Intelligent Drivesystems, Worldwide Services

SUPPLEMENTARY MANUAL BU 0260 GB

CAN OPEN FOR
FREQUENCY INVERTER **NORDAC SK 200E**

Illustration of devices with options

BU 0260 GB

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NORDAC frequency inverter

Safety and operating instructions for drive power converters

(as per: Low Voltage Directive 73/23/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 89/392/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 (89/336/EEC) is complied with.

The drive power converters meet the requirements of the Low Voltage Directive 73/23/EEC. The harmonised standards in prEN 50178/DIN VDE 0160, in association with EN 60439-1/VDE 0660 Part 500 and EN 60146/VDE 0558 were used for the drive power converter.

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

3. Transport, storage

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

4. Installation

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

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

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

5. Electrical connection

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

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

Information regarding 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 limit values specified in the EMC regulations is the responsibility of the manufacturer of the system or machine.

6. Operation

Systems where drive power converters are installed must be equipped, where necessary, with additional monitoring and protective equipment as per the applicable safety requirements, e.g. legislation concerning technical equipment, accident prevention regulations, etc. Modifications to the drive power converter using the operating software are permitted.

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

All covers must be kept closed during operation.

7. Maintenance and repairs

The manufacturer documentation must be complied with.

These safety instructions must be kept in a safe place!

Documentation

Designation:	BU 0260 GB
Part No.:	607 26 01
Device series:	CANopen for SK 200E
Device types:	**SK CU4-CAO**
	SK TU4-CAO(-C) with SK TI4-TU BUS
	SK TU4-CAO-M12(-C) with SK TI4-TU BUS

Version list

Designation of previous issues	Software version	Comments
BU 0260 GB, September 2009 Part. No. 607 2601 / 3809	V 2.0 R3	First issue

Publisher

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NOTE

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

Intended use of the frequency inverter

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

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

The field bus technology options described here are intended for use in combination with SK 200 E series frequency inverters. Use with other series is only possible with the SK TU4-CAO(-C) and SK TU4-CAO-M12(-C) technology modules for the SK 500E. The use of these technology options with other devices is not permitted and can lead to their destruction.

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

Commissioning (implementation of the intended use) is not permitted until it has been ensured that the machine complies with the EMC directive 89/336/EEC and that the conformity of the end product meets the machine directive 89/392/EEC (note EN 60204).

1 General information

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

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

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

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

The CAN bus system

The CAN bus (Controller Area Network), developed by Bosch enables the implementation of powerful automation systems with distributed intelligence. The widespread use of the CAN bus protocol is mainly due to the availability of very economical protocol modules.

CAN Bus is based on a linear topology. Branch-like topologies are possible by using repeaters. In addition to the use of twin conductor cables, there are also solutions based on optic fibres. The collision recognition and resolution, as well as error recognition, integrated in the CAN bus protocol, enables high bus utilisation and data security.

Bus access rights are not issued by a higher-level control unit. Instead, each subscriber can start transmitting a message as soon as the bus is free (multi-master capability). With simultaneous access by several participants, access is granted to the subscriber with the highest priority. The priority is assigned according to the identifier of the messenger in the CAN bus.

CANopen

CANopen is an open communications profile for various industrial automation systems. It is based on the CAN bus system and describes the layers 1 (physical layer) and 2 (data transfer) of the OSI reference model (ISO 11898). CANopen was specified by the international CAN-in-Automation (CiA) organisation and defines the communication mechanisms (process data, parameterisation, monitoring etc.) via the CANopen bus.

CANopen can be used for data exchange between devices from different manufacturers.

As well as the communication profile, CANopen defines device profiles for the most important types of device used in industrial automation technology, e.g. digital and analog I/Os, drives, etc.

Getriebebau Nord GmbH supports the CiA CANopen specification DS-301 and DS-402.

1.1 Overview

Features of the CANopen Modules

- Electrically isolated bus interface
- Data transfer rate from 10kbit/sec to 1 Mbit/sec
- Easy connection, optionally via M12 round plugs or screw terminals
- Integrated bus terminating resistor (switchable)
- CAN bus-specific status indication with 2 LEDs on the internal (Customer Unit) and external (Technology Unit) technology option
- DEVICE or FI-specific status indication with 2 LEDs on the internal (Customer Unit) and external (Technology Unit) technology option
- CAN interface as per specifications 2.0A and 2.0B
- Up to four 24V inputs and two 24V outputs are integrated into the bus module
- Direct connection of up to 4 sensors and 2 activators via M12 round plug connectors on the SK TU4-CAO-M12(-C) version. Visualisation of signal status via LEDs
- Transmission and selection of process and parameter data
- CAN Bus gateway solution → up to 4 frequency inverters can be connected to a CANopen bus module. Each FI is allocated its own SDO channel
- Up to 63 nodes (e.g. CANopen bus modules) on a single bus. With this, up to 252 frequency inverters can be operated on a single bus by means of gateway.
- Support of 11 bit and 29 bit identifiers by the technology modules
- Supports DS-301 communications profile and DS-402 drive profile for “Velocity Mode” (with Technology Units)
- Programming of all frequency inverter parameters using SDO
- Dynamic PDO mapping (5 TxPDOs and 5 RxPDOs) for great reduction in the number of parameters
- Heartbeat and node-guarding monitoring functionality
- Interface (RS232/RS485) for parameter access by means of the SK PAR-3H manual control unit or NORDCON software via RJ12 connector (Except for SK CU4-CAO. Here parameter access via the SK 200E frequency inverter is possible)
- Integrated EEPROM with extensive bus-specific parameter database with parameter editing facilities via:
  - ParameterBox and Nordcon: direct access / direct saving
  - CANopen Bus Saving via - Index 0x1010 sub0 Store Parameters,
    - Index 0x1011 sub0 Restore default Parameters
- Available as versions for installation in the inverter (IP20) or in a separate housing (optionally IP55 / IP66)

1.2 Delivery

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

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

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

1.3 Scope of supply

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

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

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

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

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

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

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

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

1.4 Certifications

1.4.1 European EMC Directive

If the NORDAC SK 200E is installed according to the recommendations in this instruction manual, it meets all EMC directive requirements, as per the EMC product standard for motor-operated systems EN 61800-3. (see also Section 8.1.3 , "Cable layout and shielding (EMC measures)")

1.4.2 RoHS compliance

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

1.5 Type code / Optional BUS modules

BUS = Bus module or I/O extension

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

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

(...) Options, only implemented if required

Optional external technology unit, SK TU4-...

Optional internal customer unit, SK CU4-…

1.6 Version with protection class IP55 / IP66

NORDAC SK 200E frequency inverters and the **external additional modules** are available in all sizes and powers in the protection classes IP55 (standard) or IP66 (optional).

The protection class IP66 must always be stated when ordering!

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

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

IP55 version:

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

IP66 version:

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

NOTE

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

Special measures:

Impregnated PCBs, painted housing

Diaphragm valve for pressure compensation on temperature changes.

Low pressure test

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

NOTE

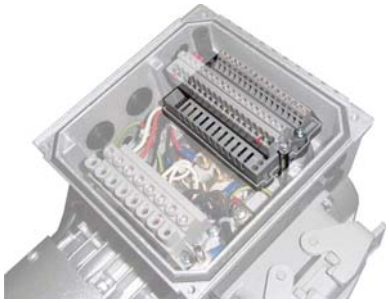
For all versions, care must be taken that the cable and the cable gland are carefully matched. This is essential to ensure that the required protection class is maintained.

2 Assembly and installation

2.1 Installation and assembly

Internal and external technology modules designed for NORDAC SK 200E series are available for CANopen. Except for the number of digital inputs and outputs, the functionalities of the various CANopen modules are identical.

These are used to connect SK 200E series speed regulated drive units to overriding automation systems via the CANopen field bus. Both the SK 200E frequency inverters and the external technology units are available in the protection classes IP55 (standard) and IP66 (optional). The type designation for the IP 66 protection class of the SK 200E and its modules is given an additional code "**-C**" (coated → coated board) to differentiate the IP55 and IP66 protection classes.



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

SK 200E with external technology unit SK TU4-… and BUS connection module SK TI4-TU-BUS

SK TIE4-WMK-TU with BUS connection module SK TI4-TU-BUS and external technology unit SK TU4-… or SK TU4-…-M12

The internal technology modules **(Customer Unit, SK CU4-...)** – designated as the **customer unit** – are integrated into the connection unit of the SK 200E. The electrical connection to the SK 200E is made via the internal system bus. The connection to external peripheral devices is made via screw terminals. The use of the optionally available 4 or 5 pin M12 round plug connector, installed in the connection unit of the SK 200E, provides a possible interface for connection to the field bus. A maximum of one customer interface (including any 24V module) can be installed in the SK 200E frequency inverter.

Optional internal
customer units, SK CU4-…

The external technology modules **(Technology Unit, SK TU4-...)** – designated as the **technology unit** – are externally attached to the SK 200E connection unit and are therefore easy to access. Mounting of the SK TU4-... separate from the frequency inverter is possible by means of the wall mounting kit **SK TIE4-WMK-TU**. The electrical connection to the SK 200E is made via the internal system bus. 4 or 5 pin M12 round plug connectors (for installation in the BUS connection unit **SK TI4-TU-BUS**) are available as an option for connection of the field bus cable. The external modules are also available as a version with integrated M12 round plug connectors (SK TU4-xxx-**M12**). These enable the connection of up to 4 digital inputs and 2 digital outputs.

Optional external
technology unit, SK TU4-…

NOTE

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

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

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

NOTE

Only one technology unit (SK CU4-... or SK TU4-...) can be connected to a system bus.

2.1.1 Overview of the CANopen modules

Bus Module	Description	Data
CANopen Module **SK CU4-CAO** Part No. 275271001 (IP20)	 Similar to illustration This option enables control of the NORDAC SK 200E via CANopen. This option is integrated into the connection unit of the frequency inverter.	Supported profiles: CiA DS-301 and CiA DSP-402 baud rate: up to 1 MBaud Connection: 16-terminal screw terminal bar 2x digital inputs: Low: 0-5V, High: 11-30V System bus
CANopen module*) **SK TU4-CAO(-C)** Part No. 275281101 (IP55) Part No. 275281151 (IP66)	 This option enables control of the NORDAC SK 200E via CANopen. This option is installed externally to the frequency inverter. According to the installation location, at least one "BUS connection unit"* is required.	Supported profiles: CiA DS-301 and CiA DSP-402 baud rate: up to 1 MBaud Connection: 36 pin spring terminal bar of the "BUS connection unit"* 4x digital inputs: Low: 0-5V, High: 11-30V 2x Digital outputs: 0/24V System bus
CANopen module with M12*) **SK TU4-CAO-M12(-C)** Part No. 275281201 (IP55) Part No. 275281251 (IP66)	 This option enables control of the NORDAC SK 200E via CANopen. This option is installed externally to the frequency inverter. According to the installation location, at least one "BUS connection unit"* is required.	As for SK TU4-CAO, but with additional: 6x M12 socket for the connection of up to 4 sensors and 2 actuators via 5 pin M12 round plug connectors (A coded)
Connection unit for TU4 **SK TI4-TU-BUS** Part No. 275280000 (IP55) Part No. 275280500 (IP66)	 The connection unit is always required in order to use an external technology unit (SK TU4-...). This implements the connection of the technology unit to the SK 200E or the wall-mounting kit.	Connection: 36 pin spring terminal bar 36x 2,5mm^2 AWG 26-14 spring terminals
TU4 Wall-mounting kit **SK TIE4-WMK-TU** Part. No. 275274002	 With the wall mounting kit, a technology unit can be used/installed separately from the SK 200E.	
*) in order to use the TU4 modules, a suitable SK TI4-TU-BUS connection unit must always be available!		

2.1.2 Installing the Customer Unit SK CU4-CAO

WARNING

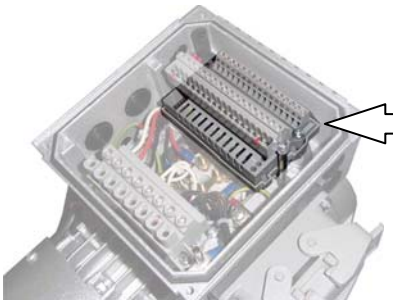
Installation must be carried out by qualified personnel only, paying particular attention to safety and warning instructions.

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

Installation of the SK CU4-... customer unit **remote** from the frequency inverter is not permitted. This must be installed in the immediate vicinity of the SK 200E frequency inverter.

The installation of customer units is carried out in the connection unit SK T14-… SK 200E underneath the control terminal bar. Fastening is by means of the terminal bar of the frequency inverter and two M4x20 screws (bag enclosed with the customer unit). Only one customer unit per FI is possible!

The pre-assembled cables for connection to the frequency inverter (SK 200E) are also included in the bag enclosed with the customer unit. Connections are made according to the following table:



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

Similar to illustration

Customer unit SK CU4-CAO

Bag enclosed with internal customer unit

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

NOTE

Set the termination resistors of the system bus!

(See Section 2.2.3 "Configuration")

2.1.3 Installing the SK TU4-CAO Technology Unit

WARNING

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

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

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

Together with the BUS connection unit SK TI4-TU-BUS(-C) the technology unit SK TU4-CAO-…(-C) forms a stand-alone functional unit. This can be attached to the SK 200E frequency inverter or installed separately by means of the optional SK TIE4-WMK-TU wall-mounting kit.

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

The optional wall-mounting kit has the following dimensions.

Wall-mounting kit SK TI4-WMK-TU

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

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

External BUS connection unit = SK TI4-TU-BUS

The following holes are available as cable inlets:

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

The transparent screw-on cover (M20 x 1.5) on the upper right serves as access to the diagnostic interface (RJ12 socket, interface RS232/RS485). The upper left screw-on cover is not used.

2.1.3.3 Mounting the SK T14-TU-BUS on the SK 200E

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

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

1. Switch off the mains.
2. Remove the two M25 caps on the required side of the frequency inverter (right / left).
3. Remove the printed circuit board (with terminal bar) from the BUS connection unit.
4. Install the SK T14-TU-BUS (with adhered seal) on the SK 200E using the 4 enclosed bolts.
5. Replace the printed circuit board (See point 3) and carry out the electrical connections.
6. Fit and screw on the SK TU4 module.

Mounting the external technology unit on the SK 200E

Wall-mounting kit SK TI4-WMK-TU

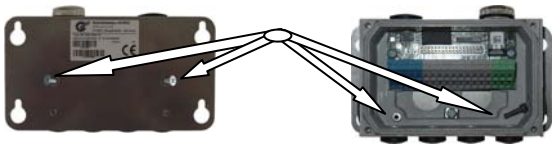
2.1.3.4 Wall-mounting the SK TI4-TU-BUS

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

The connecting cable between the technology unit and the SK 200E should not be longer than 30m.

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

Wall-mounting kit SK TI4-WMK-TU with field bus technology unit



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

2.2 Electrical connection

WARNING THE DEVICES MUST BE EARTHED.

Safe operation of the devices presupposes that qualified personnel install and commission it in compliance with the instructions provided in these operating instructions.

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

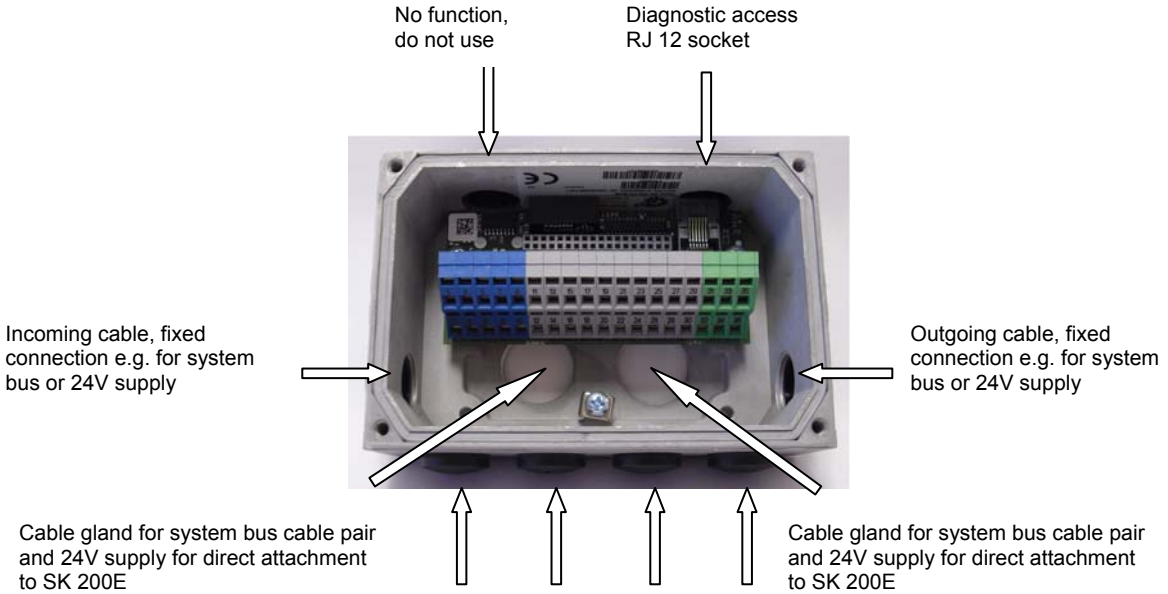
Dangerous voltages can be present at the motor connection terminals of the frequency inverter even when the inverter is switched off. Always use insulated screwdrivers on these terminal fields.

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

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

2.2.1 Cable glands

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



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

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

Example:
cable gland on BUS connection unit SK TI4-TU-BUS

2.2.2 Control connections

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

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

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

NOTE

Due to the separated potential levels of the system bus and the field bus (CANopen), both bus systems must have a separate supply (24V).

NOTE

In the customer unit, the CAN open is already installed with voltage isolation from the other signal connections.

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

NOTE

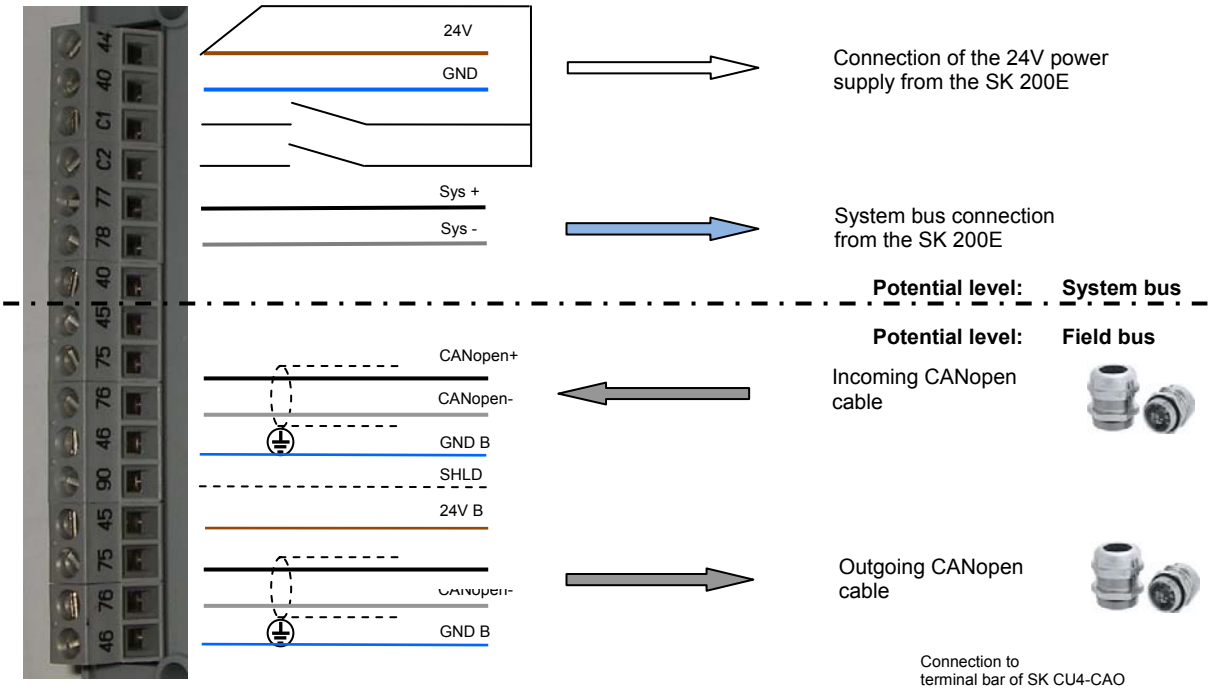
The cable shielding must be connected to the *functional earthing* [1](usually the electrically conducting mounting plate) in order to prevent EMC interference in the device.

