **POSICON (SK XU1-POS) of the SK 700E** , the absolute setpoint position can be transferred in setpoint 1. It can be transferred as a 16 or 32 Bit value with a resolution of 1=0.001 revolutions. In addition, the control terminals (POSICON control bits setting) can be transferred in binary.

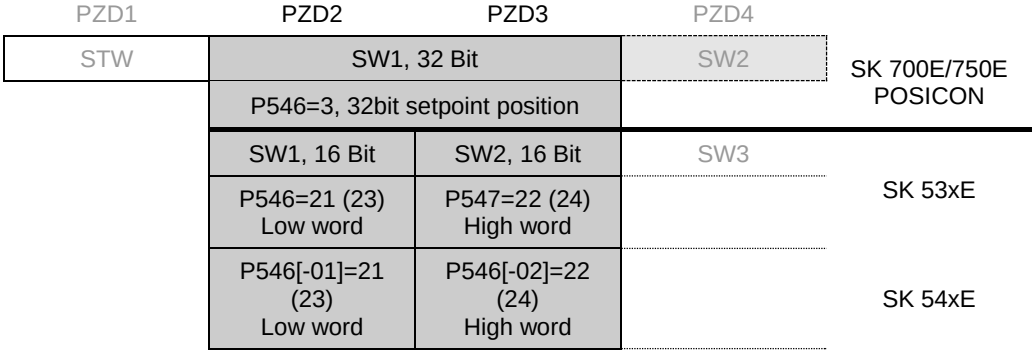
The **SK 53xE / SK54xE version** of the **SK 500E** series is also able to transfer positions, however here, the 32 Bit position is divided into two 16 Bit components (Low word and High word). The assignment of the two 16 Bit components is then carried out via appropriate parameterisation on 2 arbitrary setpoints (e.g.: SW1 and SW2).

16-Bit setpoint position setting:

As a **16 Bit** value, a range of +32767 (= 32,767 revolutions) to -32768 (= -32,768 revolutions) is possible. The 16 Bit setpoint position is transferred as the second word in the process data area (as with the setpoint, see above)

32-Bit setpoint position setting:

As a **32 Bit** value, the full position range of +/- 50000,000 revolutions is available. With the SK 700E/750E, the 32 Bit setpoint position is transferred in the area of the process data as the second and third word. With the SK 500E in any two of the three words PZD2, PZD3, PZD4.



Posicon control bits setting:

A 16 Bit value is transferred in which the control terminals of the posicon special extension unit are mapped. The setpoint position is based on the position array / position increment as per the P610 setpoint mode.

The transferred Bits have the following meaning (see Manual BU 0510 / BU 0710):

SK 7x0E + SK XU1-POS	
Bit	**Function**
Bits 0-5	Position array/position increment
Bit 6	Approach reference point
Bit 7	Reference point
Bit 8	Teach-in
Bit 9	Quit teach-in
Bit 10	Reset position

SK 53xE / SK 54xE	
Bit	**Function**
Bits 0-3	Position array/position increment
Bits 4-7	Vacant
Bits 8-15	no significance

7.3.6 Setpoint 2 and 3 (SW2/3)

If PPO type 2 or 4 are used, two further setpoint values can be transferred in addition to Setpoint 1. The division to the process data words PZD3 and PZD4 depends on the inverter series:

PZD1	PZD2	PZD3	PZD4	
STW	SW1	SW3	SW2	SK 300E, SK 7x0E
STW	SW1	SW2	SW3	SK 5xxE

SK 7x0E: third setpoint value can only be transferred if a 32 Bit setpoint value is not transferred in the first setpoint.

PZD1	PZD2	PZD3	PZD4
STW	SW1		SW2

The second and third setpoints are always 16 Bit. The function of the second and third setpoints can be set in the inverter with parameter P547 ‘’*Setpoint function 2*’ or P548 ‘’*Setpoint function 3*’ respectively.