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

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

2.2.2.1 Control connections SK CU4-CAO

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



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

NOTE

In principle, looping of the 24V supply voltage **(terminals 45/46)** or also **(terminals 44/40)** is possible, however a maximum permissible current of **2A** must not be exceeded with the **SK CU4-CAO**

Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
4424V	External 24V supply (system bus)	24VDC ±20% ≈ 50mA reverse polarity protected max. permissible current load: 2A	External supply voltage of the system bus and supply of the digital inputs (DIN1 and DIN2)	-
40 GND	Reference potential for digital signals			-
C1 DIN1	Digital input 1 [I/O CANopen DIN1]	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms	Each digital input has a reaction time of 1ms. Inputs as per EN 61131-2 Type 1	P174
C2 DIN2	Digital input 2 [I/O CANopen DIN2]			P174
77 Sys+	System bus □data cable +		System bus interface	-
78 Sys-	System bus □data cable -			-
40 GND	Reference potential for digital signals			-
Potential isolation				
45 24V Bus	24V bus supply voltage (field bus)	For CANopen - Bus 24VDC ±20% ≈ 50mA, reverse polarity protected	Version to terminal 44 electrically insulated. CANopen bus supply essential	-
75 CANopen+ (incoming)	Bus + CAN H	RS485 transfer	The use of twisted, shielded two-conductor cable is highly recommended	-
76 CANopen- (incoming)	Bus - CAN L			-
46 GND Bus	Data ground bus		Bus reference potential Version to terminal 40 electrically isolated.	-
90 SHLD	Bus shield			-
45 24V Bus	24V bus supply voltage	See above (Terminal 45).	Version to terminal 44 electrically insulated. CANopen bus supply essential	-
75 CANopen+ (outgoing)	Bus + CAN H	RS485 transfer	The use of twisted, shielded two-conductor cable is highly recommended	-
76 CANopen- (outgoing)	Bus - CAN L			-
46 GND Bus	Data ground bus		BUS reference potential Version to terminal 40 electrically isolated.	-

2.2.2.2 Control connections of the SK CU4-CAO(-...)

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

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

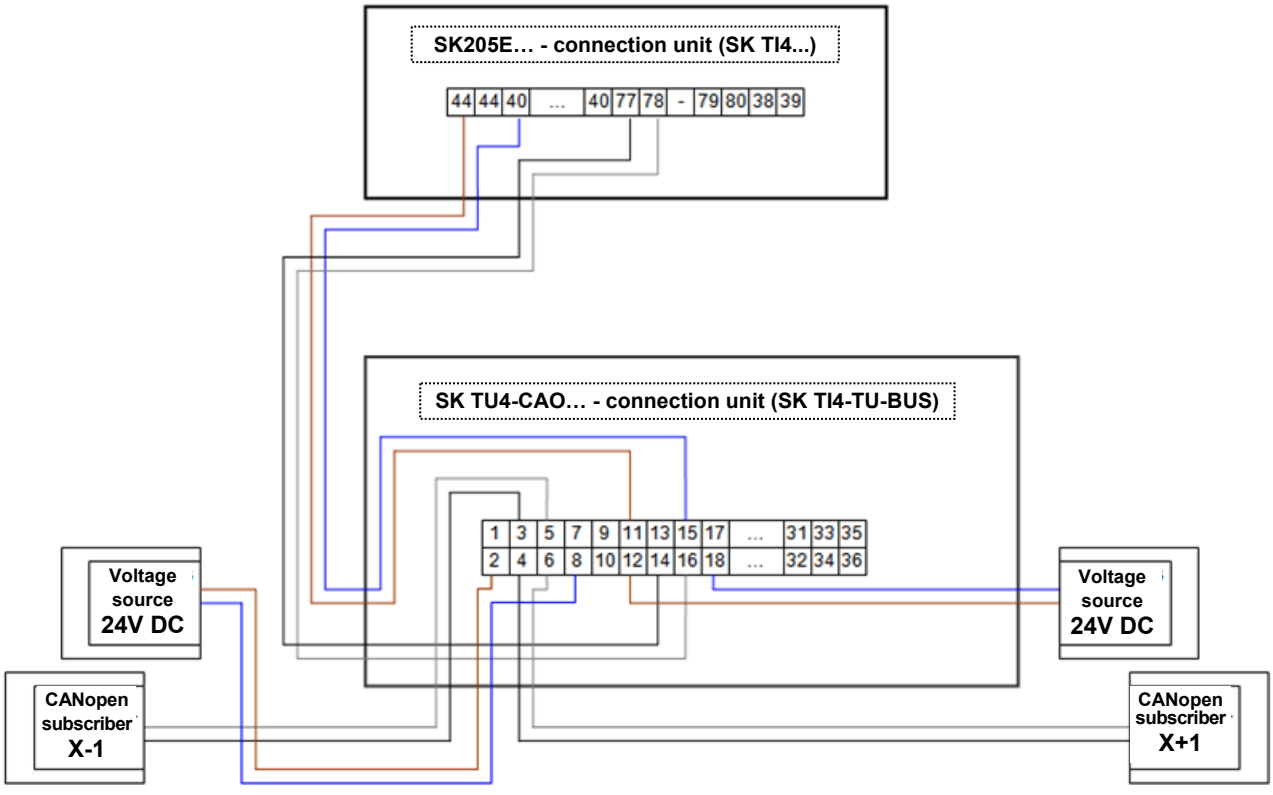
Connection of up to 4 sensors and 2 actuators is made via the terminal bar. Alternatively, the SK TU4-CAO-**M12** enables the connection of these I/Os via the M12 round plug connector (5 pin socket, A-coded) mounted on the front.

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

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

Illustration of the terminal bar of the bus connection unit SK T14-TU-BUS with allocation of functions

Connection example: SK TU4-CAO to SK 200E



NOTE

In principle, looping of the 24V supply voltage (terminals 1/2) or also e.g.: (terminals 11/15) is possible, however a maximum permissible current load of **3A** for the **SK TU4-CAO(-…)**must not be exceeded.

Control connection details

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
1 24V BUS (CAO) 2	External 24V bus supply (field bus)	24VDC -/+20% ≈ 50 mA reverse polarity protected Max. permissible current load: 3A	Supply voltage for the CANopen controller / field bus	-
3 CANopen+ (incoming) 4 (outgoing)	Bus + CAN H	RS485 transfer	The use of twisted, shielded two-conductor cable is highly recommended	-
5 CANopen- (incoming) 6 (outgoing)	Bus - CAN L			-
7 GND BUS 8	Data ground bus			-
9 SHLD	Bus shield			-
10 PE	PE bus			-
Potential isolation				
11 24V 12 13	External 24V supply (system bus)	24VDC -/+20% ≈ 50 mA reverse polarity protected Max. permissible current load: 3A	Version to terminal 1 electrically insulated. CANopen bus supply (essential)	-
14 Sys+	System bus □data cable +		System bus interface	-
15 GND	Reference potential for digital signals		External supply voltage for system bus and digital inputs (DIN1 to DIN4)	-
16 Sys-	System bus □data cable -		System bus interface	-
17 GND 18	Reference potential for digital signals		External supply voltage for system bus and digital inputs (DIN1 to DIN4)	-
19 DIN1	Digital input 1 [I/O CANopen DIN1]	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF□ Scan rate 1 ms	Each digital input has a reaction time of 1ms. Inputs as per EN 61131-2 Type 1	P174
20 DIN3	Digital input 3 [I/O CANopen DIN3]			P174
21 GND 22	Reference potential for digital signals		External supply voltage for system bus and digital inputs (DIN1 to DIN4)	-

Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
23 24V 24	External 24V supply	As for terminal 11		-
25 DIN2	Digital input 2 [I/O CANopen DIN2]	Low 0V ... 5V High 15V ... 30V R_i = 8.1kΩ Input capacitance 10nF Scan rate 1 ms	Each digital input has a reaction time of 1ms. Inputs as per EN 61131-2 Type 1	P174
26 DIN4	Digital input 4 [I/O CANopen DIN4]			P174
27 GND 28	Reference potential for digital signals		External supply voltage for system bus and digital inputs (DIN1 to DIN4)	-
29 24V 30	External 24V supply	As for terminal 11		-
Potential isolation				
31 24V o	External 24V supply for the DOs	24VDC -/+20% Up to 1A, according to load reverse polarity protected	External supply voltage for digital outputs (DO1 and DO2) If necessary, bridge to 24V terminal	-
32 GND o	Reference potential for digital signals		External supply voltage for digital outputs (DO1 and DO2) If necessary, bridge to GND terminal	-
33 DO1	Digital output 1 [I/O CANopen DO1]	Low = 0V High: 24V Rated current: 500mA each	The digital outputs should be used with a separate 24V supply	P150 P175
34 DO2	Digital output 2 [I/O CANopen DO2]			P150 P175
35 GND o 36	Reference potential for digital signals		External supply voltage for digital outputs (DO1 and DO2) If necessary, bridge to GND terminal	-

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

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

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

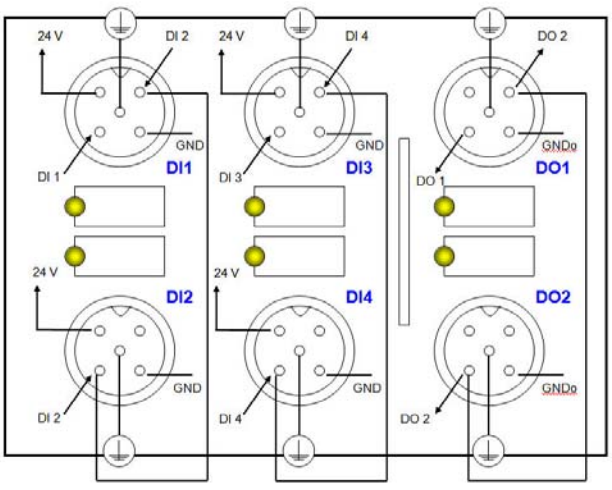
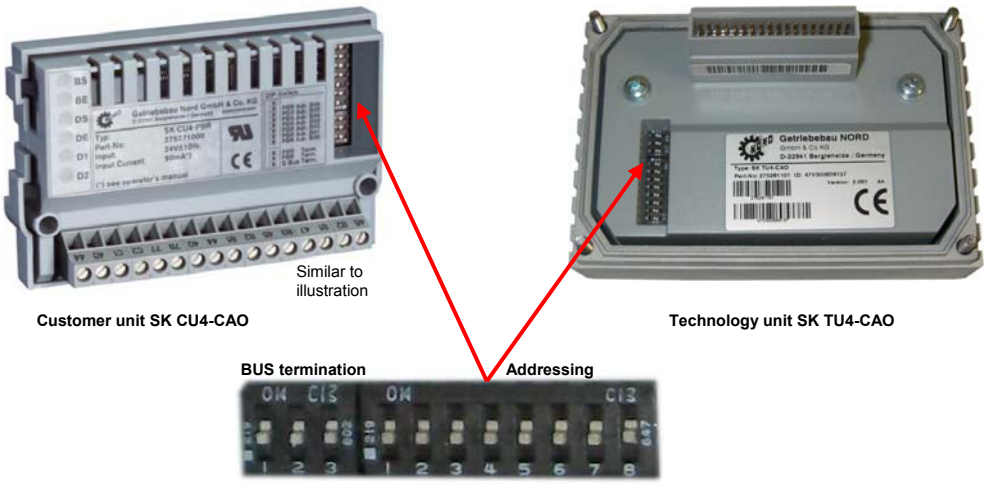


Illustration of wiring of M12 connector to SK TU4-...-M12

2.2.3 Configuration

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



DIP switch 3 + 8 part

Addressing

Note:

- CANopen address: setting only via DIP switch in binary code
- Address range: 1 … 63
- Address changes: only become effective after switching the BUS module off and on again

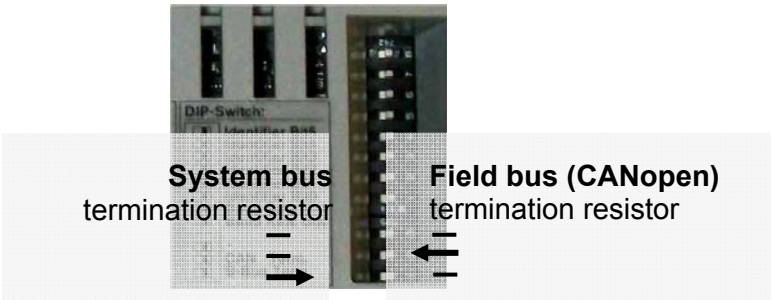
NOTE

If an application-specific configuration has been saved (memory object 1010_{hex}), the initialisation is not active after default mapping. In order to apply the new module ID settings, the configuration must be reset to the factory settings (Parameter **(P152)** or (Object 1011_{hex})) (See Section 4.7 “Saving the parameters”).

Termination resistor

The termination of the BUS system at both of its physical ends is carried out by connecting the relevant termination resistors (DIP switch).

CANopen module (view of DIP switch)



e.g.: SK CU4-CAO

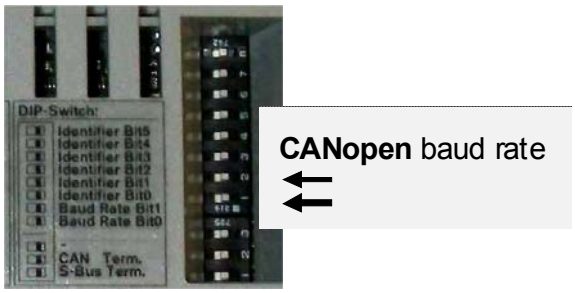
SK 200E (internal view)

e.g.: SK 200E

Baud rate

The baud rate is set in binary code via two DIP switches (only applies to field bus level).

Setting	Baud rate	DIP2	DIP1
1	125 kBaud	OFF	OFF
2	250 kBaud	OFF	ON
3	500 kBaud	ON	OFF
4	1 MBaud	ON	ON



E.g.: SK CU4-CAO

Configuration example

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

Area	Significance	DIP switch No.			DIP Switch ON - OFF	Configuration example	
Addressing	Identifier-bit 5	DIP switch No. 647	**8**	2^5		0	
	Identifier-bit 4		**7**	2^4		0	
	Identifier-bit 3		**6**	2^3		8	
	Identifier-bit 2		**5**	2^2		4	
	Identifier-bit 1		**4**	2^1		2	
	Identifier-bit 0		**3**	2^0		0	Example address = 14
Baud rate	Baud rate-bit 1		**2**	2^1		0	
	Baud rate-bit 0		**1**	2^0		0	Baud rate = 125kBaud
BUS termination	No significance	DIP switch No. 802	**3**	-		-	
	CANopen		**2**			OFF	
	System bus		**1**			ON	

3 Displays and diagnosis

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

Similar to illustration

CANopen module SK CU4-CAO
status **LEDs**

Similar to illustration

CANopen module unit SK TU4-CAO-M12 with SK TI4-TU-BUS and SK TIE4-WMK-TU

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

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

3.1 LED displays

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

A differentiation into 3 categories is made

- **Module** or module-specific displays (S and E or DS and DE)
- **CANopen**-specific displays (CR and CE)
- Status displays for the additional digital **I/Os** of the module (D1/2 or DI1...4 and DO1/2)

The possible displays differ according to the device.

3.1.1 Device-specific display versions

3.1.1.1 SK 200E frequency inverter

LED **S/E**

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

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

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

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

3.1.1.2 Customer unit SK CU4-CAO

LEDs **CR** and **CE**

The single-colour LEDs **CR(CANopen RUN)** and **CE (CANopen ERROR)** indicate the CANopen communication status.

Similar to illustration

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

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

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

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

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

3.1.1.3 Technology unit SK TU4□CAO(-M12)

LEDs **CR** and **CE**

The single-colour LEDs **CR(CANopen RUN)** and **CE (CANopen ERROR)** indicate the CANopen communication status.

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

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

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

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

These LEDs are only available in the CANopen module SK TU4-CAO-**M12**.

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

3.1.2 Signal status LEDs

This manual only describes the LED signal statuses of the CANopen modules. Information for the frequency inverter LEDs (SK 200E) can be found in the relevant manual (BU0200).

The statuses indicated by the LED can be read out with the aid of a parameterisation tool from Getriebebau Nord (NORDCON software ParameterBox) and also of course via the information parameter (P173) “Module Status” (See Section 5.2.3 "BUS module information parameters, general (P170)").

3.1.2.1 Module-specific displays

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

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

3.1.2.2 CANopen displays

The status of the CANopen module is indicated by the **CR** and **CE** LEDs.
CR (CANopen RUN) indicates the status of the CANopen bus status machine.
CR (CANopen ERROR) indicates the status of the CANopen bus state.

Displays of the CANopen bus status machine

LED (green) CR → **C**ANopen **R**UN	**Significance** ... Single flashing = (0.2s cycle) ... Double flashing (1.6s cycle, flashing interval 0.2s)
OFF	Module not in operation
ON	OPERATIONAL →"Normal operation" → complete reference data communication (PDO communication is "on")
Flashing (simple)	STOPPED → Only NMT communication possible (monitoring and initialisation functions)
Flashing (double)	PRE-OPERATIONAL →Restricted reference data communication → SDO communication is "on" → PDO mapping possible → PDO communication is "off"

CANopen bus status display

LED (red) CE → **C**ANopen **E**RROR	**Significance** ... Single flashing = (0.2s cycle) ... Double flashing (1.6s cycle, flashing interval 0.2s)
OFF	No error
ON	Bus OFF
Flashing (simple)	Bus Warning → No other subscribers present →No valid ID (DIP switch = 0) (See Section 2.2.3 "Configuration") → Bus error →Wiring faulty → Check cable length → Avoid spur cables
Flashing (double)	Timeout →A process data monitoring function has triggered → Node-guarding or → The time set in parameter (P151) has expired without new process data being received **Note:** The "node-guarding" error is reset by restarting the monitoring (remote).

3.1.2.3 I/O Displays

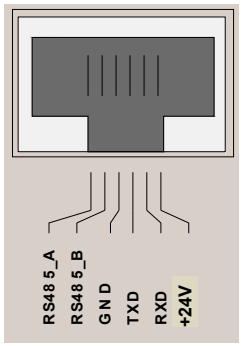
The status of additional digital inputs and outputs on the BUS module is indicated by corresponding LEDs (except for SK TU4-CAO(-C)).

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

3.2 RJ12 Diagnostic socket

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

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

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

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

NOTE

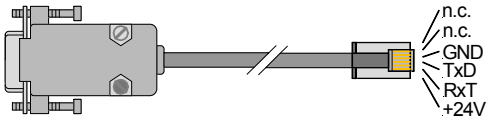
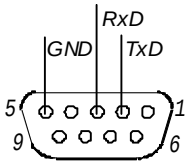
Simultaneous use of several diagnostic sockets with several diagnostic tools may lead to errors during communication. Therefore, only one diagnostic socket within a system bus network should be used.

ParameterBox SK PAR-3H

The ParameterBox **SK PAR-3H** is available as a diagnostic tool.

The necessary connecting cables are included in the scope of delivery of the ParameterBox. For a detailed description of use, please refer to Manual BU0040.

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

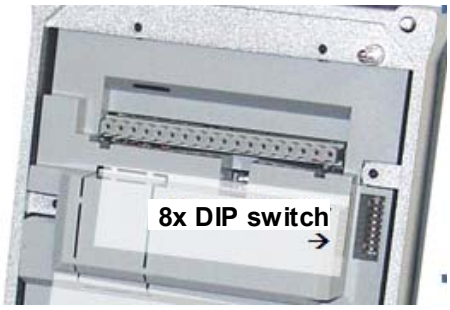
Terminal/ Designation	Function	Data	Description / wiring suggestion	Parameter
Accessory cable (optional) for PC connection				
Adapter cable RJ12 to SUB-D9	... for direct connection to a PC with NORD CON software	Length 3m Assignment RS 232 (RxD, TxD, GND) Part. No. 278910240	 Assignment of SUB-D9 connector: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

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

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

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

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



Underside of SK 200E

4 Commissioning

In addition to the electrical connection to the BUS system and the hardware configuration of the nodes, operation of a frequency inverter in a CANopen network also requires the definition of the various monitoring functions. For the operation of an SK 200E frequency inverter or the relevant BUS modules (SK xU4-CAO) in a CANopen network managed by an NMT master, the available objects are saved in an EDS file.

For the devices described in this manual, in addition to various freely configurable monitoring functions, Getriebebau Nord GmbH also enables pure process data communication (PDO) and communication via SDOs. With the aid of various parameters of the bus modules, participants can be individually adapted to a CANopen network. **However, for reasons of compatibility the default settings should be retained as far as possible.** For more simple applications the drive profile "Velocity Mode" from device profile DSP402 is available.

Sections 4.2 to 4.8 contain detailed explanations for the individual commissioning steps. Explanations for process data and examples are summarised in Section 7 "CANopen data transfer".

4.1 Quick commissioning

The bus modules SK xU4-CAO are designed so that for normal applications no software settings (mapping) on the BUS module are required for basic operation.

Commissioning therefore comprises the following steps

- Installation (see Section2.1.2 "Installing the Customer Unit SK CU4-CAO" and Section 2.1.3 "Installing the SK TU4-CAO Technology Unit")
- Connection (see Section 2.2 "Electrical connection")

NOTE

If possible, a separate 24V power supply should be used for each potential level (system bus, field bus, DOs) in order to minimise interference on the bus cables.

- Configuration (addressing and bus termination - via DIP switches) - (see Section 2.2.3 "Configuration")
- Integration of the EDS file into the control unit.
- After connection of the 24V supply voltage and a brief initialisation phase, the BUS module switches to "Pre-Operational" mode. Via the bus module, up to 4 frequency inverters can be accessed, each with one control word and up to 3 setpoints (in exchange with the status word and up to 3 actual values).
- The allocation of the functions for the setpoints and actual values is carried out on the relevant frequency inverter (e.g. SK 200E series). Here, the settings are made via parameter (P546) or (P543) (see frequency inverter manual BU0200).

The following optimisations are recommended

- Disabling of the transmission and reception channels for PDOs which are not required (reduces bus load) ((P160) or objects 0x1400 ... 0x1414 or 0x1800 ... 0x1804)

The following mapping (or re-parameterisation) is possible

- Enabling of PDO 5, in order to ensure access to the digital I/Os of the bus module.
  ((P160) or objects 0x1404 or 0x1804)
- Switching on the "Velocity Mode" to DS402 if control is to be carried out in Profile Mode.
  ((P168) or objects 0x6048, 0x6049)
- Adaptation of the inhibit and event time to optimise transmission by the PDOs
  ((P163) and (P164) or objects 0x1800 ... 0x1804)
- Setup of monitoring functions (Node monitoring - Guarding and Heartbeat)
  ((P166) and (P167) or objects 0x100C, 0x100D, 0x1017)

The following mapping (or re-parameterisation) is possible, but should only be carried out in exceptional cases
Change of the COB-ID of individual SDO and PDO objects
((P161) or objects 0x1005, 0x1200 … 0x1203, 0x1400 … 0x1404, 1800 … 1804)

NOTE

As there is a deviation from the CiA standard on changing the default settings, special care is required in order to prevent conflicts in the operation of the bus.

Access to the objects can be obtained by two methods.

- On the field bus level: Dynamic mapping (PDO mapping via SDOs)
- On the parameter level of the BUS module: ((P160)…(P168)) via NORDAC control elements (NORDCON software, ParameterBox SK PAR-3H)

NOTE

Changes are only permissible in "Pre-Operational" mode.

The following check list provides and overview for the commissioning of a relevant network.

Description	Designation	Relevant parameter	Comments
Necessary / required settings			
Hardware address			Different for each subscriber (node)
Bus node	CANopen identifier	DIP switch	
Frequency inverter	System bus address (CAN)	DIP switch (SK 200E)	alternative (P515)
Baud rate			Same for each subscriber (node)
Bus node	CANopen baud rate	DIP switch	
Frequency inverter	System bus baud rate	Fixed at 250kBaud (SK 200E)	Alternative (P514) (leave at 250kBaud!)
PDO pause time	Inhibit time	(P163)	
PDO transmission interval	Event time	(P164)	
Definition of process data (PZD)	STW / ZSW / SW / IW	(P502), (P503), (P509), (P510), (P546) (… or (P548))	alternative (P168) (profile DSP 402)
Additional settings			
PDO transmission type	PDO transmission type	(P162)	
CAN node monitoring	Guard-time and Heartbeat	(P166) and (P167)	
Validity of PDO/SDO	COB-ID On/Off	(P160)	
Setting only in special cases (if possible leave at factory setting)			
Definition of COB-ID	COB-ID	(P161)	
Definition of PZD mapping	PDO mapping	(P165)	

For a description of the individual objects please refer to Section 4.9 "Object dictionary".