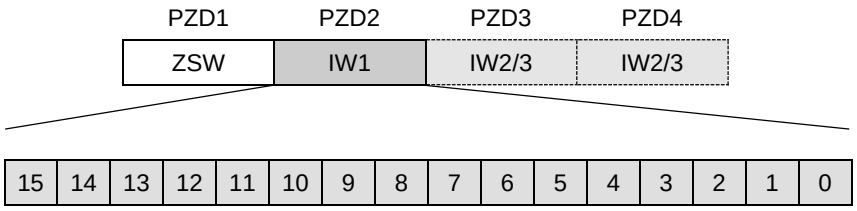
Both setpoints are transferred as whole numbers in the range -32768 to 32767. The value 16384 (4000 HEX) corresponds to 100%. The value C000 HEX is equal to –100%, so that setpoints in the range –200% to +200% can be transferred. A setpoint of 100% corresponds to the respective nominal value:

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)

In addition, *posicon* control bits can also be transferred here (see Setpoint 1)

7.3.7 Actual value 1 (IW1)

The actual value 1, i.e. the actual output frequency of the inverter, is transferred as a 16 Bit value as standard in the actual value 1. The actual value 1 is transferred to the master in the inverter response telegram as the second word in the process data area.



The actual value 1 is transferred as a whole number in the range -32768 to 32767. In addition to the actual frequency, other actual inverter values can be transferred. The setting is made in P543 *'Actual value 1 function*'.

The settings ‘Actual frequency’, ‘Actual speed’, ‘Current’ and ‘Torque current’ are transferred as percentages of the respective nominal sizes. The value 16384 (4000 HEX) corresponds to 100%. The value C000 HEX corresponds to -100%. Actual values in the range –200% to +200% can be transferred.

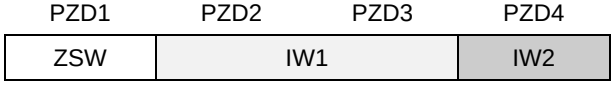
With the setting ‘Digital I/O status’, the states of the control terminals and the relay (MFR) /digital outputs can be transferred:

SK 300E/700E/750E	
Bit	**Status**
Bits 0-5	Digital input 1-6
Bit 6-11 for POSICON special extension unit	Digital input 7-12
Bit 6 for encoder special extension unit	Digital input 7
Bits 12-15	Multifunctional relay 1-4

SK 5xxE	
Bit	**Status**
Bits 0-4	Digital input 1-5
Bit 5-6 (above SK 520E)	Digital input 6-7
Bits 12-15	Relay and digital outputs 1 - 4

With the settings ‘Actual position’ and ‘Setpoint position’, the actual absolute position is transferred. The resolution is 1 = 0.001 revolutions.

If **with SK 700/750E** the value 'Setpoint position 32Bit' is set in parameter P546 *'Setpoint 1 function'*, the actual value of the setpoint position or actual position is also transferred as a 32Bit value in PZD2 and PZD3:



7.3.8 Actual value 2 and 3 (IW2/3)

It is possible to transfer two further actual values to the controller if PPO type 2 or 4 is used for transfer.

The assignment of the actual values 2 and 3 to the process data words PZD3 and PZD4 is carried out in the same way as the assignment of setpoints 2 and 3. These also differ in sequence between the SK 5xxE and other inverter series.

Second and third actual value SK 300E/SK 700E/SK 750E (IW2/3)

The actual value 2 (IW2) is transmitted in PZD4. The value to be transferred can be selected in P544 (actual bus value 2). Actual value 3 (IW3) can be transmitted in PDZ3 if actual value 1 is not a 32 Bit value. The value to be transferred can be selected in P545 (actual bus value 3).

Second and third actual value SK 5xxE (IW2/3)

The actual value 2 (IW2) is transmitted in PZD3. The value to be transferred can be selected in P544 (actual bus value 2). The actual value 3 (IW3) is transmitted in PZD4. The value to be transferred can be selected in P545 (actual bus value 3).

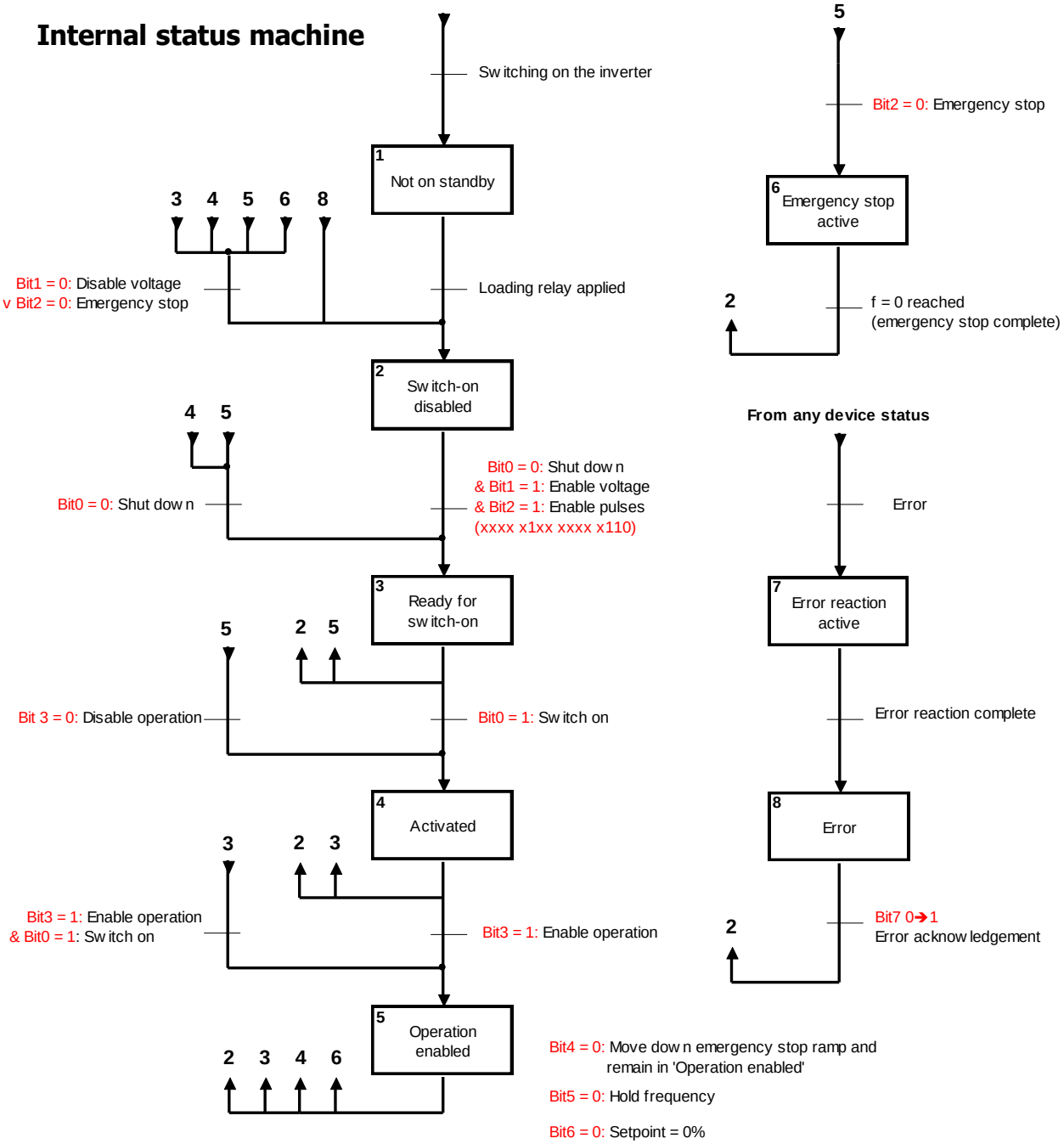
7.4 Frequency inverter status machine

The frequency inverter passes through a status machine. The changes between various states are triggered by the respective control commands in the process data control word. The actual status is returned in the process data status word. After switching on, the inverter is in **switch-on disabled** status. This status can only be ended by transmitting the “Shut down (Off 1)” command. The answer to a master telegram normally does not yet contain a reaction to the control command. The controller must 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	**Bit6** Switch-on disable	**Bit5** Emergency stop	**Bit4** Disable voltage	**Bit3** Fault	**Bit2** Operation enabled	**Bit1** Standby	**Bit0** 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. Standby / Shut down
1. Disable / enable voltage
2. Enable pulses / emergency stop
3. Disable / enable operation
4. Betriebsbedingung / HLG sperren
5. Enable / stop RUE
6. Enable / disable setpoint
7. Error acknowledgement (0➔1)
10. Control data valid / invalid
11. Direction of rotation clockwise
12. Direction of rotation anticlockwise
14. Parameter set Bit 0
15. Parameter set Bit 1

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

Coding of status:
1: Bit 0 = 0
2: Bit 6 = 1
3: Bit 0 = 1
4: Bit 1 = 1
5: Bit 2 = 1
6: Bit 5 = 0
7: Bit 2 & Bit 3 = 1
8: Bit 3 = 1

7.5 Parameter range (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 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.