4.2 EDS file

For CANopen masters which can be configured with a PC, Getriebebau Nord GmbH provides the necessary EDS file (Electronic Data Sheet) with the relevant CANopen objects for all relevant Nord products. These files are contained on the documentation CD, which is provided with the hardware. Updates on a daily basis are available on www.nord.com.

4.3 Hardware configuration of the CANopen bus modules

Configuration of the bus module is carried out exclusively via a DIP switch element attached to the module (see Section 2.2.3 "Configuration"). In addition to the baud rate and the node addresses (node identifiers) the termination resistors for the bus system and the CANopen bus must be set.

Software configuration if these items is not provided.

NOTE

The coding of the DIP switches (Identifier, address and baud rate) are only read out during the initialisation phase, i.e. after switching on the 24V power supply to the bus module. Changes to the DIP switches are therefore only recognised if the module has been switched off for a sufficient period (all LEDs out) after a change of addressing.

4.4 Gateway function

Up to four frequency inverters can be controlled via the bus module (see also Section 8.4 "System bus"). Each FI is allocated its own PDO channel for the process data. For parameterisation, each FI in the bus module has a separate allocated SDO channel. The allocation of the individual channels can be seen in the table in Section 4.9.1 "Predefined Connection Set".

4.5 Communication

After conclusion of the individual **initialisation phase**, all participants in a CANopen network can be set to one of three operational states.

According to the operational state:

- Subscribers can be configured via SDO messages (**Pre-Operational**),
- Can exchange process data via PDO messages (**Operational**) or
- Are disconnected from communication (**Stopped**), to the extent that only NMT messages can be communicated.

The coordination of the operating states is carried out on the basis of a very simple network management by an NMT master.

4.5.1 Network Management (NMT)

The individual states can be activated with the following commands:

Set network to Operational (Start Remote Node):
Identifier = 0x00 // data byte 0 = 0x01 // data byte 1 = 0x** (relevant node address)

Set network to Stopped (Stop Remote Node):
Identifier = 0x00 // data byte 0 = 0x02 // data byte 1 = 0x** (relevant node address)

Set network to Pre- Operational (Enter Pre - Operational):
Identifier = 0x00 // data byte 0 = 0x80 // data byte 1 = 0x** (relevant node address)

Reset Node :
Identifier = 0x00 // data byte 0 = 0x81 // data byte 1 = 0x** (relevant node address)

Reset Communication:
Identifier = 0x00 // data byte 0 = 0x82 // data byte 1 = 0x** (relevant node address)

4.5.2 PDO communication

If a subscriber is in an "Operational" state, it is able to exchange process data via PDO messages.

A differentiation is made between Transmit PDOs (Tx), in which the bus module transmits the status data of up to 4 connected frequency inverters, and Receive PDOs (Rx) in which it receives the relevant control data. The 4 Transmit and Receive PDOs are identified by different identifiers.

Transfer of PDOs is made without confirmation. The significance of the data transferred is determined by the CAN identifiers being used and the PDO mapping. A maximum of 8 bytes of data are transferred.

NOTE

In principle, no settings are required to ensure the correct functioning of communication, however various adaptations are possible if these are necessary for the communication sequence required by the customer.

All PDO settings can be made via the relevant parameter. However, parameterisation via the SDO parameter channel of the CANopen bus is also possible.

The settings which are made are permanently stored in the device.

4.5.2.1 Changing the COB-ID (address) of a PDO

Changes to the identifier of a PDO can only be made when the NMT status machine of the inverter is in the "Pre-Operational" state.

Setting of the COB-ID of a PDO is made via the parameters **(P160)** and **(P161)** (and therefore in the objects 0x1400-0x1404 Sub. 1 or 0x1800-0x1804 Sub. 1). If possible, the default settings of these parameters should be retained.

Alternatively, the settings can also be realised via the SDO parameter channel. Each Transmit and Receive PDO has its own parameter for this setting (see the following table).

PDO	Receive PDO	Transmit PDO
PDO for FI 1	0x1400 Sub 1	0x1800 Sub 1
PDO for FI 2	0x1401 Sub 1	0x1801 Sub 1
PDO for FI 3	0x1402 Sub 1	0x1802 Sub 1
PDO for FI 4	0x1403 Sub 1	0x1803 Sub 1
PDO for bus module	0x1404 Sub 1	0x1804 Sub 1

Index table for inverter Transmit and Receive PDOs

This parameter is a 32 bit value, which includes other information in addition to the identifier.

Bit number	Value	Significance
31	0	PDO is active
	1	PDO is switched off
30	1	Values cannot be changed
29 to 11	0	
10 to 0	X	PDO identifier (COB-ID)

Description of PDO COB-ID entry

The PDO identifier is stored in bits 0 to 10. Bit 31 must be set to null, otherwise the PDO will be deactivated. If, e.g. the identifier for a Transmit PDO is changed to 0x201, the value 0x40000201 must be entered in the appropriate parameter.

The new identifier becomes valid by setting the NMT status machine to the "Operational" state.

4.5.2.2 PDO operating modes (transmission type)

The "transmission type" determines when a transmit PDO is transmitted and when the data from a receive PDO is processed (see also Section 8.3.2.1 "PDO (Process Data Object)"). These settings are made in parameter **(P162)** (and therefore in objects 0x1400-0x1404 Sub. 2 for Rx -PDOs or 0x1800-0x1804 Sub. 2 for Tx -PDOs). The following settings can be made with NORDAC frequency inverters:

Transmission type	Value
Transmit PDO (Tx)	
0	PDO is transmitted if a SYNC command has been received and the data (status) has changed since the last SYNC command.
1-240	PDO is transmitted if 1..240 SYNC commands have been received, whether the data (status) has changed or not.
252-253	Reserved
254, 255	PDO is transmitted immediately if the data (status) has changed (standard setting).
Receive PDO (Rx)	
0-240	Data from the Receive PDO is only processed after the next SYNC command has been received.
252-253	Reserved
254, 255	Data from Receive PDO is processed immediately (standard setting)

4.5.2.3 Inhibit time

For each Transmit PDO an individual "Inhibit time" can be defined in **(P163)** (and therefore in objects 0x1800-0x1804 Sub. 3). This can be used to set a minimum transmission interval between two PDO messages. In networks with a large number of participants, the bus load can be influenced with this value. The standard setting is 10ms.

4.5.2.4 Event time

The Parameter "Event time" **(P164)** (and therefore objects 0x1800 – 0x1803 Subindex 5) can be used for all Transmit PDOs. Cyclical transmission of the PDOs is achieved via this value. The standard setting is 250ms.

4.5.2.5 PDO mapping

The sequence of the process data (PZD) in the PDOs is defined by the PDO mapping in parameter **(P165)** (and therefore in the objects 0x1600 - 0x1604 or 0x1A00 - 0x1A04). Changes to the PDO mapping are only permissible in the "Pre-Operational" state. The PDOs shown here correspond to the default setting.

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
Control word		Setpoint 1		Setpoint 2		Setpoint 3	
16 bit		32 bit (e.g. position setpoint)				16 bit	
Low byte	High byte	Low Low byte	Low High byte	High Low byte	High High byte	Low byte	High byte

The 16 and 32 bit process data must be transmitted in "Little Endian" format (Low byte - High byte).

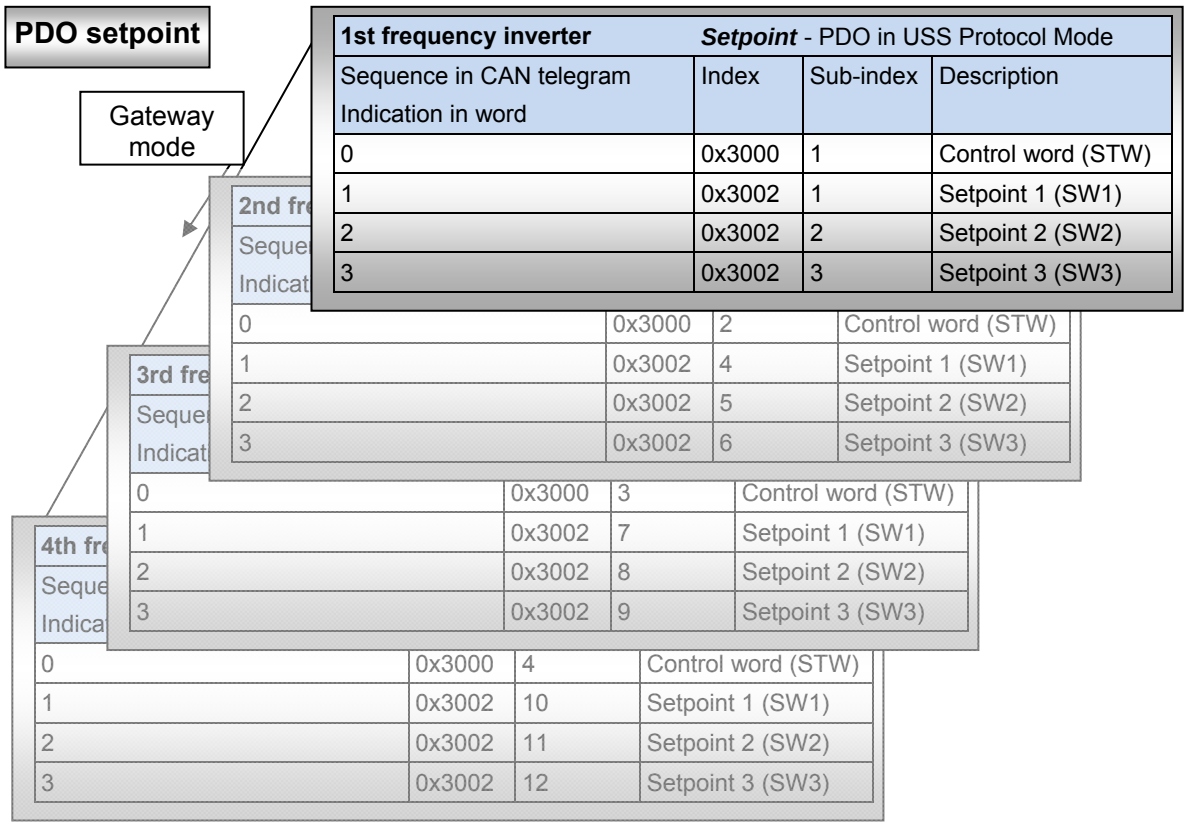
NOTE

The PDO structure for a frequency inverter is pre-defined. With the use of the associated EDS file, no adaptation for the exchange of data is necessary.

Due to mapping of the PDO with 16 bit width, so-called dummy mapping is not necessary.

4.5.2.6 PDO transmission / access in USS Protocol Mode

The internal status machine of the frequency inverter (USS) applies for the transfer of process data. Access to the individual frequency inverters is according to the following pattern (see Section 4.9.4 "Frequency inverter objects (2000hex - 3005hex)").



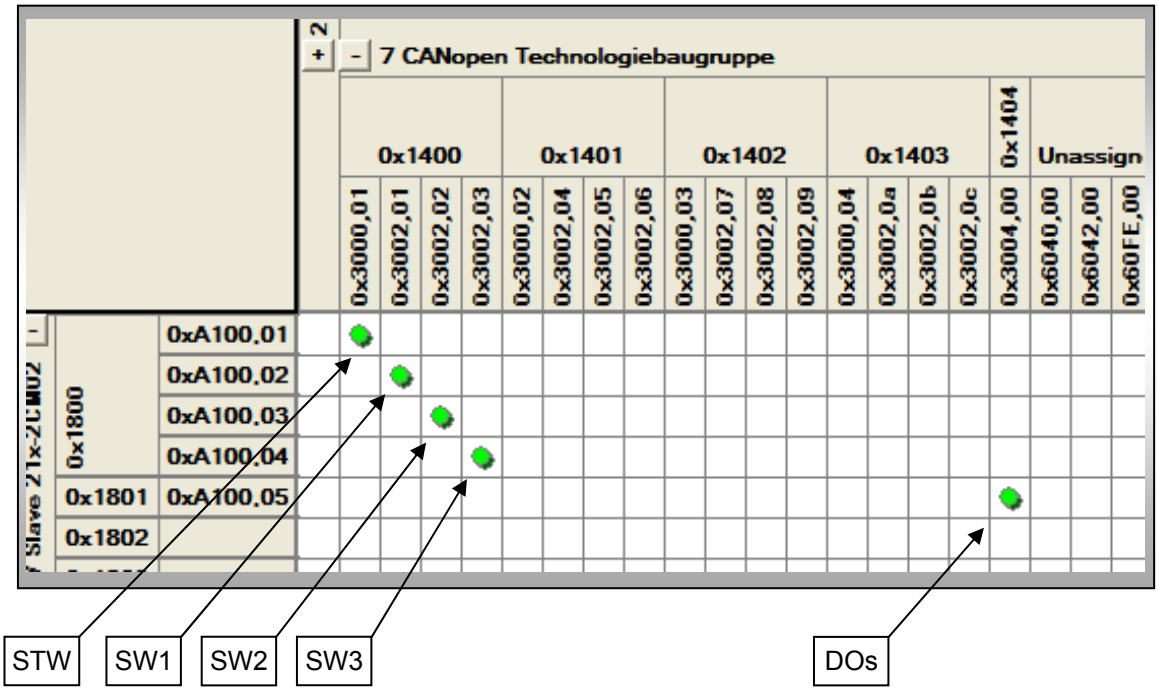
1st frequency inverter	*Setpoint* - PDO in USS Protocol Mode		
Sequence in CAN telegram Indication in word	Index	Sub-index	Description
0	0x3000	1	Control word (STW)
1	0x3002	1	Setpoint 1 (SW1)
2	0x3002	2	Setpoint 2 (SW2)
3	0x3002	3	Setpoint 3 (SW3)

2nd fr			
Seque			
Indicat			
0	0x3000	2	Control word (STW)
1	0x3002	4	Setpoint 1 (SW1)
2	0x3002	5	Setpoint 2 (SW2)
3	0x3002	6	Setpoint 3 (SW3)

3rd fre			
Seque			
Indicat			
0	0x3000	3	Control word (STW)
1	0x3002	7	Setpoint 1 (SW1)
2	0x3002	8	Setpoint 2 (SW2)
3	0x3002	9	Setpoint 3 (SW3)

4th fr			
Seque			
Indica			
0	0x3000	4	Control word (STW)
1	0x3002	10	Setpoint 1 (SW1)
2	0x3002	11	Setpoint 2 (SW2)
3	0x3002	12	Setpoint 3 (SW3)

In the following example of a VIPA control, the linking of the objects (control word and setpoint) of FI 1 to those of the CANopen master is illustrated.



Actual PDO value

Gateway mode

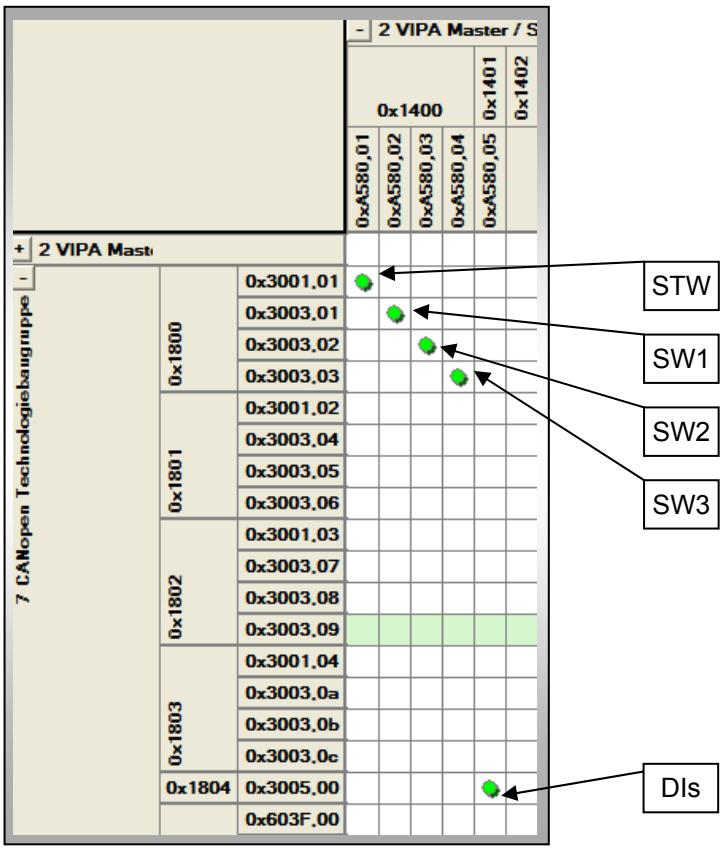
1st frequency inverter	***Actual value*** - PDO in USS Protocol Mode		
Sequence in CAN telegram Indication in word	Index	Sub-index	Description
0	0x3001	1	Status word (ZSW)
1	0x3003	1	Actual value 1 (IW1)
2	0x3003	2	Actual value 2 (IW2)
3	0x3003	3	Actual value 3 (IW3)

2nd fr Seque Indica			
0	0x3001	2	Status word (ZSW)
1	0x3003	4	Actual value 1 (IW1)
2	0x3003	5	Actual value 2 (IW2)
3	0x3003	6	Actual value 3 (IW3)

3rd fre Sequer Indicat			
0	0x3001	3	Status word (ZSW)
1	0x3003	7	Actual value 1 (IW1)
2	0x3003	8	Actual value 2 (IW2)
3	0x3003	9	Actual value 3 (IW3)

4th fre Sequer Indicat			
0	0x3001	4	Status word (ZSW)
1	0x3003	10	Actual value 1 (IW1)
2	0x3003	11	Actual value 2 (IW2)
3	0x3003	12	Actual value 3 (IW3)

In the following example of a VIPA control, the linking of the objects (status word and actual value) of FI 1 to those of the CANopen master is illustrated.



CANopen also enables direct access to the inputs and outputs of the BUS module. An example of the linking of the relevant objects in the control unit is shown in the illustrations above.

PDO setpoint

BUS module	***Setpoint*** - PDO in USS Protocol Mode			
Sequence in CAN telegram Indication in word	Index	Sub-index	Bit	Description
1	0x3004	0	0	Output 1
			1	Output 2

Actual PDO value

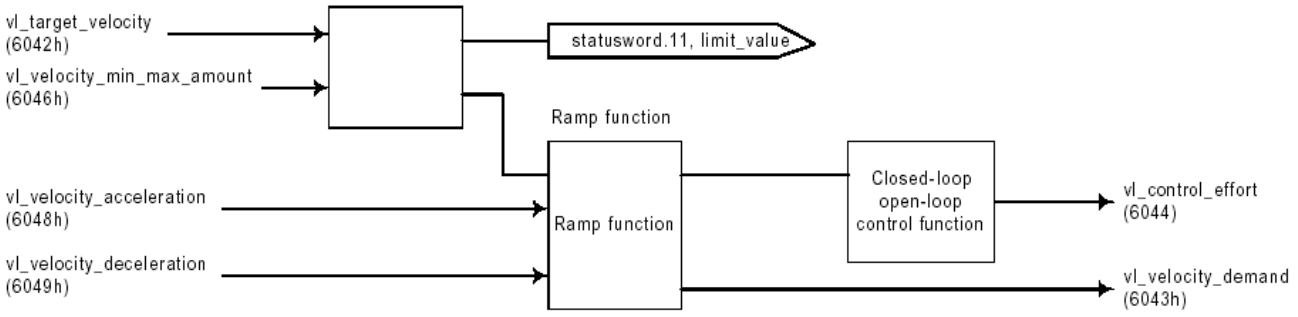
BUS module	***Actual value***- PDO in USS Protocol Mode			
Sequence in CAN telegram Indication in word	Index	Sub-index	Bit	Description
1	0x3005	0	0	Input 1
			1	Input 2
			2	Input 3
			3	Input 4

4.5.3 PDO communication in drive profile DS 402 ("Velocity Mode")

For more simple applications (only speed setpoints) the Velocity Mode in device profile DS 402 is available. For this, the profile must be activated in parameter (P168 [-01]) of the CANopen bus module SK xU4-CAO-… (corresponds to the default setting).

Activation of the profile affects all the frequency inverters on the system bus in the same way. The profile is only valid in parameter set 1.

The association of the objects in the drive profile Velocity Mode (Speed) can be seen from the following illustration.



Source: Velocity Mode CiA DSP 402 V1.1 page 178

For the transfer of process data in profile mode, the status engine is implemented according to the CANopen drive profile CiA DSP 402. In association with the drive profile, objects 0x6040 - 0x6044 are relevant instead of objects 0x3000 - 0x3004.

DS 402

PDO setpoint

Frequency inverter	***Setpoint*** - PDO in „Drive and Motion Control“		
Sequence in CAN telegram Indication in word	Index	Sub-index	Description
0	0x6040	0	Status word
1	0x6042	0	Setpoint speed value

Actual PDO value

Frequency inverter	***Actual value*** - PDO in "Drive and Motion Control"		
Sequence in CAN telegram Indication in word	Index	Sub-index	Description
0	0x6041	0	Status word
1	0x6044	1	Actual speed value

Illustration in the tables: Association with FI 1 – 4, bus modules DI/Os 0x60... parameter P168, P165, dynamic mapping.

In this mode the digital inputs and outputs can only be mapped into the PDO via the objects 0x60FD and 0x60FE (see Section 4.9.3 "CANopen objects DSP402 – drive profile").

4.5.4 SDO communication

In order to exchange parameter data, the participants can communicate via SDOs.

In order to access the various frequency inverters in Gateway mode (see Section 4.9.1 "Predefined Connection Set") the SDOs must be enabled. Enabling of the relevant SDO channels is made via parameter (P160) of the CANopen technology unit.

4.5.4.1 Dynamic PDO mapping

The technology units SK xU4-CAO-... support so-called "Dynamic PDO mapping". This means that the information content of the PDOs can be changed. Mapping of the PDOs is not necessarily carried out by means or NORD parameterisation tools (NORDCON software or ParameterBox SK PAR-3H), but can also be performed directly via the CANopen protocol with the aid of SDOs. A detailed example of this is described in Section 7.4.2.3 "Application-specific mapping".