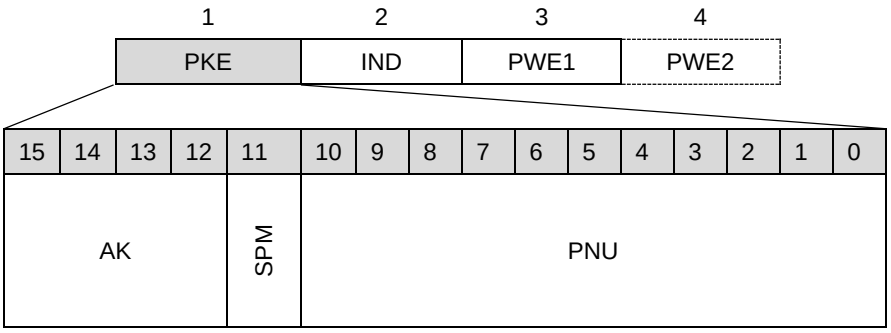
WARNING

The maximum number or write cycles on the EEPROM of the frequency inverters is limited to 100,000 cycles. Continuous writing to the EEPROM therefore results in the destruction of the EEPROM.

Writing to the RAM of the frequency inverter should therefore be used for writing parameter data. The setting for this is made in parameter P560 of the frequency inverter.

7.5.1 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.

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.

Note

For the inverter parameter numbers (PNU) of the particular inverter series please refer to the relevant operating instructions.

Note

With the Profibus 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).

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

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.

Meanings 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	-

The following table lists all the orders which can be transferred from the master to the SK 200E frequency inverter or the technology units. The right-hand column contains the response, which is normally sent (response label positive). Only certain response labels are possible, depending on the order label. In case of error (AK negative) the SK 200E frequency inverter will always supply the value 7 in the response label (AK) to the master.

AK	Function	Response label positive
11	Change parameter value (array double word) without writing into EEPROM	5
12	Change parameter value (array word) without writing into EEPROM	4
13	Change parameter value (double word) without writing into EEPROM	2
14	Change parameter value (word) without writing into EEPROM	1

Meanings 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.

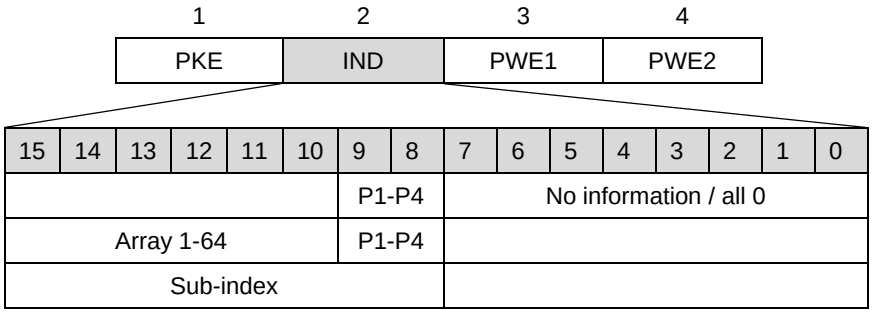
For the plausibility check, the value in the response label (AK), the received parameter number (PNU) with the corresponding Index (IND) as well as the current parameter value (PWE) can be used for the description of parameters.

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. For the meanings of the values transferred, please refer to the following table.

AK	Meaning
0	Invalid parameter number
1	Parameter value cannot be changed
2	Lower or upper value limit exceeded
3	Incorrect sub-index
4	No array
5	Invalid data type (at present only for SK 700E)
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
9	Description data not present
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

7.5.2 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 parameter is not dependent on the parameter set, then Bits 8 -15 are used for the sub-index.

Please refer to the operating instructions for details of the structure of the individual parameters and which values may be called up.

If the sub-index is used, nos. 6, 7, 8 or 11, 12 must be used as the order label (see Section 7.5.1), in order for the sub-index to be effective.

7.5.3 Parameter value (PWE)

According to the type of the PPO or parameter, transfer of the parameter value (PWE) is always as a word (16 Bit) or double word (32 Bit) Only one parameter value can be transferred in a telegram.

A 32 bit parameter value comprises PWE1 (High value word) and PWE2 (Low value word, 4th word). A 16 Bit parameter value for PPO1 and PPO2 is transferred in PWE2. For negative values the High word must be set to FFFF hex.

Note

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

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} = $270F_{hex}$ must be transferred.