4.5.4.2 Structure of SDO telegrams

Access to all parameters of the frequency inverters connected to a common system bus is carried out via so-called service data objects (SDO). Access is via handshake between client and server, i.e. after a message is transmitted, the response must be waited for before a new message can be sent.

Only one TxSDO and one RxSDO are assigned to each frequency inverter in the object data set of the associated field bus module SK xU4-CAO-... As delivered, only the SDO for the frequency inverter FI 1 is enabled in the bus module. All further frequency inverters (FI 2 ... FI 4) these must be enabled as required via parameter (P160 [-03] ... [-05].

The node ID of the CANopen BUS Module is set via its DIP switch (see Section 2.2.3 "Configuration"). The Transmit and Receive IDs of the frequency inverters connected to this system bus result from the node ID and the system bus address of the frequency inverter.

Transmit and receive addresses for SDO access as seen from the PLC:

$$Transmit\ ID = 0x600 + Node\ ID$$

$$Receive\ ID = 0x580 + Node\ ID$$

The definition of addresses is summarised in Section 4.9.1 "Predefined Connection Set".

An SDO telegram is divided into a configuration area and a data area. "Little Endian" format is also used for SDOs.

	Configuration area			Data area			
Control byte	**Index**		**Sub-index**	**Data**			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
E.g.: "Download"	E.g.: "Parameter number"		E.g.: "Array"	E.g.: "Parameter values"			
Byte	Low byte	High byte	Byte	Low Low byte	Low High byte	High Low byte	High High byte

4.5.4.3 Transmitting parameter data via SDO

Transmission of an SDO on the bus is as follows:

Transmit an 8 bit value (0x100d Sub 00 / Data = 10)

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x2f	0x0d	0x10	0x00	0x0a	0x00	0x00	0x00

Transmitting a 16 bit value (0x1800 Sub 03 / Data = 100)

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x2b	0x00	0x18	0x03	0x64	0x00	0x00	0x00

Transmitting a 32 bit value (0x1801 Sub 01 / Data = 0x40000282)

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x23	0x01	0x18	0x01	0x82	0x02	0x00	0x40

The response for an error-free telegram is =x60 in Byte 0. Other responses indicate an error (see Section 4.5.4.5 "Cancelling of parameter communication").

4.5.4.4 Loading parameter data via SDO

The request of an SDO via the bus is as follows.

Load a 16 bit value (0x1800 Sub 03)

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x40	0x00	0x18	0x03	0x00	0x00	0x00	0x00

Response (0x1800 Sub 3 = 1000)

Status byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x4b	0x00	0x18	0x03	0xe8	0x03	0x00	0x00

Load a 32 bit value (0x1800 Sub 01)

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x40	0x00	0x18	0x01	0x00	0x00	0x00	0x00

Response (0x1800 Sub 1 = 0x40000182)

Status byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x43	0x00	0x18	0x01	0x82	0x01	0x00	0x40

If the query is faulty, the response in byte 0 = 0x80.

4.5.4.5 Cancelling of parameter communication

If problems occur during parameter communication (e.g. value range overflow), a cancel telegram is sent. This can be recognised by the number 0x80 in byte 0. The cause of the cancellation is indicated in bytes 4 to 7.

Status byte	Last index used			Error code			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x80	0x00	0x18	0x01	0x02	0x00	0x01	0x06

Example of error message (0x06010002 = Access to read-only object)

A list of all possible error codes is contained in Section 4.9.5 "Error codes – cancellation of parameter communication"

4.6 Timeout monitoring

Various timeout monitoring modules can be defined. Details of these are described in Section 6.1.1 "Error monitoring details".

4.7 Saving the parameters

If the CANopen bus module is accessed via RS232 (e.g. via NORDCON software or the ParameterBox), the parameter changes are saved in the EEPROM immediately. Loading of the factory settings can be carried out via parameter (P152).

For changes to module parameters via the CANopen bus, 0x1010 Subindex 1 is used to save the parameter. Restoration of default values is possible via 0x1011 Subindex 1.

4.8 Special features of CANopen communication

The DSP402 drive profile is only implemented in the field bus modules (SK xU4-CAO).

Broadcast operation is not possible via the CANopen field bus modules (SK xU4-CAO). This can only take place directly between the frequency inverters at system bus level or with direct connection of the frequency inverter to the CANopen field bus.

4.9 Object dictionary

The object dictionary describes the complete functionality of the CANopen devices and is organised in the form of a table (see also the table in Section 7.2 "Structure of reference data"). In addition to standardised data types and objects of the CANopen communication profile, this dictionary also contains the device profiles of Nord product-specific objects (inverter and module parameters). Addressing is performed via a 16 bit index (row address of the table) and an 8 bit subindex (column address of the table).

Index (hex)	Object
0000	Not used
0001 - 001F	Statistical data types
0020 - 003F	Complex data types
0040 - 005F	Data types specific to manufacturer
0060 - 007F	Statistical data types specific to profile
0080 - 009F	Statistical data types specific to profile
00A0 - 0FFF	Reserved
1000 - 1FFF	Communication profile (DS-301)
2000 - 5FFF	Parameters specific to manufacturer (Nord product-specific parameters)
6000 - 9FFF	Parameters from standardised device profiles (DSP-402)
A000 - FFFF	Reserved

All available objects are contained in the “Electronic data sheet” (eds file) of the NORDAC frequency inverter or the SK xU4-CAO-...-BUS module.

4.9.1 Predefined Connection Set

The bus module is equipped with 5 Transmit and Receive PDOs and 4 SDO channels.

The Predefined Connection Set of the CANopen standard DS301 does not provide so many PDO and SDO channels. Therefore there is a danger of address conflicts with devices which use the Predefined Connection set defined in DS301. In order to keep this danger as small as possible, the additional channels are divided into the address space (Node-ID) 64 to 127.

The following table contains the Predefined Connection Set for the bus modules SK xU4-CAO-... . With these default settings (see also parameter (P161) “COB-ID” and (P160) for the validity of the COB-ID) an exchange of process data to all 4 frequency inverters connected to the system bus (Gateway Mode) is possible.

In order to implement communication via SDOs, the relevant arrays must be enabled in parameter (P160).

Object	Availability	COB-ID	Accessed FI
NMT	Enabled	0	FI 1, FI 2, FI 3, FI 4 and bus module
SYNC	Enabled	0x80	FI 1, FI 2, FI 3, FI 4 and bus module
EMERGENCY	Enabled	0x80 + Address	FI 1, FI 2, FI 3, FI 4 and bus module
PDO1 (Tx)	Enabled	0x180 + Address	FI 1
PDO1 (Rx)	Enabled	0x200 + Address	FI 1
PDO2 (Tx)	Enabled	0x280 + Address	FI 2
PDO1 (Rx)	Enabled	0x300 + Address	FI 2
PDO3 (Tx)	Enabled	0x380 + Address	FI 3
PDO3 (Rx)	Enabled	0x400 + Address	FI 3
PDO4 (Tx)	Enabled	0x480 + Address	FI 4
PDO4 (Rx)	Enabled	0x500 + Address	FI 4
PDO5 (Tx)	Disabled	0x1C0 + Address	Bus module
PDO5 (Rx)	Disabled	0x240 + Address	Bus module
SDO1 (Tx)	Enabled	0x580 + Address	FI 1, bus module
SDO1 (Rx)	Enabled	0x600 + Address	FI 1, bus module
SDO2 (Tx)	Disabled	0x2C0 + Address	FI 2
SDO2 (Rx)	Disabled	0x340 + Address	FI 2
SDO3 (Tx)	Disabled	0x3C0 + Address	FI 3
SDO3 (Rx)	Disabled	0x440 + Address	FI 3
SDO4 (Tx)	Disabled	0x4C0 + Address	FI 4
SDO4 (Rx)	Disabled	0x540 + Address	FI 4
NMT Error Control	Enabled		FI 1, FI 2, FI 3, FI 4 and bus module

ATTENTION

For devices from other manufacturers, CAN addresses (Node-ID) higher than 64 should be used with caution, as they could be occupied by CANopen bus modules:

Additionally occupied Node-ID = Node-ID (bus module) + 64.

4.9.2 CANopen profile DS301

The available objects are defined according to communication profile DS301.

4.9.2.1 Communication objects (1000_{hex} - 1200_{hex})

Index	Sub	Object	Description	Unit	Access	Type
0x1000	0	Device type	Device type and functionality		RO	U32
0x1001	0	Error register	The Error Register is set to 1 (=generic error) if one of the connected frequency inverters is in an error state. In addition, it is monitored whether a registered inverter goes missing. In this case, this register will also be set.		RO	U8
0x1002	0	Status register	Status of the module		RO	U32
0x1003	ARR	Pre-defined error	Error signaled by an emergency object			U8
	0	Number of errors	Number of errors; 0 deletes the error list		RW	U8
	1	Error code	Error number		RO	U32
0x1005	0	COB-ID SYNC	Identifier for SYNC messages (default 80h) **(see parameter (P161 [-01]))**		RW	U32
0x1008	0	Device name	Device name		RO	STR
0x1009	0	Hardware version	Hardware version		RO	STR
0x100A	0	Software version	Software version FI+CO		RO	STR
0x100C	0	Guard time	Guard time (0=off) **(see parameter (P166 [-01]))**	ms	RW	U16
0x100D	0	Life time factor	Life time = Life time factor * Guard time **(see parameter (P167))**		RW	U8
0x1010	0	Store parameters	With this object it is possible to permanently save settings made by the user. To do this, the signature “Save“ (lower case letters ASCII – MSB - 0x65 76 61 73 - LSB) must be written in Index 0x1010 Sub-index 1. The saving process runs in the background and is confirmed with an SDO response telegram. Caution: If the module ID is changed with the DIP switches after saving a configuration, the saved configuration will still be used. The default mapping is restored with the object 0x1011.		RW	U32
0x1011	0	Restore default parameters	With this object it is possible to restore parameters saved by the user to the default settings. By writing the signature "load" (lower case letters ASCII - MSB 0x64 0x61 0x6F 0x6C LSB) in Index 0x1011 Sub-index 1, the standard factory settings will be loaded after the following Power ON and every other Power ON (until the next SAVE command). **(see parameter (P152))**		RW	U32
0x1014	0	COB-ID Emergency Object	Identifier Emergency Object (80h+Node-ID)		RO	U32
0x1015	0	Inhibit time EMCY	Minimum repeat time	ms	RW	U16
0x1017	0	Producer Heartbeat time	Cycle time of the heartbeat function **(see Parameter (P166 [-02]))**	ms	RW	U16
0x1018	REC	Identity object	General device information			U32
	0	Largest sub-index	Number of elements		RO	U8
	1	Vendor ID	CiA-listed manufacturer code		RO	U32
	2	Product code	Device version (product number)		RO	U32
	3	Revision number	Software version and revision number (2x16 bit)		RO	U32

Index	Sub	Object	Description	Unit	Access	Type
	4	Serial number	Serial number		RO	U32
0x1200	REC	Default server SDO	Server SDO			
	0	Largest sub-index	Number of elements		RO	U8
	1	COB-ID Server>Client (rx)	Identifier of Receive SDO (600h+ID) SDO for FI 1 and the bus module **(see parameter (P161 [-03]))**		RO	U32
0x1200	2	COB-ID Server>Client (tx)	Identifier of Receive SDO (580+ID) SDO for FI 1 and the bus module **(see parameter (P161 [-03]))**		RO	U32
0x1201- 0x1203	Rec, 0		See above (0x1200)			
0x1201	1	COB-ID Server>Client (rx)	Identifier of Receive SDO (340h+ID) SDO for FI 2 **(see parameter (P161 [-05]))**		RW	U32
	2	COB-ID Server>Client (tx)	Identifier of Transmit SDO (2C0h+ID) SDO for FI 2 **(see parameter (P161 [-04]))**		RW	U32
0x1202	1	COB-ID Server>Client (rx)	Identifier of Receive SDO (440h+ID) SDO for FI 3 **(see parameter (P161 [-07]))**		RW	U32
	2	COB-ID Server>Client (tx)	Identifier of Transmit SDO (3C0h+ID) SDO for FI 3 **(see parameter (P161 [-06]))**		RW	U32
0x1203	1	COB-ID Server>Client (rx)	Identifier of Receive SDO (540h+ID) SDO for FI 4 **(see parameter (P161 [-09]))**		RW	U32
	2	COB-ID Server>Client (tx)	Identifier of Transmit SDO (4C0h+ID) SDO for FI 4 **(see parameter (P161 [-08]))**		RW	U32

4.9.2.2 PDO objects (1400_{hex} - $1A04_{hex}$)

Index*	Sub	Object	Description	Unit	Access	Type
0x1400-0x1404	REC	Receive PDO communication parameter	Receive PDO characteristics		RW	
	0	Largest sub-index	Number of elements		RO	U8
	1	COB-ID used by PDO	Receive PDO identifier **(see parameter (P161 [-11,-13,-15,-17,-19]))**		RW	U32
	2	Transmission type	Receive PDO type (see Section 4.5.2.2 "PDO operating modes (transmission type)") **(see parameter (P162 [-02,-04,-06,-08,-10]))**		RW	U8
	3	Not used	Not used		-	-
	4	Reserved	Reserved		-	-
	5	Not used	Not used		-	-
0x1600-0x1604	REC	Receive PDO mapping parameter	Receive PDO mapping (see Section 4.5.2.5 "PDO mapping")		RW	
	0	Largest sub-index	Number of elements		RO	U8
0x1600-0x1603	1-4	PDO mapping	Mapped objects (FI 1 … FI 4) **(see parameter (P165 [-05 … -08], (P165 [-13 … -16], (P165 [-21 … -24], (P165 [-29 … -32])**		RW	U32
0x1604	1	PDO mapping	Bus module **(see parameter (P165 [-34])**		RW	U32
0x1800-0x1804	REC	Transmit PDO communication parameter	Transmit PDO characteristics		RW	
	0	Largest sub-index	Number of elements		RO	U8
	1	COB-ID used by PDO	Receive PDO identifier **(see parameter (P161 [-10,-12,-14,-16,-18]))**		RW	U32
	2	Transmission type	Transmit PDO type (see Section 4.5.2.2 "PDO operating modes (transmission type)") **(see parameter (P162 [-01,-03,-05,-07,-09]))**		RW	U8
	3	Inhibit time	Minimum transmission time **(see parameter (P163 [-01 … -05]))**	100µs	RW	U16
	4	Reserved	Reserved		-	-
	5	Event timer	Cyclical transmission timer **(see parameter (P163 [-01 … -05]))**	ms	RW	U16
0x1A00-0x1A04	REC	Transmit PDO mapping parameter	Receive PDO mapping (see Section 4.5.2.5 "PDO mapping")		RO	
	0	Largest sub-index	Number of elements		RW	U8
0x1A00-0x1A03	1-4	PDO mapping	Mapped objects (FI 1 ... FI 4) **(see parameter (P165 [-01 … -04], (P165 [-12 … -15], (P165 [-20 … -23], (P165 [-28 … -31])**		RW	U32
0x1A04	1	PDO mapping	Bus module **(see parameter (P165 [-33])**		RW	U32

* xx00 hex = FI1, xx01 hex = FI2, xx02 hex = FI3, xx03 hex = FI4, xx04 hex = Bus module

4.9.3 CANopen objects DSP402 – drive profile

From the device profile DS402, the operating mode "Velocity Mode" is supported by the CANopen modules SK xU4-CAO(-...). In order to use this drive profile, the operating mode "Profile" must be switched on in parameter (P168 [-01]) and the PDOs mapped to the objects used (e.g. 0x6040 + 0x6042 RxPDO and 0x6041 + 0x6044 TxPDO) In this operating mode the digital inputs and outputs of the bus module can only be mapped in the PDO via the objects 0x60FD and 0x60FE. Direct processing of these I/Os via the connected frequency inverter(s) is not possible.

Index	Sub	Object	Description	Unit	Access	Type
0x603F	0	Error code	Last error		RO	U16
0x6040	0	Control word	Control word 0 = Standby / Shut down 1 = Disable voltage / Enable voltage 2 = Rapid stop / Enable operation 3 = Enable / Disable operation 4 = Rapid stop / No rapid stop 5 = Stop run-up encoder / Enable run-up encoder 6 = Disable / Enable setpoint 7 = 0 / Acknowledge fault 8 = Reserved 9 = Reserved 10 = Reserved 11 = Rotation right / Rotation left 12 = Reserved 13 = Reserved 14 = Reserved 15 = Reserved		RW	U16
0x6041	0	Status word	Status word 0 = Not on standby /Standby 1 = Not ready / Ready 2 = Operation disabled / Enabled 3 = No fault / Fault 4 = Voltage enabled / Voltage disabled 5 = Rapid stop active / No rapid stop 6 = No switch-on lock / Switch-on lock 7 = No warning / Warning 8 = Reserved 9 = Local control / Bus control 10 = Setpoint not reached / Setpoint reached 11 = Setpoint not limited / Setpoint limited *12 = Reserved* *13 = Reserved* *14 = Reserved* *15 = Reserved*		RO	U16
0x6042	0	Vl_target_velocity	Speed setpoint	rpm	RW	I16
0x6043	0	Vl_velocity_demand	Speed setpoint after ramp	rpm	RO	I16
0x6044	0	Vl_control_effort	Actual speed value	rpm	RO	I16
0x6046		Vl_velocity_min_max_amount				
	0	Largest sub-index	Number of elements		RO	U8
	1	Vl_velocity_min_amount	Min. speed	rpm	RW	U32
	2	Vl_velocity_max_amount	Max. speed	rpm	RW	U32
0x6048		Vl_velocity_acceleration	Speed acceleration			
	0	Largest sub-index	Number of elements		RO	U8
	1	Delta_speed	Delta speed **(see Parameter (P168 [-02, -06, -10, -14]))**	rpm	RW	U32
	2	Delta_time	Delta time **(see Parameter (P168 [-03, -07, -11, -15]))**	S	RW	U16

Index	Sub	Object	Description	Unit	Access	Type
0x6049		VI_velocity_deceleration	Speed deceleration			
	0	Largest sub-index	Number of elements		RO	U8
	1	Delta_speed	Delta speed **(see parameter (P168 [-04, -08, -12, -16]))**	rpm	RW	U32
	2	Delta_time	Delta time **(see parameter (P168 [-05, -09, -13, -17]))**	S	RW	U16
0x60FD		Digital inputs profile PDO data (00 0X 00 00)	0…15 = Reserved 16 = Digital input 1 (ext. + int. modules) 17 = Digital input 2 (ext. + int. modules) 18 = Digital input 3 (ext. modules) 19 = Digital input 4 (ext. modules) 20…31 = Reserved		RO	U32
0x60FE		Digital outputs profile	0…15 = Reserved 16 = Digital output 1 (ext. modules) 17 = Digital output 2 (ext. modules) 18…31 = Reserved		RW	U32

4.9.4 Frequency inverter objects (2000_{hex} - 3005_{hex})

Index	Sub	Object	Description	Unit	Acc	Type
0x2000- 0x23E7	-	FI parameter	FI parameter			
			(see parameter (P165)):			
0x3000	0	Largest Subindex	Number of control word elements		RO	U8
0x3000	1	Control word	Control word (STW) FI 1		RW	U16
0x3000	2	Control word	Control word (STW) FI 2		RW	U16
0x3000	3	Control word	Control word (STW) FI 3		RW	U16
0x3000	4	Control word	Control word (STW) FI 4		RW	U16
0x3001	0	Largest Subindex	Number of status word elements		RO	U8
0x3001	1	Status word	Status word (ZSW) FI 1		RO	U16
0x3001	2	Status word	Status word (ZSW) FI 2		RO	U16
0x3001	3	Status word	Status word (ZSW) FI 3		RO	U16
0x3001	4	Status word	Status word (ZSW) FI 4		RO	U16
0x3002	0	Largest Subindex	Number of setpoint elements		RO	U8
0x3002	1	Setpoint 1	Setpoint 1 (SW1) FI 1		RW	U16
0x3002	2	Setpoint 2	Setpoint 2 (SW2) FI 1		RW	U16
0x3002	3	Setpoint 3	Setpoint 3 (SW3) FI 1		RW	U16
0x3002	4	Setpoint 1	Setpoint 1 (SW1) FI 2		RW	U16
0x3002	5	Setpoint 2	Setpoint 2 (SW2) FI 2		RW	U16
0x3002	6	Setpoint 3	Setpoint 3 (SW3) FI 2		RW	U16
0x3002	7	Setpoint 1	Setpoint 1 (SW1) FI 3		RW	U16
0x3002	8	Setpoint 2	Setpoint 2 (SW2) FI 3		RW	U16
0x3002	9	Setpoint 3	Setpoint 3 (SW3) FI 3		RW	U16
0x3002	10	Setpoint 1	Setpoint 1 (SW1) FI 4		RW	U16
0x3002	11	Setpoint 2	Setpoint 2 (SW2) FI 4		RW	U16
0x3002	12	Setpoint 3	Setpoint 3 (SW3) FI 4		RW	U16
0x3003	0	Largest Subindex	Number of actual value elements		RO	U8
0x3003	1	Actual Value 1	Actual value 1 (IW1) FI 1		RO	U16
0x3003	2	Actual Value 2	Actual value 2 (IW2) FI 1		RO	U16
0x3003	3	Actual Value 3	Actual value 3 (IW3) FI 1		RO	U16
0x3003	4	Actual Value 1	Actual value 1 (IW1) FI 2		RO	U16
0x3003	5	Actual Value 2	Actual value 2 (IW2) FI 2		RO	U16
0x3003	6	Actual Value 3	Actual value 3 (IW3) FI 2		RO	U16
0x3003	7	Actual Value 1	Actual value 1 (IW1) FI 3		RO	U16
0x3003	8	Actual Value 2	Actual value 2 (IW2) FI 3		RO	U16
0x3003	9	Actual Value 3	Actual value 3 (IW3) FI 3		RO	U16
0x3003	10	Actual Value 1	Actual value 1 (IW1) FI 4		RO	U16
0x3003	11	Actual Value 2	Actual value 2 (IW2) FI 4		RO	U16
0x3003	12	Actual Value 3	Actual value 3 (IW3) FI 4		RO	U16
0x3004	0	Digital outputs	Control of digital outputs		RW	U16
0x3005	0	Digital inputs	Status of digital inputs		RO	U16

4.9.5 Error codes – cancellation of parameter communication

The following table gives an overview of the possible error codes which may be generated on cancellation of parameter communication.