8. Operating status messages

According to the cause, frequency inverters and technology units generate appropriate messages if they deviate from their normal operating status. There is a differentiation between warning and error messages. If the frequency inverter is in the status "Start disabled", the reason for this can also be displayed.

The messages generated for the frequency inverter are displayed in the corresponding array of parameter (P700).

Frequency inverter start disabled

If the frequency inverter is in the status "Not Ready" or "Start Disabled", the reason for this is indicated in the third array element of parameter (P700) (software version V1.9 R0 and above).

Display is only possible with the NORD CON software or the ParameterBox (SK PAR-3H).

Warning messages

Warning messages are generated (software version V1.9 R0 and above) as soon as a defined limit is reached. However this does not cause the frequency inverter to switch off. These messages can be displayed via the array element [-02] in parameter (P700) until the reason for the warning is no longer present or the frequency inverter has gone into a fault state with an error message.

Error messages

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):

- Switching the mains off and on again,
- By an appropriately programmed digital input (P420 ... P425 / P470 = Function 12),
- By switching of the “enable” on the frequency inverter (if no digital input is programmed for acknowledgement),
- By Bus acknowledgement or
- By P506, the automatic error acknowledgement.

Device LEDs:	As delivered, without the technology unit, 2 LEDs (green/red) are visible externally. These indicate the actual device status. The **green LED** indicates that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output. The **red LED** flashes with a light sequence corresponding to the error code number, e.g. 5 x flash up refers to error code number 5.

8.1 Table of possible error messages

The following list shows the possible error messages specific to Profibus.

Display in the ControlBox		Fault Text in the ParameterBox	Cause • Remedy
Group	**Details in P700 / P701**		
E010	**10.0**	**Bus Timeout**	Telegram timeout, data transfer is faulty. Check P513. • Check external Bus connection. • Check bus protocol program process. • Check Bus Master.
	10.2	**Bus Timeout Option**	Telegram timeout for external bus module, telegram communication is faulty. • Check external connection. • Check bus protocol program process. • Check Bus Master.
	10.4	**Init error Option**	External bus module initialisation failure • Check P746. • Bus module not correctly plugged in. • Check Bus module current supply.
	10.1	**System error option**	External Bus module system failure For further details see Section 8.2.
	10.3		
	10.5		
	10.6		
	10.7		
	10.8	**Option error**	External module communication failure • Connection fault / error in the external component

8.2 Error monitoring

The PROFIBUS module monitors the following functions:

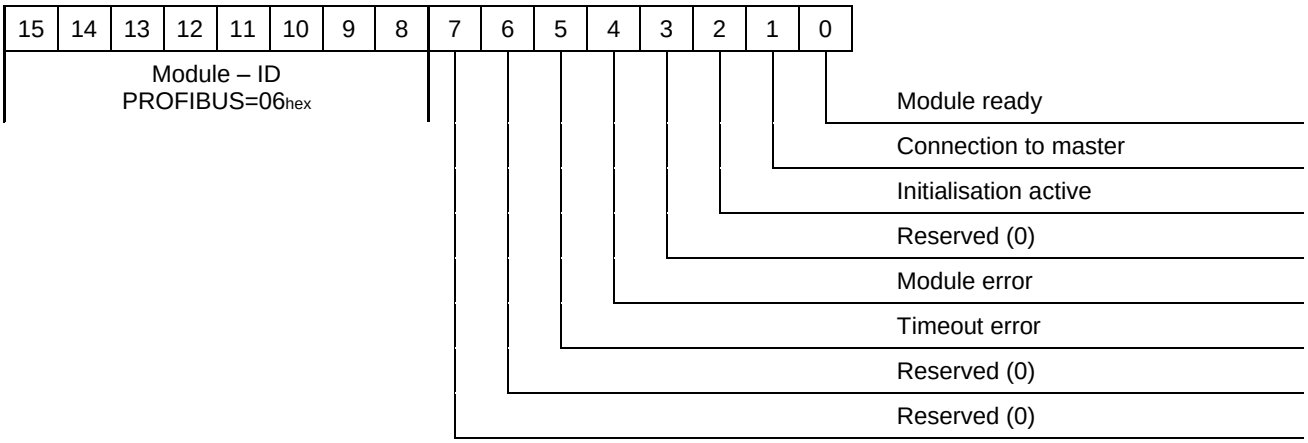
- Connection to master: error, e.g. due to disconnection of the bus cable.
- Baud rate detection
- Reception of process data from PROFIBUS:

  Following receipt of a valid telegram, the next one must arrive within the period set in the inverter parameter "USS Time Out".
- Reception of process data from inverter: on interruption of the connection to the frequency inverter, an error message is entered in the extended diagnosis of the PROFIBUS telegram (2 bytes: 0x02 0x04).