Error code	Description
0x0503 0000	Toggle bit unchanged
0x0504 0000	SDO timeout message
0x0504 0001	Client/Server command invalid / unknown
0x0504 0005	No memory
0x0601 0000	Illegal access to an object
0x0601 0001	Access to write-only parameter
0x0601 0002	Access to read-only object
0x0602 0000	Object does not exist in object dictionary
0x0604 0041	Object cannot be mapped in PDO
0x0604 0042	Object exceeds PDO length
0x0604 0043	Parameter incompatibility
0x0604 0047	Module internally incompatible
0x0606 0000	Access failure due to hardware error
0x0607 0010	Data type or parameter length do not match
0x0607 0012	Data type incorrect, parameter length too long
0x0607 0013	Data type incorrect, parameter length too short
0x0609 0011	Sub-Index of parameter does not exist
0x0609 0030	Parameter value range overflow
0x0609 0031	Parameter value range overflow
0x0609 0032	Parameter value range undershot
0x0800 0020	Data transfer or storage not possible
0x0800 0021	Data transfer or storage not possible; reason: local control

4.9.6 Error messages (EMCY message)

The following error groups are defined in the communication profile DS-301.

Error Code (hex)	Significance
00xx	No error
10xx	Undefined error type
20xx	Current error
30xx	Voltage error
40xx	Temperature error
50xx	Hardware error
60xx	Software error
70xx	Additional module
80xx	Communication
90xx	External error
FF00	Specific to device

The allocation of special error codes for Nord inverters is carried out as follows:

Error code	FI error number (corresponds to (P700))	Explanation
0x1000	---	The error number transmitted by FI is not known to the technology unit. It must be read out via (P700) or an actual value.
0x4210	1.0 / 1.1	Meaning: see frequency inverter manual.
0x4310	2.0 / 2.1 / 2.2	
0x2310	3.0	
0x7112	3.1	
0x2311	3.2	
0x2312	3.3	
0x2200	4.0 / 4.1	
0x3210	5.0	
0x3110	5.1	
0x3230	6.0	
0x3120	6.1	
0x3130	7.0	
0x6310	8.0	
0x5530	8.1 / 8.2	
0x8100	10.0 / 10.1 / 10.2	
0x8111	10.3 / 10.4 / 10.5 / 10.6 / 10.7 / 10.9	
0x5000	10.8	
0x5110	11.0	
0x9000	12.0	
0x7305	13.0	
0x8400	13.1	
0x8300	13.2	
0x7120	16.0 / 16.1	
0x5300	17.0	
0x7120	18.0	
0x7120	19.0	
0x5510	20.0	
0x6000	20.1 / 20.2 / 20.3 / 20.4 / 20.5 / 20.6 / 20.7	
0x5520	20.8	
0x6000	20.9 / 21.0 / 21.1 / 21.2 / 21.3	
0x8110	---	CAN reception overflow (message lost)
0x8111	---	CAN reception overflow (message lost)
0x8120	---	Passive CAN error
0x8130	---	CAN Guarding / Heartbeat error detected
0x8210	---	PDO length error
0x8220	---	PDO length error (too long)

5 Parameterisation

In order to enable communication via CANopen, the frequency inverter and the CANopen Technology Unit must be parameterised accordingly.

With the CANopen protocol, the inverter parameters are mapped in the range above 2000_{hex} i.e. for parameterisation via the bus, 2000_{hex} must be added to the parameter numbers (e.g. (P508): 508_{dez} = $1FD_{hex}$ → 2000_{hex}+$1FD_{hex}$=$21FD_{hex}$).

5.1 Parameterising the SK 200E frequency inverter

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

5.1.1 Basic parameters (P100)

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

5.1.2 Control terminal parameters (P400)

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

0 ... 72

{ [-01] = 01 }

{ [-02] = 02 }

{ [-03] = 04 }

{ [-04] = 05 }

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

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

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

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

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

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

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

Except...

Value	Function	Description	Signal
00	No function	Input switched off.	---
... **14** [1] **...**	Remote control	With bus system control, low level switches the control to control via control terminals.	High

[1] Also effective for bus control (RS232, RS485, CANbus, CANopen, DeviceNet, Profibus, InterBus, AS-Interface)

Parameter {Factory setting}		Setting value / Description / Note	Device	Supervisor	Parameter set
P480	**... [-01]** **...** **... [-12]**	**Function bus I/O In Bits**			

0 ... 72

{ [-01] = 01 }

{ [-02] = 02 }

{ [-03] = 05 }

{ [-04] = 12 }

{ [-05...-12] = 00 }

The bus I/O In Bits are perceived as digital inputs. They can be set to the same functions (P420).

These I/O bits can also be used in combination with the AS Interface (SK 225E or SK 235E) or the I/O extension (SK CU4-IOE or SK TU4-IOE).

... [-01] = Bus I/O In Bit 0

... [-02] = Bus I/O In Bit 1

... [-03] = Bus I/O In Bit 2

... [-04] = Bus I/O In Bit 3

... [-05] = Bus I/O In Bit 4

... [-06] = Bus I/O In Bit 5

... [-07] = Bus I/O In Bit 6

... [-08] = Bus I/O In Bit 7

... [-09] = Flag 1

... [-10] = Flag 2

... [-11] = Bit 8 BUS control word

... [-12] = Bit 9 BUS control word

The possible functions for the bus In bits can be found in the table of functions for the digital inputs in parameter (P420).

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

5.1.3 Supplementary parameter (P500)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P509	**Control word source**		S	
0 ... 4 { 0 }	Selection of the interface via which the FI is controlled. **0 = Control terminals or keyboard control**** with the SimpleBox (if (P510)=0), the ParameterBox or via BUS I/O Bits. **1 = Only control terminals ***, the FI can only be controlled via the digital and analog input signals or via the bus I/O bits. **2 = USS ***, the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies. **3 = System bus*** **4 = System bus broadcast *** *) Keyboard control (SimpleBox, ParameterBox, PotentiometerBox) is disabled, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will disable without an error message.			
	NOTE: For details of the optional bus systems, please refer to Manual BU 0250. - www.nord.com – As an alternative to setting the parameter, **System Bus Broadcast** can be selected with DIP switch 3.			
P510 **... [-01]** **... [-02]**	**Setpoint source**		S	
0 ... 4 { [-01] = 0 } { [-02] = 0 }	Selection of the setpoint source to be parameterised. **… [-01] =** Main setpoint source **… [-02] =** Subsidiary setpoint source Selection of the interface via which the FI receives the setpoint. **0 = Auto:**the 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** **3 = System bus** **4 = System bus broadcast**			
P513	**Telegram downtime**		S	
-0.1 / 0.0 / 0.1 ... 100.0 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. **Note:** In BUS mode (e.g.: CANopen), monitoring is controlled via parameter (P120). Settings in parameter (P513) therefore have no effect. Exception: Setting {-0,1}			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P514	**CAN baud rate (system bus)**		S	
0 ... 7 { 5 }**	Setting of the transfer rate (transfer speed) via the system bus interface. All bus subscribers must have the same baud rate setting. **0 =** 10kBaud **3 =** 100kBaud **6 =** 500kBaud **1 =** 20kBaud **4 =** 125kBaud **7 =** 1Mbaud * **2 =** 50kBaud **5 =** 250kBaud** *) Safe operation cannot be guaranteed **) for communication with the bus module, the parameter must be left at the factory setting (250kBaud) otherwise no communication is possible.			
P515 **... [-01]** **...** **... [-03]**	**CAN address (system bus)**		S	
0 ... 255 dec { all 32 dec} or { all 20 hex}	Setting of the system bus address. **… [-01] =** Receive address for system bus **… [-02] =** Broadcast – Receive address for system bus (slave) **… [-02] =** Broadcast – Transmit address for system bus (master)			
NOTE:	If up to four SK 200E are to be linked via the system bus, the addresses must be set as follows →FI 1 = 32, FI 2 = 34, FI 3 = 36, FI 4 = 38. The system bus addresses should be set via the DIP switches 1/2 (Section 2.2.3).			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P543 **… [-01] ... … [-03]**	**Actual bus value 1 3**		S	P

0 ... 22
{ [-01] = 01 }
{ [-02] = 04 }
{ [-03] = 09 }

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

NOTE: For further details, please refer to the description for (P418).

… [-01] = Actual bus value 1

… [-02] = Actual bus value 2

… [-03] = Actual bus value 3

Possible values which can be set:

0 = Off
1 = Actual frequency
2 = Actual speed
3 = Current
4 = Torque current (100% = P112)
5 = State of digital inputs and outputs[2]
6 = ... 7 Reserved
8 = Setpoint frequency
9 = Error number
10 = ... 11 Reserved
12 = Bus Out bits 0...7
13 = ... 16 Reserved
17 = Value analog input 1 (P400)
18 = Value analog input 2 (P405)
19 = Setpoint frequency master value (P503)
20 = Setpoint frequency after master value ramp
21 = Actual frequency without master value slip
22 = Speed from encoder

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

0 ... 24
{ [-01] = 01 }
{ [-02] = 00 }
{ [-03] = 00 }

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

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

… [-01] = Actual bus value 1

… [-02] = Actual bus value 2

… [-03] = Actual bus value 3

Possible values which can be set:

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

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

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = Reserved	Bit 5 = Reserved	Bit 6 = Reserved	Bit 7 = Reserved
Bit 8 = Reserved	Bit 9 = Reserved	Bit 10 = Reserved	Bit 11 = Reserved
Bit 12 = Out 1	Bit 13 = Out 2	Bit 14 = Reserved	Bit 15 = Reserved

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P552 **… [-01]** **… [-02]**	**System bus master cycle time**		S	

0 / 0.1 … 100.0 ms

{ 0 }

In this parameter, the cycle time for the system bus master mode and the CAN open encoder is set (see P503/514/515):

… [01] = Cycle time for system bus master functions

… [02] = Cycle time for system absolute value encoder

With the setting **0 = "Auto"** the default value (see table) is used.

According to the baud rate set, there are different minimum values for the actual cycle time:

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

P560	**Save in EEPROM**		S	

0 ... 1

{ 1 }

0 = Changes to the parameter settings are no longer saved on the EEPROM. Previously saved settings remain stored, even if the FI is disconnected from the mains; however new changes are not saved after a mains failure.

1 = All parameter changes are automatically written to the EEPROM and remain stored there even if the FI is disconnected from the mains supply.

NOTE: If BUS communication is used to implement parameter changes, it must be ensured that the maximum number of write cycles (100,000 x) in the EEPROM is not exceeded.

5.1.4 Information parameters (P700)

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

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P741 ... [-01] ... ... [-10]	**Process data bus Out**		S	

0000 ... FFFF (hex)

This parameter provides information about the actual status word and the actual values that are transferred via the bus systems.

... [-01] = Status word	Status word
... [-02] = Actual value 1 (P543 [-01])	
... [-03] = Actual value 2 (P543 [-02])	
... [-04] = Actual value 3 (P543 [-03])	
... [-05] = Bus I/O Out Bit (P481)	The displayed value depicts all bus Out bit sources linked with *OR*.
... [-06] = Parameter data Out 1	
... [-07] = Parameter data Out 2	
... [-08] = Parameter data Out 3	Data during parameter transfer.
... [-09] = Parameter data Out 4	
... [-10] = Parameter data Out 5	

P748 System bus status

0000 ... FFFF (hex)
or
0 ... 65535 (dec)

Shows the status of the system bus.

Bit 0	24V Bus supply voltage
Bit 1	CANbus in "Bus Warning" status
Bit 2	CANbus in "Bus Off" status
Bit 3	Bus module is online
Bit 4	Additional module 1 is online
Bit 5	Additional module 2 is online
Bit 6	The protocol of the CAN module is 0 = CAN / 1 = CANopen
Bit 7	Vacant
Bit 8	"Bootup Message" sent
Bit 9	CANopen NMT state
Bit 10	CANopen NMT state

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

P749 DIP switch status

0000 ... 00FF (hex)
or
0 ... 255 (dec)

This parameter shows the current setting of the FI DIP switch (Section 2.2.3 "Configuration").

Bit 0	DIP switch 1	Bit 4	DIP switch 5
Bit 1	DIP switch 2	Bit 5	DIP switch 6
Bit 2	DIP switch 3	Bit 6	DIP switch 7
Bit 3	DIP switch 4	Bit 7	DIP switch 8

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

The following parameters affect the bus modules.

With access via CANopen, 0x2000 must be added to the parameter. Counting of the sub-indices begins with 1.

5.2.1 BUS module standard parameters (P150)

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P150	**Set relays**			
0 ... 4 { 0 }	**0 =** Via bus **1 =** Outputs OFF **2 =** Output 1 to (DO1) **3 =** Output 2 to (DO2) **4 =** Outputs 1 and 2 ON			
P151	**Timeout for external bus**			
0 ... 32767 ms { 0 }	Monitoring function of the active bus technology unit. Following receipt of a valid telegram, the next one must arrive within the set period. Otherwise the inverter reports an error and switches off with the error message E010 / E10.2 >Bus Time Out< >Bus Time Out<. **0 = OFF:** Monitoring is switched off. Behaviour is identical to parameter (P513) telegram timeout for SK 200E.			
P152	**Factory setting**			
0 ... 1 { 0 }	By selecting the appropriate value and confirming it with the ENTER key, the selected parameter range is entered in the factory setting. Once the setting has been made, the value of the parameter returns automatically to 0. **0 = No change:**Does not change the parameterisation. **1 = Load factory settings:** The complete parameterisation of the FI reverts to the factory setting. All originally parameterised data are lost.			

5.2.2 CANopen parameter (P160)

This parameter reflects the 0x1xxx communication parameters of CANopen. Therefore they can be read out or set by means of NORDCON or a ParameterBox. A summary of the objects can be found in Sections 8.4.2 and 8.4.3.

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P160 **... [-01] ... ... [-10]**	**COB-ID ON/OFF**			

0 ... 4

{ [-01] = 3 }
{ [-02] = 3 }
{ [-03] = 0 }
{ [-04] = 0 }
{ [-05] = 0 }
{ [-06] = 3 }
{ [-07] = 3 }
{ [-08] = 3 }
{ [-09] = 3 }
{ [-10] = 0 }

Sets the validity of the SDO and PDO objects.
(see Objects 1200 (hex)… 1203 (hex), 1400 (hex) …1404 (hex) and 1800 (hex) …1804 (hex), each Sub-Index 1)

[-01] = Sync Message*
[-02] = SDO1** (FI 1)
[-03] = SDO2 (FI 2)
[-04] = SDO3 (FI 3)
[-05] = SDO4 (FI 4)
[-06] = PDO1*** (FI 1)
[-07] = PDO2*** (FI 2)
[-08] = PDO3*** (FI 3)
[-09] = PDO4*** (FI 4)
[-10] = PDO5*** (bus module)

Possible setting values for Array [-02] to [-10]:

0 = Transmit and Receive channel off
1 = Receive channel on
2 = Transmit channel on
3 = Transmit and Receive channel on

* Setting here **0 =** "OFF" **1 - 3 =** "ON"
** Read Only
*** Writing access only permitted for **Pre-Operational**

P161 **... [-01] ... ... [-19]**	**COB-ID**			

0 ... 7FF(hex)

{see table on right}

Definition of the COB Index of individual SDO and PDO objects
(see objects 1005(hex) und 1200 (hex) … 1203 (hex), Sub-index 1 - Rx, Sub-index 2 - Tx,
1400 (hex) …1404 (hex) and1800 (hex) …1804 (hex), each sub-index 1)

Array	Factory setting
[-01] = COB-ID Sync Message	{ 0x0080 }
[-02] = SDO1 TX* (FI 1)	{ 0x0580+Addr.}
[-03] = SDO1 RX* (FI 1)	{ 0x0600+Addr.}
[-04] = SDO2 TX (FI 2)	{ 0x02C0+Addr.}
[-05] = SDO2 RX (FI 2)	{ 0x0340+Addr.}
[-06] = SDO3 TX (FI 3)	{ 0x03C0+Addr.}
[-07] = SDO3 RX (FI 3)	{ 0x0440+Addr.}
[-08] = SDO4 TX (FI 4)	{ 0x04C0+Addr.}
[-09] = SDO4 RX (FI 4)	{ 0x0540+Addr.}

Array	Factory setting
[-10] = PDO1 TX** (FI 1)	{ 0x0180+Addr.}
[-11] = PDO1 RX** (FI 1)	{ 0x0200+Addr.}
[-12] = PDO2 TX** (FI 2)	{ 0x0280+Addr.}
[-13] = PDO2 RX** (FI 2)	{ 0x0300+Addr.}
[-14] = PDO3 TX** (FI 3)	{ 0x0380+Addr.}
[-15] = PDO3 RX** (FI 3)	{ 0x0400+Addr.}
[-16] = PDO4 TX** (FI 4)	{ 0x0480+Addr.}
[-17] = PDO4 RX** (FI 4)	{ 0x0500+Addr.}
[-18] = PDO5 TX** (bus module)	{ 0x01C0+Addr.}
[-19] = PDO5 RX**(bus module)	{ 0x0240+Addr.}

* Read Only
** Writing access only permitted for **Pre-Operational**

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P162 ... [-01] ... ... [-10]	**PDO transmission type**			
0 ... 255 { 255 }	Setting of transmission type. (see objects 1400 (hex) …1404 (hex) and 1800 (hex) …1804 (hex), each Sub-index 2) **[-01] =** PDO1 TX (FI 1) **[-02] =** PDO1 RX (FI 1) **[-03] =** PDO2 TX (FI 2) **[-04] =** PDO2 RX (FI 2) **[-05] =** PDO3 TX (FI 3) **[-06] =** PDO3 RX (FI 3) **[-07] =** PDO4 TX (FI 4) **[-08] =** PDO4 RX (FI 4) **[-09] =** PDO5 TX (bus module) **[-10] =** PDO5 RX (bus module)			
P163 ... [-01] ... ... [-05]	**TxPDO Inhibit time**			
0 ... 3276.7 ms { 10.0 }	Determines the minimum interval between the transmission of the same COB-IDs. (see objects 1800 (hex) …1804 (hex), each Sub-index 3) **[-01] =** PDO1 (FI 1) **[-02] =** PDO2 (FI 2) **[-03] =** PDO3 (FI 3) **[-04] =** PDO4 (FI 4) **[-05] =** PDO5 (bus module)			
P164 ... [-01] ... ... [-05]	**TxPDO Event time**			
0 ... 32767 ms { 250 }	Defines a time interval, after which the process data (PDO) are transmitted. (see objects 1800 (hex) …1804 (hex), each Sub-index 5) **[-01] =** PDO1 (FI 1) **[-02] =** PDO2 (FI 2) **[-03] =** PDO3 (FI 3) **[-04] =** PDO4 (FI 4) **[-05] =** PDO5 (bus module) **0 =** "OFF"			

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P165 **... [-01]** **...** **... [-34]**	**PDO mapping parameter**			

0 ... FFFFFFFF$_{(hex)}$

{see table on right}

Definition of the mapping for transmitted and received process data.
(see objects 1600 $_{(hex)}$ … 1604 $_{(hex)}$ und 1A00 $_{(hex)}$ …1A04 $_{(hex)}$, each Sub-index 1 - 4)

(PDO1 = FI1, PDO2 = FI2, PDO3 = FI3, PDO4 = FI4 PDO5 = Bus module)

Array	Factory setting	Array	Factory setting
[-01] = PDO1 Tx Value 1	{ 0x30000110 }	**[-17] =** PDO3 Tx Value 1	{ 0x30000310 }
[-02] = PDO1 Tx Value 2	{ 0x30020110 }	**[-18] =** PDO3 Tx Value 2	{ 0x30020710 }
[-03] = PDO1 Tx Value 3	{ 0x30020210 }	**[-19] =** PDO3 Tx Value 3	{ 0x30020810 }
[-04] = PDO1 Tx Value 4	{ 0x30020310 }	**[-20] =** PDO3 Tx Value 4	{ 0x30020910 }
[-05] = PDO1 Rx Value 1	{ 0x30010110 }	**[-21] =** PDO3 Rx Value 1	{ 0x30010110 }
[-06] = PDO1 Rx Value 2	{ 0x30030110 }	**[-22] =** PDO3 Rx Value 2	{ 0x30030710 }
[-07] = PDO1 Rx Value 3	{ 0x30030210 }	**[-23] =** PDO3 Rx Value 3	{ 0x30030810 }
[-08] = PDO1 Rx Value 4	{ 0x30030310 }	**[-24] =** PDO3 Rx Value 4	{ 0x30030910 }
[-09] = PDO2 Tx Value 1	{ 0x30000210 }	**[-25] =** PDO4 Tx Value 1	{ 0x30000410 }
[-10] = PDO2 Tx Value 2	{ 0x30020410 }	**[-26] =** PDO4 Tx Value 2	{ 0x30020A10 }
[-11] = PDO2 Tx Value 3	{ 0x30020510 }	**[-27] =** PDO4 Tx Value 3	{ 0x30020B10 }
[-12] = PDO2 Tx Value 4	{ 0x30020610 }	**[-28] =** PDO4 Tx Value 4	{ 0x30020C10 }
[-13] = PDO2 Rx Value 1	{ 0x30010210 }	**[-29] =** PDO4 Rx Value 1	{ 0x30010410 }
[-14] = PDO2 Rx Value 2	{ 0x30030410 }	**[-30] =** PDO4 Rx Value 2	{ 0x30030A10 }
[-15] = PDO2 Rx Value 3	{ 0x30030510 }	**[-31] =** PDO4 Rx Value 3	{ 0x30030B10 }
[-16] = PDO2 Rx Value 4	{ 0x30030610 }	**[-32] =** PDO4 Rx Value 4	{ 0x30030C10 }
		[-33] = PDO5 Tx Value 1	{ 0x30050010 }
		[-34] = PDO5 Rx Value 1	{ 0x30040010 }

Note: [-33] and [-34] (PDO5) is the device itself, therefore only 2 bytes)

P166	... [-01] ... [-02]	**Timeout control**			

0 ... 32767 ms

{ 0 }

Defines a time interval for the monitoring of the slave by the master (node-guarding) or .
Definition of the slave transmission interval (Heartbeat).
(see objects 100C $_{(hex)}$ and 1017$_{(hex)}$)

[-01] = Guard time

[-02] = Producer Heartbeat time

0 = "OFF"