In parameter P746, the status of the PROFIBUS module can be read. With a customer unit (only SK 300E and SK 700E/750E) this can be performed with a technology unit or a ControlBox. If a technology unit is used, the parameter must be read out with an additional BUS module with a USS or CAN interface. However, 2 LEDs are still available for diagnosis with the technology unit (see below).

Parameter P746 is a subindex parameter: The status of the PROFIBUS technology unit is in Subindex 0, the status of the PROFIBUS customer unit is in Subindex 1.

The parameter contains binary coded information which is displayed in hexadecimal:



LED display with the technology unit:

The status of the PROFIBUS technology unit is indicated by the two built-in LEDs:

Green LED BR → Bus Ready	**Red LED** BE → Bus Error	**Meaning** ... slow flashing = 1Hz (1s cycle), rapid flashing = 2Hz (0.5s cycle)	
ON	**OFF**	**Normal operation**; cyclic transfer of data via the PROFIBUS.	
ON	ON	Faulty operation; e.g. the PPO type was changed during operation.	
Slow flashing	OFF	Process data has not yet been received after switch-on → e.g. no connection to master	
Slow flashing	Brief illumination	Initialisation of the PROFIBUS module (on switch-on or change to a Profibus parameter on the frequency inverter)	
Slow flashing	ON	Timeout in process data reception: the Watchdog time parameterised in the Profibus master has expired without the reception of new process data for a maximum of 3s (e.g. baud rate not detected, cable break).	
Slow flashing	Slow flashing	Timeout in process data reception: The time set in **P513** has expired without new process data being received	
Slow flashing	Rapid flashing	software version 3.3 R0 and above	Communication between the inverter and the PROFIBUS module has been interrupted.
ON	Slow flashing	up to software version 3.2 R0	

9. Telegram examples

Various example telegrams are shown below to clarify the control and parameterisation of the frequency inverter with the bus system.

9.1 Switch-on block → 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). Parameter set 1 is valid. Only the PZD channel is evaluated.

Procedure:

- Check last status word (ZSW **0B 70**)
- Generate control word (STW **04 7E**)
- Check response telegram (ZSW **0B 31**)

Details:

- Status word of frequency inverter → frequency inverter is in *switch-on block* status

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	B	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

Abbreviations used

PKW	Parameter identifier value
PZD	Process data
PKE	Parameter identifier
IND	Index
PWE	Parameter value
STW	Control word 1
ZSW	Status word1
SW1..3	Setpoint
IW1..3	Actual value

To switch the frequency inverter to the *standby* status, the following telegram must be sent:

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

When the frequency inverter switches to *standby* status, it sends 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.

9.2 Enable with 50% setpoint

A frequency inverter in the "Standby" status must be enabled for clockwise rotation with 50% setpoint. The last response telegram was received as follows in the controller.

Procedure:

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

Details:

- Starting requirement (status word of frequency inverter):

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

- The following telegram must be sent to the frequency inverter:

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.

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

Note

The status of MFR 1 is indicated in Bit 10 of the response telegram. Depending on the programmed function and status, the status word may differ.

9.3 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 as the PPO type.

The acceleration time parameter (PNU = 102_{dec} / 66_{hex}) of a frequency inverter should be set to the value 10sec in parameter set 3. 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:

- Specify order label (Change parameter value (array word)= 7)
- Select parameter (P 102_{dec} + 1000 = P 1102 = P $44E_{hex}$)
- Select parameter set 3 (IND = 02)
- Set parameter word (1000_{dec} / $3E8_{hex}$)
- 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

WARNING

The maximum number or write cycles on the EEPROM of the frequency inverters is limited to 100,000 cycles. Continuous writing to the EEPROM therefore results in the destruction of the EEPROM.

Writing to the RAM of the frequency inverter should therefore be used for writing parameter data. The setting for this is made in parameter P560 of the frequency inverter.