Parameter {Factory setting}	Setting value / Description / Note	Device	Supervisor	Parameter set
P167	**Life time factor**			
0 ... 255 { 0 }	Factor for the monitoring of the master by the slave (see objects 100D $_{(hex)}$) **0 =** "OFF"			

P168 **... [-01]** **...** **... [-17]**	**Profile parameters**			
0 ... 3FFF$_{(hex)}$ {see table on right}	Parameter setting for the profile parameters (Velocity Mode of the drive profile DSP 402). (see objects 6048 $_{(hex)}$ and 6049 $_{(hex)}$, each Sub-index 1 - 2) Acceleration and deceleration This results in the unit: rpm/s (achieved change in [rpm] divided by the time elapsed during the change in [s])			

Array	Factory setting
[-01] = Profile: 0= "OFF" 1= "ON"	{ 0 }
[-02] = Δn for acceleration FI 1	{ 1500 }
[-03] = Δt for acceleration FI 1	{ 2 }
[-04] = Δn for deceleration FI 1	{ 1500 }
[-05] = Δt for deceleration FI 1	{ 2 }
[-06] = Δn for acceleration FI 2	{ 1500 }
[-07] = Δt for acceleration FI 2	{ 2 }
[-08] = Δn for deceleration FI 2	{ 1500 }
[-09] = Δt for deceleration FI 2	{ 2 }

Array	Factory setting
[-10] = Δn for acceleration FI 3	{ 1500 }
[-11] = Δt for acceleration FI 3	{ 2 }
[-12] = Δn for deceleration FI 3	{ 1500 }
[-13] = Δt for deceleration FI 3	{ 2 }
[-14] = Δn for acceleration FI 4	{ 1500 }
[-15] = Δt for acceleration FI 4	{ 2 }
[-16] = Δn for deceleration FI 4	{ 1500 }
[-17] = Δt for deceleration FI 4	{ 2 }

Units: Δn in [rpm]
Δt in [ms]

5.2.3 BUS module information parameters, general (P170)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P170 ... [-01] ... [-02]	**Current error**			
0 ... 9999	Current error present. Further details in Section 6.2 "Error messages". **… [-01]** = Current module error **… [-02]** = Last module error **Possible values:** **1000 =** EEPROM error **1010 =** System bus 24V missing **1020 =** System bus timeout (see time in P151) **1030 =** System bus OFF **Specific to CANopen** **5110 =** CANopen bus OFF **5111 =** CANopen warning **5112 =** CANopen overrun **5113 =** CANopen invalid address **5120 =** CANopen timeout / communication error			
P171 ... [-01] ... ... [-03]	**Software version/ Revision**			
0,0 ... 9999.9	This parameter shows the software and revision numbers in the module. Array 03 provides information about any special versions of the hardware or software A zero stands for the standard version. **… [-01]** = Software version **… [-02]** = Software revision **… [-03]** = Special version			
P172	**Configuration**			
0 ... 2	The version can be queried in this parameter. **Possible values:** **0 =** Internal module **1 =** External module **2 =** Bus TO via SPI			

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

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P176 ... [-01] ... ... [-17]	**Process data bus In**			
-32768 ... 32767	Bus data received from CANopen "Master"			

... [-01] = Bus module outputs
... [-02] = Control word FI 1
... [-03] = Setpoint 1 for FI 1
... [-04] = Setpoint 2 for FI 1
... [-05] = Setpoint 3 for FI 1
... [-06] = Control word FI 2
... [-07] = Setpoint 1 for FI 2
... [-08] = Setpoint 2 for FI 2
... [-09] = Setpoint 3 for FI 2
... [-10] = Control word FI 3
... [-11] = Setpoint 1 for FI 3
... [-12] = Setpoint 2 for FI 3
... [-13] = Setpoint 3 for FI 3
... [-14] = Control word FI 4
... [-15] = Setpoint 1 for FI 4
... [-16] = Setpoint 2 for FI 4
... [-17] = Setpoint 3 for FI 4

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P177 ... [-01] ... ... [-17]	**Process data bus Out**			
-32768 ... 32767	Bus data transmitted from CANopen "Master"			

... [-01] = Bus module inputs
... [-02] = Status word FI 1
... [-03] = Actual value 1 for FI 1
... [-04] = Actual value 2 for FI 1
... [-05] = Actual value 3 for FI 1
... [-06] = Status word FI 2
... [-07] = Actual value 1 for FI 2
... [-08] = Actual value 2 for FI 2
... [-09] = Actual value 3 for FI 2
... [-10] = Status word FI 3
... [-11] = Actual value 1 for FI 3
... [-12] = Actual value 2 for FI 3
... [-13] = Actual value 3 for FI 3
... [-14] = Status word FI 4
... [-15] = Actual value 1 for FI 4
... [-16] = Actual value 2 for FI 4
... [-17] = Actual value 3 for FI 4

5.2.4 Module information parameters specific to the bus (P180)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P180	**CANopen address**			
1 ... 63	Each module transmitting on the bus must be allocated a unique address. After the new setting of addresses, all the devices on this bus must be restarted by switching the power supply off and on again. Setting of addresses (node address / node ID) is only made via DIP- switches (see Section 2.2.3 "Configuration"). An address in the range between 1 and 63 must be defined. The setting "0" (all DIP switches "OFF") is not permitted. In this case, the address **127** will be displayed in parameter (P180)			
P181	**CANopen baud rate**			
0 ... 3	**Possible values:** **0 =** 125 kBaud **1 =** 250 kBaud **2 =** 500 kBaud **3 =** 1 MBaud Setting of addresses baud rate can only be made via DIP- switches (see Section 2.2.3 "Configuration"). **Note:** The restriction of the cable legth for the set baud rate must be taken into account. (Section 8.1.2 "Cable material").			

6 Error monitoring and error messages

6.1 Error monitoring

The majority of bus module and frequency inverter functions and operating data are continuously monitored and simultaneously compared with limiting values. If a deviation is detected, the bus module or inverter reacts with a warning or an error message.
For detailed information, please refer to the relevant main manual of the frequency inverter.

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

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

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

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

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

NOTE

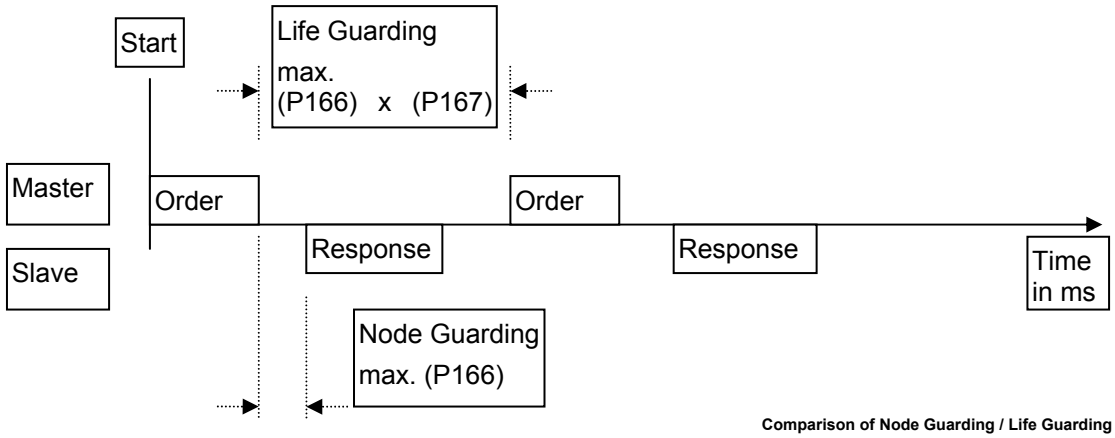
The display of a bus error is shown in the operating display of the SimpleBox **SK CSX-3H** by means of the error group number **E1000**. In order to obtain the precise error number, the module information parameter P170 must be selected. The current error is shown in Array [01] of this parameter, the last error is stored in Array [02].

6.1.1 Error monitoring details

Monitoring of bus communication is divided into the following categories:

- **EMERGENCY messages**
  The bus module sends a so-called "EMCY Message", if a connected frequency inverter becomes faulty. According to the CANopen specification DS-301 and DS-402 this message contains a detailed error code (see also 6.1.2 "EMCY message").
- **Timeout monitoring**
  Communication problems are detected with the aid of timeout monitoring. Various versions of the timeout monitoring can be selected, which either relate to general functionalities ("no bus communication") or to specific modules ("failure of a participant").
  These monitoring modules can be used in various combinations.

	General process data monitoring...			Detailed monitoring of subscribers	
	… of a technology unit (TB)	… of a frequency inverter (FI)	Option monitoring	Node / Life Guarding	Heartbeat
relevant parameters	(P151)	(P513)	(P120)	(P166 [-01]) x (P167)	(P166[-02])
relate to...	... basic bus communication ...			Bus nodes	Bus node
	... of the TO	... of the FI	... to the TB		
Monitoring by	TB	FI	FI	Bus nodes	Bus master
Example	{ 500 ms} If no further telegram is recieved within 500ms after receipt of a telegram, an error is triggered.	{ 0.5 s } If no further telegram is recieved within 0.5s after receipt of a telegram, an error is triggered.	{ 1 } If the communication to a module is interupted, or the module cannot be found on switch-on, an error message is triggered.	{ 250 }x{ 3 } If the subscriber does not receive the expected response within 250ms of sending a data package (telegram) or it does not receive a further data package within 750ms (250 ms x 3) of receiving a data package, an error is triggered.	{ 250 } The slave sends a corresponding telegram every 250 ms, which can be processed by an overriding control system.
Error code	E010 / E10.3	E010 / E10.2	E010 / E10.8 or E10.9	E010 / E10.2	/



Comparison of Node Guarding / Life Guarding

General process data monitoring with a technology unit (SK xU4-…)

The parameter (P152) "Timeout external bus" generally monitors the existence of bus communication. If no process data is received within the parameterised monitoring time (The content of the process data is irrelevant) the subscriber assumes that the bus communication to this subscriber is generally faulty and reports an error.

General monitoring of frequency inverter process data

SK 500E series frequency inverters offer the facility for monitoring the active bus interface by means of the parameter (P513) "Telegram timeout". If the frequency inverter does not receive a telegram within the time entered here, it assumes that there is a general fault with the bus communication and reports an error.

Note: With SK 200E series frequency inverters, this function of this parameter is implemented by parameter (P120). All settings (except { -0.1 }) are then without effect in parameter (P153).

Option monitoring

With the parameter (P120) "Option monitoring", SK 200E series frequency inverters provide the facility for monitoring connected technology units (SK xU4-…) with regard to their current functional status. Generally, this function corresponds to monitoring via parameter (P513). Except for the setting { -0.1 } this parameter (P513) therefore has no effect.

Node Guarding

The Node Guarding function enables the monitoring of the slave(s) by the master. If after a query by the master, a response is not received from the slave after after a defined time, an error message is triggered.

The monitoring interval is defined in parameter (P166[-01]) "Timeout control" / "Guard Time".

Life Guarding

The Life Guarding function enables the monitoring of the master by the slave. If after the receipt of a protocol and the elapse of a defined time the slave does not receive a further protocol from the master, an error message is triggered.

The monitoring interval is defined by the combination of parameter (P166[-01]) "Timeout control" / "Guard time" and)P167) "Life time factor".

Heartbeat monitoring

For overriding monitoring, a "Producer Heartbeat time" can be defined. Activation of the parameter (P166 [-02]) "Timeout control" / "Producer Heartbeat time" by a value ≠ "0" prompts the slave to the cyclic transmission of a corresponding protocol

6.1.2 EMCY message

In case of faults with frequency inverters connected to the system, the bus module sends an error message via the CANopen bus. The identifier of the message is 0x80 + address of the bus module. The message is structured as follows.

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Error code		Parameter 0x1001	FI-ID 0...3	Not used			

The assignment of error codes can be found in Section 4.9.6 "Error messages (EMCY message)".

After the error is reset, the *Emergency Object* is sent with the error message null.

The Transmit ID for the error telegram is based on the following formula:

$$Transmit\ ID = 0x80 + Node\ ID$$

6.2 Error messages

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

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

Error code display on the SimpleBox		**Fault** **Text in the ParameterBox**	**Cause** **Remedy**
Group	Details in P700 / P701		
E010	**10.2**	**External bus module telegram timeout**	Telegram transfer is faulty. Check external connection. Check bus protocol program process. Check bus master.
	10.3	**Timeout via (P151)**	Telegram transfer is faulty. Check watchdog time (P151) Check physical bus connections Contains cyclic telegrams
	10.4	**External bus module initialisation failure**	Bus module cannot be accessed Check bus module power supply
	10.8	**External module communication failure**	Connection fault / error in the external module to the FI
	10.9	**Module not found**	The module entered in parameter (P120) is not available.

6.2.2 Table of possible error messages in the bus module

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

Error number		Fault Text in the ParameterBox	Cause Remedy
Group	Details in P170		
E1000	**1000**	**EEPROM error**	Module faulty
	1010	**System bus 24V missing**	Check connections and supply cables Ensure 24V voltage supply
	1020	**System bus timeout**	Check time set in parameter (P151). Telegram transfer is faulty. Check external connection. Check bus protocol program process. Check bus master.
	1030	**System bus OFF**	Check connections and supply cables Ensure 24V voltage supply Check bus master.
	5110	**CANopen bus OFF**	Subscriber is disconnected from bus
	5111	**CANopen warning**	Bus error No other subscriber present on the system bus Wiring not correct (cable length, spur cables) No valid ID (DIP switch)
	5112	**CANopen overrun**	Message box (message buffer) for the module was overwritten by a new telegram before processing Increase master inhibit time Reduce baud rate
	5113	**Invalid CANopen address**	Avoid double assignment of addresses Comply with address range 1 ... 63
	5120	**CANopen timeout**	Telegram transfer is faulty. Check external connection. Check bus protocol program process. Check bus master.

7 CANopen data transfer

CAN / CANopen communication is based on a multi-master principle. Although the network can be overridden by a so-called NMT master (Network Management Master), this only takes over control of the functions of all connected nodes (subscribers) and can can change their operating statuses (initialisation / pre-operational / operational / stopped (previously: prepared)).

Communication between the individual subscribers, both as queries and responses is controlled by the participants themselves. In principle, all nodes are in a "ready" status. On request from other nodes, or according to their own requirements all peers are able to sent protocols on the bus (multi-master). Simultaneous transmission access by several nodes is resolved by a prioritisation of the messages to be sent. This ensures that the message with the highest priority receives permission for transmission. Messages which are postponed due to lower priority are then sent.

Therefore a pseudo real-time capability of the systems is ensured, in particular for telegrams with higher priority* (*with maximum bus load 40%). The priority of a telegram is defined by its identifier. The identifier of a telegram is comprised of its node address and the type of telegram (e.g.: Emergency Message). This rules out the double assignment of identifiers. The lower the identifier, the higher its priority.

Communication between subscribers largely complies with the client-server model. The producer-consumer model only comes into effect for the transfer of process data.

7.1 Protocol

Communication on the bus is carried out with the aid of telegrams on the basis of the CAN protocol. A CAN protocol consists of an overhead section (addressing, error monitoring ...) and a reference data section (for process control). CANopen is based on this structure, whereby two groups of reference data telegrams have been defined for the process.

In addition to the length of 8 bytes, the "addressing" via identifier is identical for both types of telegram.

The primary differentiating features are the following:

Property	SDO telegram	PDO telegram
Transfer of parameter data (parameterisation)	Yes	No
Exchange of process data	Not usual (not real-time)	Yes
Data processing model	Client - Server	Producer - Consumer
Response to query necessary	Yes (handshake)	No
Data rate	Low	High
Required node operating status	Operational Pre-Operational	Operational

7.2 Structure of reference data in USS standard

After switch-on a node runs through an initialisation phase and automatically changes to the operating status "Pre-Operational". In this state it is able to communicate via SDOs. The node only attains full operational readiness by setting into the operating status "Operational", and is then entitled to exchange data via PDOs.

The parameters of a node are stored in an object dictionary, whose structure corresponds to that of other bus systems. Therefore there is a basic compatibility between various bus systems.

As process data is also stored in the object dictionary of the node, this can also be processed via SDOs.

Example: Excerpt from the object dictionary of an SK 200E.

Object dictionary			
Index	Sub-index	Data	Comments
…			
2102	-	200	Parameter (P102), setting 2.00s)
2103	-	200	Parameter (P103), setting 2.00s)
…			

Structure of an SDO

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
E.g.: "Download"	E.g.: "Parameter number"		E.g.: "Array"	E.g.: "Parameter values"			

SDOs (Service Data Objects) enable access to all device parameters from the object dictionary. They enable these to be changes and are used for status queries. An SDO consists of eight bytes, of which the first four are occupied with protocol information (e.g.: data request / parameter number). The remaining four bytes define the associated data content (e.g.: setting values)

If the length of four bytes is not sufficient, the data contents is divided over several SDOs (segmented). Here, for all "data SDOs" which follow the first SDO, seven of the eight bytes are available for data transfer. The last segment contains an "End code".

The exchange of SDOs is carried out by means of a handshake process, i.e. queries are always confirmed with a response. However, segmented messages are only confirmed once, after receipt of the last associated SDO. Exchange of new messages is only possible after confirmation of or response to the previous message.

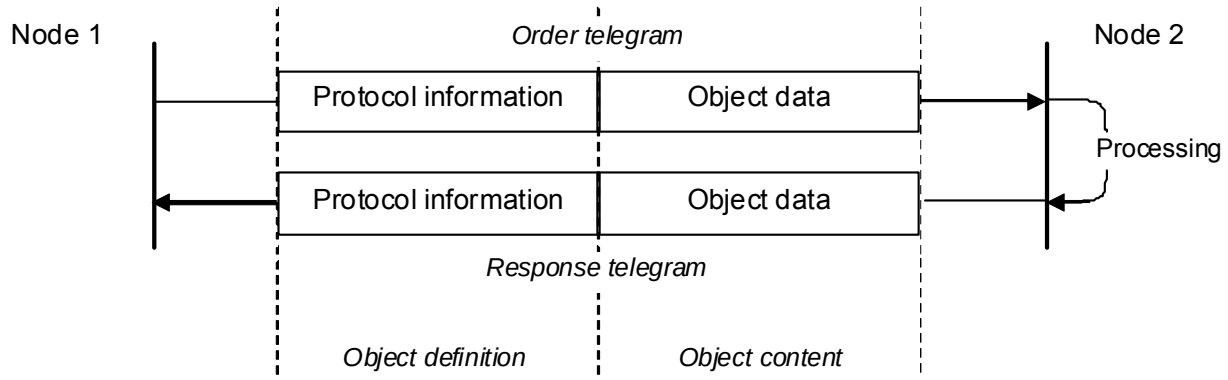


Diagram: Telegram traffic / structure of reference data area

On the other hand, PDOs (Process Data Objects) serve exclusively for the exchange of process data. A PDO sent by a node is received by all connected bus subscribers. Each subscriber, which recognises that the message is relevant on the basis of the identifier, processes it accordingly, however without acknowledgement. Therefore a message can also be accessed by several subscribers simultaneously (multicast).

The most important advantage of a PDO in comparison with an SDO is that due to the lack of protocol information, all 8 bytes are available for the exchange of process data. The associated increase in bandwidth increases the flow of process data by a large factor, which is an advantage for time-critical applications.

ATTENTION

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

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

Note: This does not apply to parameters which relate to the bus module ((P150) to (P199)). Here too, the EEPROM only permits a maximum of 100,000 writing cycles. However, the parameters are only written into the EEPROM if access is made via the ParameterBox or NORDCON, or if the parameter values are changed in the bus module by means of SDOs.

7.2.1 Process data (PZD) in USS standard

In the process data area PZD, control words and setpoints or status words and actual values are transferred from one node (frequency inverter) to another. The structure of the PZD area is always the same with regard to the sequence of its elements (words (= 2 bytes each)) whereby the processing of the individual bytes is carried out by the typical CAN method according to the "Little Endian" format.

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

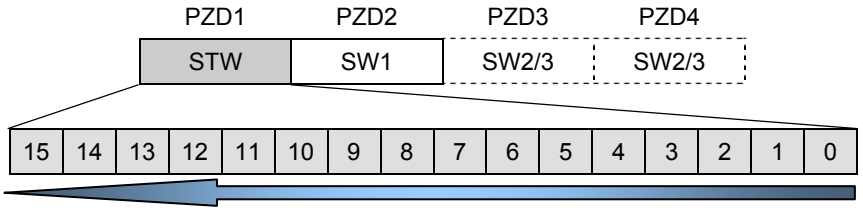
- STW: **Control Word**; length 16 bit, order telegram contains control bits (e.g. enable, rapid stop, error acknowledgement)
- ZSW: **Status Word**; length 16 bit, response telegram contains status bits (e.g. FI running, fault)
- SW1..3: **Setpoints**; maximum 3 possible, 16 or 32 bit, order telegram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

	1. Word (Byte 0,1)	2. Word (Byte 2,3)	3. Word (Byte 4,5)	4. Word (Byte 6,7)
PZD area with 1x16 bit setpoint	STW ZSW	SW1 IW1		
PZD area with up to 3 16 bit setpoints	STW ZSW	SW1 IW1	SW2 IW2	SW3 IW3

Note: 32 bit setpoints (e.g.: positions) are comprised of High or Low words (each 16 bit), whereby according to the Little Endian format, processing starts with the Low word.

7.2.1.1 Control word (STW)

In the order telegram, in the area of the process data the control word (STW) is transferred to the frequency inverter as the first word (taking into account the "Little Endian" format). For example, a control word "ready for switch-on" corresponds to 047E$_{(hex)}$, whereby in *Byte 0* the value *7E$_{(hex)}$* and in *Byte 1* the *value 04$_{(hex)}$* are transferred.

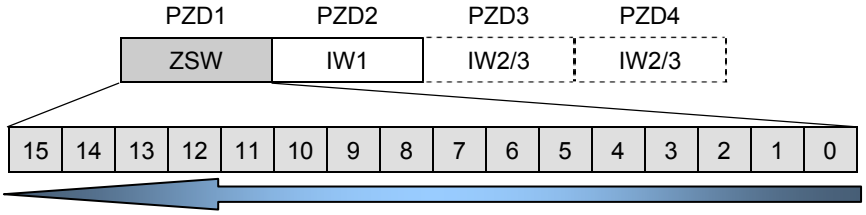


Meaning of the individual bits:

Bit	Value	Significance	Comments	
0	0	OFF 1	Return with the brake ramp, at f=0Hz voltage activation	
	1	ON	Standby	
1	0	OFF 2	Disable voltage; the inverter output voltage is switched off, the FI goes into switch-on disabled status.	
	1	Operating condition	OFF 2 is cancelled	
2	0	OFF 3	Emergency stop with programmed emergency stop time; at f = 0Hz voltage enable; the FI goes into switch-on disabled status	
	1	Operating condition	OFF 3 is cancelled	
3	0	Disable operation	Disable voltage; the inverter output voltage is switched off, the FI goes into standby status.	
	1	Enable operation	Output voltage enabled, run-up to present setpoint.	
4	0	Disable run-up encoder	Run-up encoder is set to zero; at f = 0Hz no voltage enable; FI remains in operation enabled status.	
	1	Operating condition	Run-up encoder is enabled	
5	0	Stop run-up encoder	Freezing of actual setpoint from run-up encoder (hold frequency).	
	1	Enable run-up encoder	Enable setpoint on run-up encoder	
6	0	Disable setpoint	Selected setpoint is set to zero in the run-up encoder.	
	1	Enable setpoint	Selected setpoint on run-up encoder 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 is programmed to the function "Error ack.", this bit must not be set permanently to 1 via the bus (otherwise this will prevent edge detection).	
8	0			
	1	Bit 8 active	Bus bit 8 from the control word is set. (Only for SK 200E and SK 500E) For further details of 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 200E and SK 500E) 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:**If setpoints only are transferred via the bus, this bit must be set so that the transferred setpoint is valid.	
11	0			
	1	Rotation right	Rotation right (priority) is on.	
12	0			
	1	Rotation left	Rotation left is on.	
13	0/1		Reserved	
14	0/1	Parameter set switch Bit 0	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	Parameter set switch Bit 1		

7.2.1.2 Status word (ZSW)

In the inverter response telegram, in the area of the process data the status word (ZSW) is transferred as the first word (taking into account the "Little Endian" format. For example, a status word "ready for switch-on" corresponds to $0B31_{(hex)}$, whereby in *Byte 0* the value $31_{(hex)}$ and in *Byte 1* the *value* $0B_{(hex)}$ are transferred.



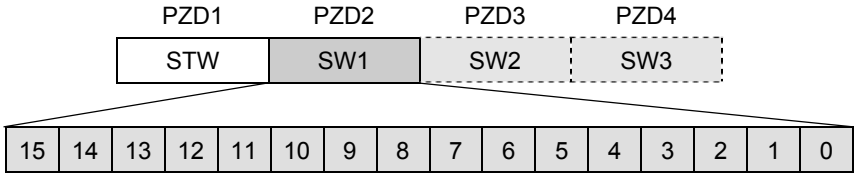
Meaning of the individual bits:

Bit	Value	Significance	Comments	
0	0	Not ready for switch-on		
	1	Redy for switch-on	Initialisation complete, load relay on, output voltage disabled	
1	0	Not operational	Causes: No On command, an error has occurred, OFF 2 or OFF 3 active, switch-on disable status active.	
	1	Standby	ON command active, no errors. The inverter can be started with the ENABLE OPERATION command.	
2	0	Operation disabled		
	1	Operation enabled	Output voltage enabled, run-up to present setpoint.	
3	0	No errors		
	1	Fault	Drive malfunctioning therefore out of order, if acknowledgement is successful, will go to switch-on disabled status.	
4	0	OFF 2	OFF 2 disable voltage command active	
	1	No OFF 2		
5	0	OFF 3	OFF 3 rapid stop command active	
	1	No OFF 3		
6	0	No switch-on disable		
	1	Switch-on disabled	Goes to standby status through OUT 1 command	
7	0	No warning		
	1	Warning	Drive still in operation, no acknowledgement necessary	
8	0	Actual value not O.K.	Actual value does not match the setpoint (with *posicon:* Setpoint position not reached)	
	1	Actual value O.K.	Actual value matches the setpoint (setpoint reached) (with *posicon:* Setpoint position reached)	
9	0	Local guidance	Local guidance active on device	
	1	Guidance required	The master is called upon to take over the guidance.	
10	0			
	1	Bit 10 active	Bus bit 10 from the status word is set. For further details of function, please refer to parameter P481.	
11	0			
	1	Rotation right	Inverter output voltage has right-hand rotating field	
12	0			
	1	Rotation left	Inverter output voltage has left-hand rotating field	
13	0			
	1	Bit 13 active	Bus bit 13 from the status word is set. For further details of function, please refer to parameter P481.	
14	0/1	Actual active parameter set Bit 0	00 = Parameter set 1 01 = Parameter set 2	10 = Parameter set 3 11 = Parameter set 4
15	0/1	Actual active parameter set Bit 1		

7.2.1.3 Setpoint 1 (SW1)

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

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



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

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

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

7.2.1.4 Setpoints 2 and 3 (SW2/3)

In addition to setpoint 1, two further setpoints can be transferred in the words "PZD3" and "PZD4".

PZD1	PZD2	PZD3	PZD4
STW	SW1	SW2	SW3

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

If the transfer of a 32 bit setpoint is necessary (Example: position setpoint), this must be divided into two **16 bit values**, i.e. into two PZDs (**Position Low** and **High** words). It does not matter in which of the three process data words (PZD 2 ... 4) the two position words are transferred.

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

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

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

Example

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

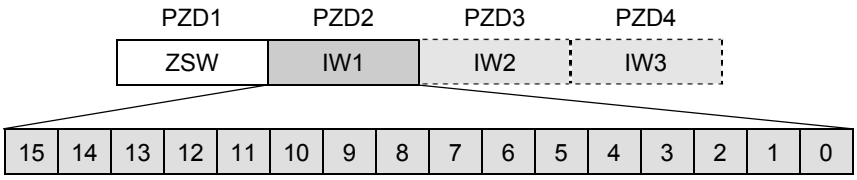
As a **16 bit** value, a range of +32767 (= 32,767 revolutions) to -32768 (= -32,768 revolutions) is possible. Here, exactly one PZD word is required in order to transfer the position.

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

7.2.1.5 Actual value 1 (IW1)

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

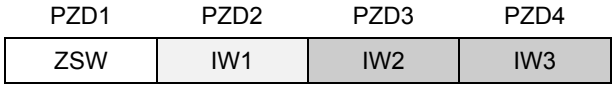
In the order telegram, actual value 1 follows immediately after the control word. Setpoint 1 is pre-set to the transfer of the current output frequency of the frequency inverter (16 bit value).



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

7.2.1.6 Actual values 2 and 3 (IW2/3)

In addition to actual value 1, two further actual values can be transferred in the words "PZD3" and "PZD4".



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

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

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

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

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

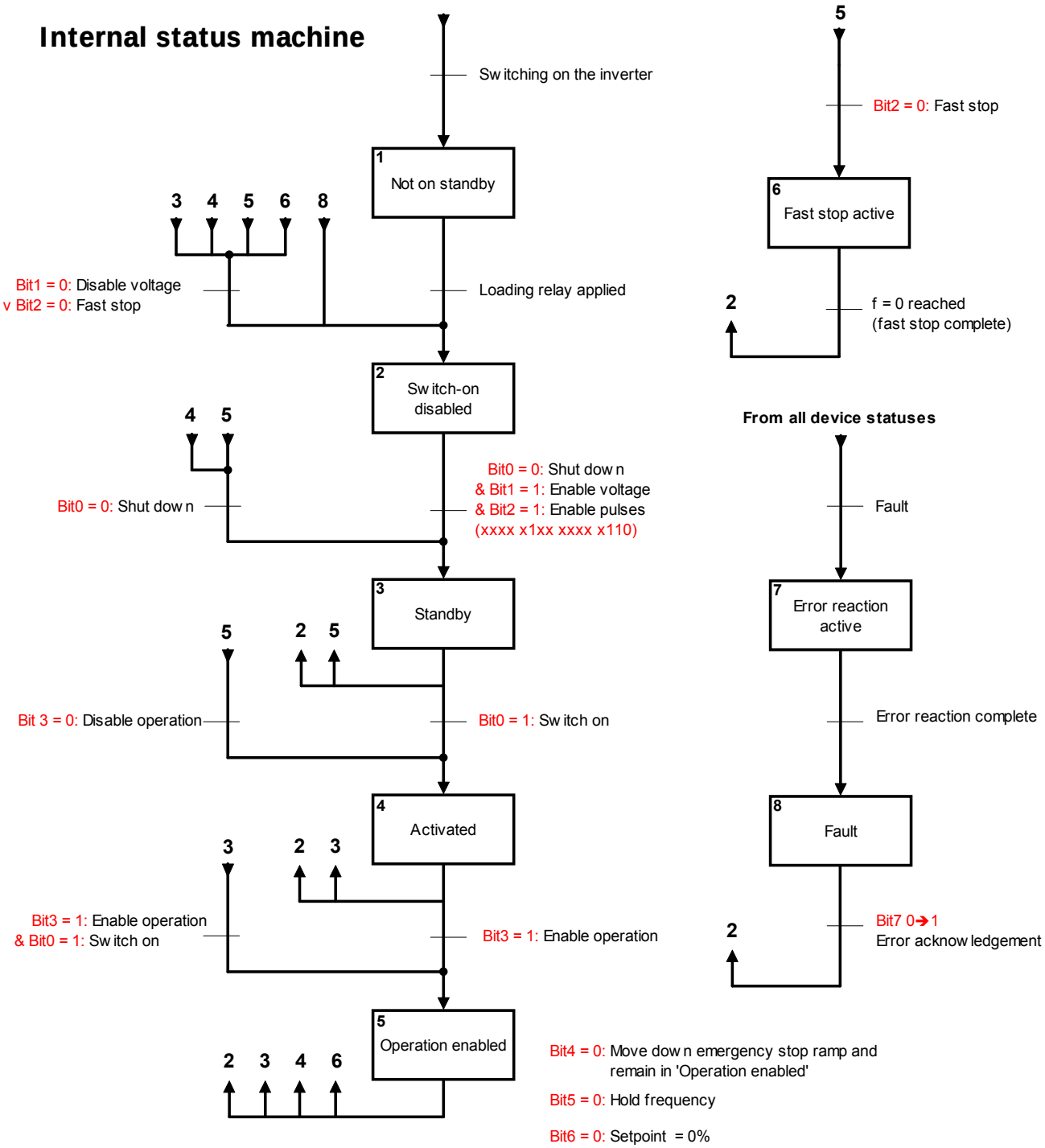
7.2.2 The status machine

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

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

The following bits indicate the status of the frequency inverter:

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



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

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

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

7.3 Structure of reference data in the standard drive profile (DS402)

The structure of reference data associated with the profile DSP402 is standardised by the CiA users organisation (see also Section 8.1.4 "CiA (CAN in Automation) recommendations").

7.4 Examples

7.4.1 Configuration examples

The configuration examples described here are intended as supplementary and summary support in addition to the detailed descriptions in this manual during the configuration of the system bus or field bus (CANopen).

7.4.1.1 "Velocity Mode" from profile DS 402

Via a bus module, 3 frequency inverters are to be independently controlled with a single speed.

given:

Serial No.	Device type	Designation	Motor	Other
1	SK 2x5E frequency inverter	FI 1	2-pole / n=2890 rpm / 50Hz	Ramp time: t=6s
2	SK 2x5E frequency inverter	FI 2	4-pole / n=1390 rpm / 50Hz	Ramp time: t=4s
3	SK 2x5E frequency inverter	FI 3	4-pole / n=1390 rpm / 50Hz	Ramp time: t=3s
4	SK TU4-CAO (with connection unit SK Ti4-TU-Bus) CANopen technology unit (external)	Bus module		

The bus module and FI 3 should always be the last physical subscribers on the system bus.

NOTE

The profile only works in parameter set 1 of the frequency inverter.

Relevant bus system	Serial No.	Step	Comments
System bus	1	Set up system bus	24V supply of the system bus level necessary (see Section 2.2.2.2 "Control connections of the SK CU4-CAO(-...)")
	2	Set termination resistor	• DIP switch "Bus termination, system bus" on CAO module "ON" • DIP switch "Bus termination, system bus" on FI 3 "ON" • All other DIP switches to "OFF"
	3	Set system bus addresses	Setting of FI addresses preferably via DIP switches (see manual BU0200): • Bus module: fixed (at 5) • FI 1: to 32 • FI 2: to 34 • FI 3: to 36
	4	System bus baud rate	set to 250kBaud for FI and bus module (is preset accordingly)
	5	System bus communication	Make settings on each FI • (P509): { 3 } "System bus" • (P510 [-01 … -02]): { 0 } "Auto" • (P543 [-01]): { 1 } "Actual frequency" • (P546 [-01]): { 1 } "setpoint frequency"
Field bus (CANopen)	6	Configure bus module for field bus	24V supply of the field bus level necessary (see Section 2.2.3 "Configuration") • If the bus module is the last physical subscriber in the field bus system: Set termination resistor: DIP switch "Bus termination CANopen" to "ON" • Set baud rate • Set node address (identifier)
	7	Field bus communcation	Make bus module settings: • (P168 [-01]): { 1 } "Profile ON" • (P168 [-02]): { 3000 } „+Δn (FI 1)" • (P168 [-03]): { 6 } „+ Δt (FI 1)" • (P168 [-04]): { 3000 } „- Δn (FI 1)" • (P168 [-05]): { 6 } „- Δt (FI 1)" • (P168 [-06]): { 1500 } „+Δn (FI 2)" • (P168 [-07]): { 4 } „+ Δt (FI 1)" • … • (P162 [-01,-03,-05,-09]) { 255 } • (P162 [-02,-04,-06,-10]) { 255 } • (P163) { 10 } • (P164) { 250 } • (P165), (P160), (P161) leave at factory setting
System bus	8	Monitoring at system bus level	• (P151): { 200 } • (P120 [-01]) { 1 } or { 2 }
Field bus (CANopen)	9	Monitoring at field bus level (node monitoring)	• (P166 [-01]): { 250 } • (P166 [-02]): { 400 } • (P167): { 3 }
System bus	10	Checking system bus communication	• (P748): "System bus status" • (P740 [-01]): "Control word" • (P740 [-02]): "Setpoint 1" • (P741 [-01]): "Status word" • (P741 [-02]): "Actual value 1" • (P173): "Module status"
Field bus (CANopen)	11	Checking field bus communication	• (P173): "Module status" • (P176): "PZD Bus In" • (P177): "PZD Bus Out"

Note: Settings specific to the application (motor data, control parameters, control terminal functions etc.) cannot of course be described here.

7.4.1.2 PZD exchange via PDO telegram according to CANopen DS 301

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

Given:

Serial No.	Device type	Designation	Motor	Other
1	SK 2x5E frequency inverter	FI 1	4-pole / n=1390 rpm / 50Hz	Motor with CANopen absolute value encoder (AG1)
2	SK 2x5E frequency inverter	FI 2	4-pole / n=1390 rpm / 50Hz	Motor with CANopen absolute value encoder (AG2)
3	SK 2x5E frequency inverter	FI 3	4-pole / n=1390 rpm / 50Hz	Motor with CANopen absolute value encoder (AG3)
4	SK TU4-CAO (with connection unit SK Ti4-TU-Bus) CANopen technology unit (external)	Bus module		

The bus module and FI 3 should always be the last physical subscribers on the system bus.

Relevant bus system	Serial No.	Step	Comments
System bus	1	Set up system bus	24V supply of the system bus level necessary (see Section 2.2.2.2 "Control connections of the SK CU4-CAO(-...)")
	2	Set termination resistor	• DIP switch "Bus termination, system bus" on CAO module "ON" • DIP switch "Bus termination, system bus" on FI 3 "ON" • All other DIP switches to "OFF"
	3	Set system bus addresses	Setting of FI addresses preferably via DIP switches (see manual BU0200): • Bus module: fixed (at 5) • FI 1: to 32 • FI 2: to 34 • FI 3: to 36 • AG1: to 33 • AG2: to 35 • AG3: to 37
	4	System bus baud rate	set to 250kBaud for FI, AG and bus module (preset accordingly for FI and bus module)
	5	System bus communication	Make settings on each FI • (P509): { 3 } "System bus" • (P510 [-01 … -02]): { 0 } "Auto" • (P543 [-01]): { 1 } "Actual frequency" • (P543 [-02]): { 10 } "Actual position in inc. Low-Word" • (P543 [-03]): { 15 } "Actual position in inc. High-Word" • (P546 [-01]): { 1 } "setpoint frequency" • (P546 [-02]): { 23 } "Setpoint position in inc. Low-Word" • (P546 [-03]): { 24 } "Setpoint position in inc. High-Word"

Relevant bus system	Serial No.	Step	Comments
Field bus (CANopen)	6	Configure bus module for field bus	24V supply of the field bus level necessary (see Section 2.2.3 "Configuration") • If the bus module is the last physical subscriber in the field bus system: Set termination resistor: DIP switch "Bus termination CANopen" to "ON" • Set baud rate • Set node address (identifier)
	7	Field bus communcation	Make bus module settings: • (P168 [-01]): { 0 } "Profile OFF" • (P162 [-01,-03,-05,-09]) { 255 } • (P162 [-02,-04,-06,-10]) { 255 } • (P163) { 10 } • (P164) { 250 } • (P165), (P160), (P161) leave at factory setting
System bus	8	Monitoring at system bus level	• (P151): { 200 } • (P120 [-01]) { 1 } or { 2 }
Field bus (CANopen)	9	Monitoring at field bus level (node monitoring)	• (P166 [-01]): { 250 } • (P166 [-02]): { 400 } • (P167): { 3 }
System bus	10	Checking system bus communication	• (P748): "System bus status" • (P740 [-01]): "Control word" • (P740 [-02]): "Setpoint 1" • (P741 [-01]): "Status word" • (P741 [-02]): "Actual value 1" • (P173): "Module status"
Field bus (CANopen)	11	Checking field bus communication	• (P173): "Module status" • (P176): "PZD Bus In" • (P177): "PZD Bus Out"

Note: Settings specific to the application (motor data, control parameters, control terminal functions etc.) cannot of course be described here.

7.4.2 Example telegrams

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

7.4.2.1 Example for switching the frequency inverter on and off

In this example, a FI will be operated with a setpoint (setpoint frequency) and an actual value (actual frequency). The "maximum frequency" is 50Hz.

Parameter settings:

- P105 = 50
- P543 = 1
- P546 = 1

Control word	Setpoint 1	Status word	Actual value 1	Explanation
- - -	- - -	0000_{hex}	0000_{hex}	
- - -	- - -	$xx40_{hex}$	0000_{hex}	The mains voltage is switched on at the FI
$047E_{hex}$	0000_{hex}	$xx31_{hex}$	0000_{hex}	FI is set to "Standby" status
$047F_{hex}$	2000_{hex}	$xx37_{hex}$	2000_{hex}	FI is set to "Operation enabled" status and controlled with a 50% setpoint.
The FI is enabled, the motor is supplied with current and rotates with a frequency of 25Hz.				
$0047E_{hex}$	2000_{hex}	$xx31_{hex}$	0000_{hex}	FI is set to "Standby" staus, the motor runs up its parameterised ramp to speed 0 and is switched off.
The FI is disabled again and the motor is without current.				
$047F_{hex}$	1000_{hex}	$xx37_{hex}$	1000_{hex}	FI is set to "Operation enabled" status and controlled with a 25% setpoint.
The FI is enabled, the motor is supplied with current and rotates with a frequency of 12.5Hz.				

7.4.2.2 CANopen with USS process data

The following example is designed to clarify control using PDOs. The following settings are assumed:

- FI 1 on field bus module SK xU4-CAO
- Node-ID "4"
- Parameter (P509) "Source control word"
  for SK500E: Setting: {6} "CANopen control word" (object number ($21FD_{hex}$) = 6) or
  for SK200E: Setting: {3} "System bus" (object number ($21FD_{hex}$) = 3,
  (P510)= {0}
- Rx-PDO1 is used for control. The device transmits its actual values via Tx-PDO1
- The drive profile is disabled
  for SK 500E: Setting: (P551) = {0} or
  for SK200E: Setting: (P168 [-01]) = {0}

Identifier

Rx-PDO1: 0200_{hex} + NODE-ID $\rightarrow$ 0204_{hex}

Tx-PDO1: 0180_{hex} + NODE-ID $\rightarrow$ 0184_{hex}

Mapping

Byte	1	2	3	4
Rx-PDO1	Obj 0x3000 (Sub 1) (control word)		0bj. 0x3002 Sub1 (Setpoint 1)	

Byte	1	2	3	4
Tx-PDO1	Obj 0x3000 (Sub 1) (status word)		0bj. 0x3003 Sub1 (Actual value 1)	

NOTE

Objects 3002_{hex} and 3003_{hex} can be used to specify which setpoint or actual value is to be transferred. The meaning of the setpoint or actual values is set in the frequency inverter via parameters (P543) - (P548) for SK 500E and via parameters (P543[-01]-[-03]) or (P546[-01] - [-03]) for SK 200E.

Control data, profile DS301 with USS State Machine:

In order to be able to control the frequency inverter, the CANopen status must first be set to “Operational”

After switching on, the frequency inverter is in “Switch-on disabled” status. It has to be switched to "Ready for switch-on" status using a control command. To do so, the control word “0x047E” must be transmitted. The PDO telegram then has the following structure:

Byte	1	2	3	4
ID=204	$7E_{hex}$	04_{hex}	00_{hex}	00_{hex}

The drive should then run at 50% of its maximum frequency. For this purpose, the control words “0x047F” and “0x2000” must be transmitted as setpoints:

Byte	1	2	3	4
ID=204	$7F_{hex}$	04_{hex}	00_{hex}	20_{hex}

7.4.2.3 Application-specific mapping

Instead of using the default mapping, an application-specific mapping can define which data is to be transmitted by means of PDOs. For this, the module must be in "Pre-Operational" status or should be put in this status with the NMT service "Enter Pre-Operational".

The procedure for an application-specific mapping is explained on the basis of a specific example.

Example:

With the aid of a Transmit PDO, the control word and setpoint 3 are to be transferred to the frequency inverter with a data width of 16 bit.

- The CAN identifier 0x432 is to be used for the transfer.
- The transfer is to be carried out sychronously with each third SYNC object.
- The default CAN-IDs are used for the SDOs.

Changes to the mapping for the Transmit PDO1

Deactivation of Transmit PDO 1

Deactivation of the PDO mapping by setting "0" - Setting of the number of mapping objects in Index 0x1A00, Sub-Index 0 (Transmit PDO Mapping Parameter).