10. Additional information

10.1 Device master data (GSD file)

All performance features of the NORD PROFIBUS modules are summarised in a device master data file. For simple PROFIBUS communication, the structure, content and coding of the device master file (GSD) are standardised in a readable ASCII text file. The GSD file is an electronic data sheet provided by the manufacturer of the device. It enables convenient planning of the NORDAC inverter in combination with devices from various manufacturers. 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 available for download free of charge on the homepage of Getriebebau Nord under www.nord.com. In addition, the GSD file can be found on the documentation CD (Electronic Product Documentation) which is enclosed with the frequency inverter.

For each of the device series **vector CT, vector mc, SK 300E, SK 5xxE, SK 700E and SK 750E** a GSD file is available for the standard components up to 1.5 MBaud as well as a file for the special versions up to 12 MBaud.

- **up to 1.5 MBaud** NORD_1_5.GSD (module without 24V supply)
- **up to 12 MBaud** NORD_12.GSD (module with 24V supply)

For the decentralised device series **SK 2xxE** with **SK CU4-… or SK TU4-…** technology units and separate 24V power supply, the following GSD file must be implemented.

- **up to 12 MBaud** NORD0BA8.GSD (SK 2xxE technology unit, incl. DP-V1)

This "new" GSD file differs from the previous "old GSD files by the use of newer modules and extension of the DPV1 functionality.

The PROFIBUS users´ organisation archives this information for all manufacturers and provides this in Internet. It can be downloaded under www.profibus.com.

10.2 Ident number

In order for the PROFIBUS 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 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 in this manual

10.3 PROFIDRIVE Standard Parameters

The following parameters defined by the PROFIDRIVE profile are implemented in the PROFIBUS module:

PNU	Explanation
918	Address of participant
927	Control authority PKW (always 1, i.e. PROFIBUS interface)
947	Error number: The actual error number is saved in this parameter.
965	Profile number (3.0)
967	Control word
968	Status word
970	Load data set If the value of this parameter is set to 1 a factory setting is used and all change bits are set to 0.
971	Transfer to the non-volatile memory (always performed automatically)

These parameter numbers are not mapped.

10.4 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.

10.5 Repair information

If you contact our technical support, please have the precise device type (rating plate/display), accessories and/or options, the software version used (P707) and the series number (name plate) at hand.

10.5.1 Repairs

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

NORD Electronic DRIVESYSTEMS GmbH

Tjüchkampstraße 37

26605 Aurich, Germany

For queries about repairs, please contact:

Getriebebau NORD GmbH & Co. KG

Tel.: 04532 / 289-2515

Fax: 04532 / 289-2555

If a frequency inverter is sent in for repair, no liability can be accepted for any added components, e.g. such as mains 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 also obtain a suitable return goods voucher from Getriebebau NORD.

Unless otherwise agreed, the device is reset to the factory settings after inspection or repair.

10.5.2 Internet information

You can also find the comprehensive manual in German and in English on our Internet site. www.nord.com

10.6 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 consists of 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 output information (e.g. control word and setpoints) to the slaves.
DP-V1	With the performance level DP-V1, acyclic data traffic can additionally be carried out between the central control unit (bus master) and the connected slaves. 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 for the device
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 (OSI) 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.

10.7 Abbreviations

AIN	Analog input	**IW**	Actual value
AOUT	Analogue output	**LED**	Light-emitting diode
DI (DIN)	Digital input	**P**	Parameter which depends on a parameter set
DO (DOUT)	Digital output	**Pxxx**	Parameter number
DP	Decentralized peripheral	**PKE**	Parameter identifier
EEPROM	Non-volatile memory	**PNO**	PROFIBUS users´ organisation
EMC	Electromagnetic compatibility	**PPO**	Parameter Process data Object
FI	Frequency inverter	**PWE**	Parameter value
GND	Earth	**PZD**	Process data
HW	Hardware	**STW**	Control word
IND	Index	**SW**	Software version, P707
IO (I/O)	In / Out (Input / Output)	**ZSW**	Status word

Key word index

NORD DRIVESYSTEMS GROUP

Headquarters:

Getriebebau NORD GmbH & Co. KG
Rudolf-Diesel-Straße 1
22941 Bargteheide, Germany
Fon +49 (0) 4532 / 289-0
Fax +49 (0) 4532 / 289-2253
info@nord.com, www.nord.com

Member of the NORD DRIVESYSTEMS GROUP

NORD DRIVESYSTEMS

607 0202 / 2612