	CAN-ID	Data
Transmit	0x0600	0x2F 00 1A 00 00 xx xx xx
Receive	0x0580	0x60 00 1A 00 xx xx xx xx

Entering the mapping objects

Entry in the Transmit PDO mapping structure (Index 0x1A00) of:

- Index
- Sub-index
- Object length of the application object

A maximum of 8 bytes of data can be assigned to each PDO.

Application object	Index	Sub-index
FI 1 control word	0x3000	1
FI 1 Setpoint 3	0x3002	3

The following structure must be achieved in the mapping parameters of the 1st Transmit PDO (Objekt 0x1A00).

Sub-index	Index	Sub-index	Object length in bits	Comments
0	2			→ Number of mappings
1	0x3000	1	0x10	→ FI 1 control word
2	0x3002	3	0x10	→ FI 1 Setpoint 3

NOTE

The number of valid sub-indices are only entered into Sub-Index 0 after the mapping parameters in Sub-Index 1 ... 8 have been entered.

These objects are stored with the aid of SDO transfers:

Map object 0x3000

	CAN-ID	Data
Transmit	0x0600	0x23 00 1A 01 10 01 00 30

→ Set object 0x1A00 Sub-index 1 to object 0x3000 Sub-index 1 and 16 bit data width

Map object 0x3002

	CAN-ID	Data
Transmit	0x0600	0x23 00 1A 02 10 03 02 30

→ Set object 0x1A00 Sub-index 2 to object 0x3002 Sub-index 3 and 16 bit data width

Number of mapping objects = 2, enter into Sub-index 0

	CAN-ID	Data
Transmit	0x0600	0x2F 00 1A 00 02 xx xx xx
Receive	0x0580	0x60 00 1A 00 xx xx xx xx

Change communication parameters

Deactivation of Transmit PDO 1

In order to change the communication parameters, the Transmit PDO 1 which was prepared in the example above must be deactivated.

To do this, the value 0x80000000 must be written into the communication object of the Transmit PDO1 (Transmit PDO communication parameter, Index 0x1800, Sub-index 01).

	CAN-ID	Data
Transmit	0x0600	0x23 00 18 01 00 00 00 80
Receive	0x0580	0x60 00 18 01 xx xx xx xx

Setting the communication parameters for Transmit PDO1

In the object with the index 0x1800, Sub-index 1 to 3 (Transmit PDO communication parameter) the communication parameters must now be written into the structure.

Here, Transmission Type 3 (synchronous transmission with each 3rd SYNC object) is defined.

TxPDO communication parameter, Index 0x1800

Sub-index	Value	Significance
0	3	Number of entries
1	0x0432	COB-ID used by PDO
2	3	Transmission type
3	0	Inhibit time

Sub-index 3: Inhibit time = 0

	CAN-ID	Data
Transmit	0x0600	0x2B 00 18 03 00 00 xx xx
Receive	0x0580	0x60 00 18 03 xx xx xx xx

Sub-index 2: Transmission Type = 3

	CAN-ID	Data
Transmit	0x0600	0x2F 00 18 02 03 xx xx xx
Receive	0x0580	0x60 00 18 02 xx xx xx xx

Sub-index 1: Set COB-ID = 432 for the PDO and set the PDO from invalid to valid

	CAN-ID	Data
Transmit	0x0600	0x23 00 18 01 32 04 00 00
Receive	0x0580	0x60 00 18 01 xx xx xx xx

As soon as the module is set to the status "Operational" with the command "Start Remote Node", the PDOs become active and the TxPDO object can be used for the transmission of data.

8 Additional information

8.1 Bus configuration

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

8.1.1 Laying of the CAN/CANopen bus cables

A CAN network consists of a maximum of 128 subscribers (nodes) and is based on a linear topology. The number of subscribers is dependent on the driver modules (standard approx. 100 nodes). Repeaters must be used for a high number of nodes.

With NORDAC frequency inverters, a twisted two-wire cable (with connected shield) is used for data transfer.

8.1.2 Cable material

The frequency inverter is usually connected to the CANopen system by a twisted, shielded two-wire cable. . The guaranteed transfer speeds or transfer distances can only be achieved without errors if the specific cable parameters are complied with.

The following relationship exists between the individual cable parameters:

Bus cable length	Resistance	Cable cross-section	Possible transfer rates
0 - 25m	70 mΩ/m	≥ 0.25 mm^2, AWG23	1 Mbit/s
25 - 50m	70 mΩ/m	≥ 0.25 mm^2, AWG23	800 kBits/s
50 - 80m	< 60 mΩ/m	≥ 0.34 mm^2, AWG23	500 kBits/s
80m - 230m	< 40 mΩ/m	≥ 0.5 mm^2, AWG21	250 kBits/s
230m – 480m	< 26 mΩ/m	≥ 0.75 mm^2, AWG18	125 kBits/s
480m – 1km	< 20 mΩ/-	≥ 1 mm^2, AWG…	50 kBits/s

The interface is compliant with ISO 11898. The maximum permissible voltage on the CAN_L and CAN_H cables is -8V … +18V.

NOTE

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

8.1.3 Cable layout and shielding (EMC measures)

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

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

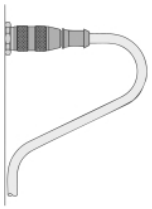
The best shielding characteristics are achieved with the following measures:

- Avoid long connections between bus subscribers
- Shield the bus cable *on both ends* with large-area connection to the plug housing
- Avoid spur cables
- Avoid extensions to bus cables via plug connectors

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

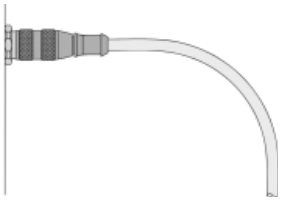
Special attention should be paid to bending radii:

Fixed cable



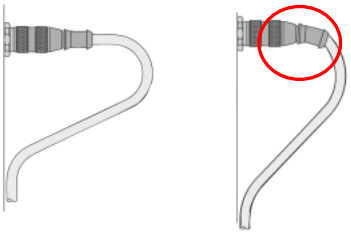
Minimum radius
5 x cable diameter

Freely laid cable



Minimum radius
10 x cable diameter

Bending radius of cable



Correct

Incorrect

NOTE

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

8.1.4 CiA (CAN in Automation) recommendations

Important information about CAN and CANopen can be found in Internet under www.can-cia.org and www.drivecom.org.

8.2 Cable glands and shielding connections

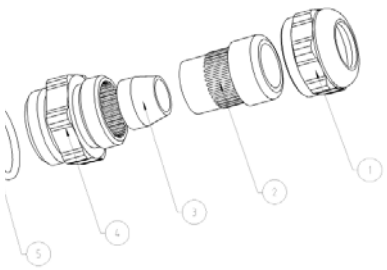
Nowadays, field bus systems are a normal part of plant technology. The sensitivity of these systems to electromagnetic interference (EMC) means that it is essential to protect bus systems from outside interference by means of uninterrupted or complete screening. Therefore the use of shielded cables and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

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

8.2.1 Fixed connection (cable gland)

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

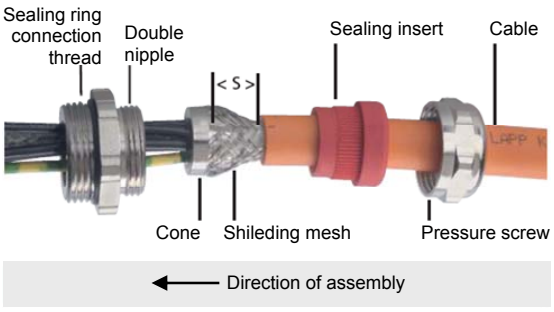
1 Pressure screw
2 Earthing insert
3 Inner earthing cone
4 Metric fitting
5 O-ring mounted



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

Installation

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



Function

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

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

8.2.2 Connection with M12 round plug connectors

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

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

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

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

Flanged coupling

Flanged plug

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

8.2.3 Round plug connector

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

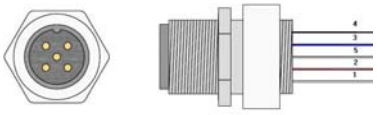
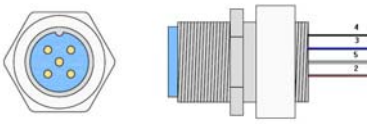
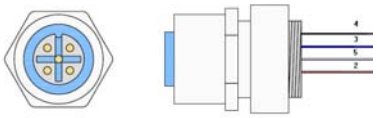
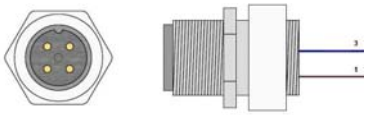
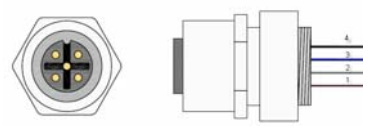
Coding

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

Designation	A coding	B coding
Example: coupling		
Format	M12	M12
Coupling version	with coding groove	with coding pin
Plug version	with coding pin	with coding groove
Field of use	System bus CANopen Devicenet 24V supply Sensors/ Actuators	PROFIBUS DP

8.2.3.1 M12 flanged connector

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

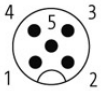
System components	Description	Data
CANopen		
SK TIE4-M12-CAO Part No. 275274501 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect the CANopen or DeviceNet cable to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 PE (shield) white PIN 2 +24V brown PIN 3 GND blue PIN 4 CAN-H black PIN 5 CAN-L grey Plastic body and screw cap in **grey**
System bus		
SK TIE4-M12-SYSS Part No. 275274506 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect the incoming system bus cable to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 not used PIN 2 +24V brown PIN 3 GND blue PIN 4 Sys-H black PIN 5 Sys-L grey Plastic body and screw cap in **light blue**
SK TIE4-M12-SYSM Part No. 275274505 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect the outgoing system bus cable to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 not used PIN 2 +24V brown PIN 3 GND blue PIN 4 Sys-H black PIN 5 Sys-L grey Plastic body and screw cap in **light blue**
External voltage supply		
SK TIE4-M12-POW Part No. 275274507 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect a 24V- supply to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 +24V DC brown PIN 2 not used PIN 3 GND blue PIN 4 not used PIN 5 not used Plastic body and screw cap in **black**
Sensors and actuators		
SK TIE4-M12-INI Part No. 275274503 (IP67) The protection class is only valid when screwed together!	 **M12 flanged plug** to connect sensors and actuators to the technology unit	M12 round plug connector A coded, 5 pin, adjustable direction PIN 1 +24V (out) brown PIN 2 Diagnosis /opener white PIN 3 GND blue PIN 4 Sensor or control signal black PIN 5 not used Plastic body and screw cap in **grey**

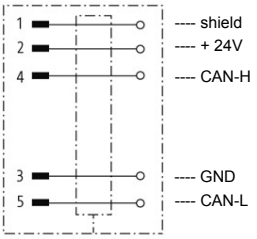
8.2.3.2 M12 round plug connector (cable connector)

The following plug connectors are recommended by Getriebebau NORD GmbH.

M12 connector

A coded

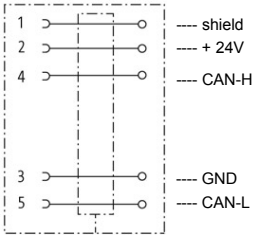




Supplier	Designation	Part no.	
		straight	angled
MURR Elektronik	M12 plug, 6..8mm, 5-pin, screwed, IP67, shielded	7000-13321-0000000	7000-13361-0000000
Franz Binder GmbH	M12 plug, 6..8mm, 5-pin, screwed, IP67,	99 1437 812 05	99 1437 822 05

M12 socket

A coded



Supplier	Designation	Part no.	
		straight	angled
MURR Elektronik	M12 socket, 6..8mm, 2-pin, screwed, IP67, shielded	7000-13401-0000000	7000-13441-0000000
Franz Binder GmbH	M12 socket, 6..8mm, 5-pin, screwed, IP67,	99 1436 812 05	99 1436 822 05

If required, pre-assembled CANopen cables of various lengths can be obtained from the manufacturers listed here.

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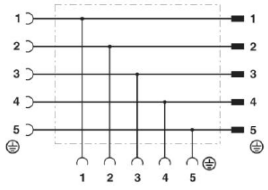
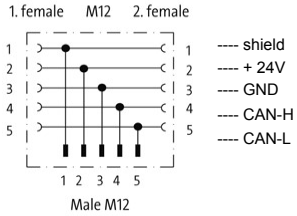
M12-connectors T

A coded





Supplier	Designation	Part no.
MURR Elektronik	M12 plug to 2x M12 socket, 5-pin, parallel distributor, IP67	7000-41141-0000000
Phoenix Contact GmbH & Co. KG	M12 socket to M12 plug and socket, 5-pin, parallel distributor, IP67	1541186

NOTE

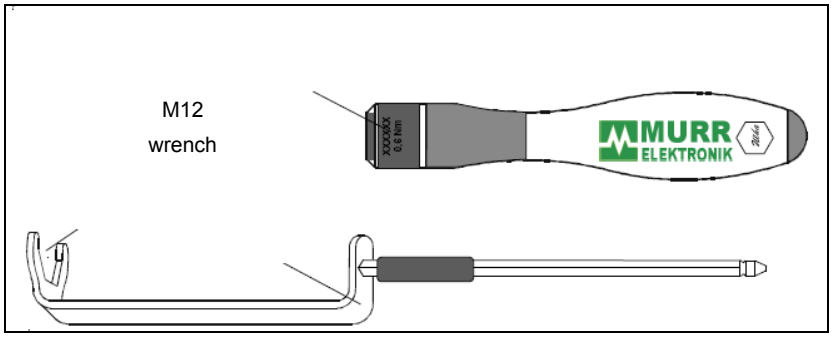
For preference, pre-assembled CAN bus cables and connection components should be used.

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

8.2.3.3 Assembly tools

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

Suitable assembly tools are commercially available.




Anwenderhinweise

MURR ELEKTRONIK

Mit Sicherheit dicht!

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

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

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

Supplier	Designation	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

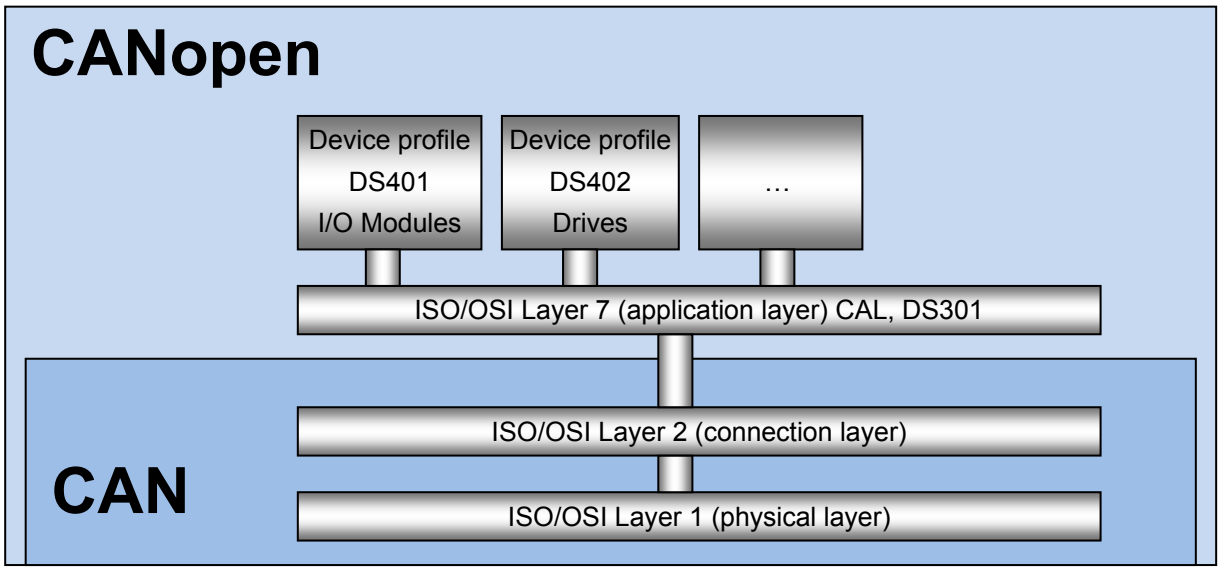
NOTE

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

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

8.3 CANopen technology and protocol

The CAN bus is a high-speed standardised bus system. Because of its structure it is possible to design a bus structure without a central master, i.e. with partners with entirely equal rights. With the aid of the CANopen system, based on CAN and the defined profiles for communication and application categories which it contains (I/O profile or Drive profile), this system is comparatively easy to configure.



ISO/OSI Layer model

A wide variety of field devices can therefore be easily interlinked. In case of failure of individual field devices, data transfer to the remaining bus subscribers continues uninterrupted.

8.3.1 Overview /Protocol architecture

The ISO/OSI layer model describes the communication between the individual subscribers (nodes) of a communication or automation system. Of the seven defined OSI layers, CANopen uses the layers 1, 2 and 7.

- Layer 1 **Physical layer** defines the hardware, coding, speed etc. of data transfer
- Layer 2 **Connection layer** describes the bus access procedure including data security, i.e. it defines the physics of transfer
- Layer 7 **Application layer** defines the interface to the application program with the application-orientated commands.
  Here, in addition to the communication profile (DS301), CANopen also defines various device profiles (e.g.: DS402)

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.

8.3.2 Overview /Communication possibilities

CANopen provides various possibilities for communication, so that there is always an exchange of telegrams. The structure of a telegram complies with the CAN telegram format.

Initial field	Status field	Control field	Data field	Security field	Confir-mation field	End field
1 bit	12 bit / 32 bit (identifier)	6 bit	0 - 64 bit	18 bit	2 bit	7 bit

	Protocol information
	Reference data

Due to the different structures of the data field (reference data area) of the CAN protocol, CANopen enables the exchange of two different types of telegram, the PDO (Process Data Object) and the SDO (Service Data Object).

A PDO uses the data field exclusively for process data information and is therefore able to transfer 8 bytes of process data with each telegram.

On the other hand, an SDO divides the data field into a 4 byte configuration area and a 1 - 4 byte data area. This enables access to the object dictionary and therefore to the function of a subscriber (e.g. frequency inverter), i.e. enables its parameterisation. However, it restricts the possible size of the data content.

Control byte	Index		Sub-index	Data			
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
E.g.: "Download"	E.g.: "Parameter number"		E.g.: "Array"	E.g.: "Parameter values"			

8.3.2.1 PDO (Process Data Object)

A PDO is used for the exchange of data relevant to the process. In addition to the control word (or status word) it contains up to 3 setpoints (or actual values).

These can be

- event-controlled (e.g. after elapse of a time unit),
- on request (Polling by Remote Frame) or
- synchronous (via a sync telegram (message without data content))

or transmitted (transmission type).

PDOs can only be processed by CANopen subscribers which are in the status "Operational".

PDO messages have comparatively high priorities. This ensures that messages with time-critical process data are processed with high priority, a fundamental condition for the real-time facility of a system. The fact that PZD telegrams are transmitted without confirmation plays an important role for this.

The verification of the correct receipt of this data by the relevant subscriber performed by the security mechanisms of the CANopen protocol on which the exchange of PDO data is based is ensured (bit-stuffing, CRC, frame-check,...).

8.3.2.2 SDO (Service Data Object)

An SDO telegram primarily serves for the exchange of parameter data (for changes in the object dictionary of a subscriber) and for status queries.

The configuration of functions, i.e. the parameterisation of the frequency inverter is carried out with the aid of SDOs. However, SDOs are also used for PDO mapping (user-specific specification of the sequence of process data of a PDO message).

SDO messages have comparatively low priorities. This ensures that messages which are critical for the process (PDOs, EMCY messages) are handled with priority. SDOs can be transferred in segments if the necessary amount of reference data is too large for an individual SDO. The receipt of an SDO is confirmed by the recipient. This ensures the correct exchange of data.

SDOs are processed by CANopen subscribers which are in the status "Pre-Operational" or "Operational".

8.4 System bus

With NORDAC inverter technology, units or modules communicate via a dedicated system bus. With the introduction of the SK 200E frequency inverter series and the associated components SK CU4-… and SK TU4-… functions and interfaces were implemented in this system bus, which allow users to make useful adaptations without having detailed knowledge of the function of the bus system (data allocation / error handling, etc.).

A decisive advantage is provided by the fact that the system bus is no longer restricted to a single inverter and a directly connected module, but rather that up to 4 frequency inverters can jointly use a BUS interface (e.g.: CANopen). This increases the number of possible subscribers on a field bus system (by a factor of 4) with comparatively low investment costs.

The system bus address of the BUS modules (SK CU4-… and SK TU4-…) is set to "5". The system bus address of the up to 4 frequency inverters which can be connected are set by means of DIP switches (see manual BU0200) on the relevant frequency inverter, optionally between 32 / 34 / 36 and 38, whereby no address may be doubly assigned within a system bus system.

8.5 Repairs

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

NORD Electronic DRIVESYSTEMS GmbH
Tjüchkampstr. 37
26605 Aurich, Germany

For queries about repairs, please contact:

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

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

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

NOTE

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

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

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

9 Index

Keyword Index:

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.
Little Endian	describes the sequence in which the bytes are processed in a data word. Here: first Low-Byte, then High-Byte
Monitoring	a participant which transmits, receives its telegram simultaneously. If the comparison shows deviations, there is an error present. (Mechanism of the detection of errors in a CAN telegram (or a PDO))
OSI layer model	The Open Systems Interconnection Reference Model defines the elements, structures and tasks necessary for data communication and assigns these to the times for the communication process in seven consecutive layers.
Polling	cyclical querying of individual components by a central component (NMT master / NMT slave)
Producer-consumer model	a subscriber (producer) places data on the bus, all other subscribers (consumers) receive this message and decide on the basis of the identifier, whether this message is relevant to them.

Abbreviations used:

BE	Bus error (fault)
BG	Bus module
BR	Bus ready
BS	BUS state (status)
CAO	CANopen
CE	CANopen error (fault)
CiA	CAN in Automation
CR	CANopen ready
CU	Customer Unit (customer interface - internal technology unit)
D, DI, DIN	Digital IN
DE	DEVICE error (fault)
DO, DOUT	Digital OUT
DS	DEVICE state (status)
DSP	Draft Standard Proposal (CiA device profile)
EMC	Electromagnetic compatibility
FI	Frequency inverter
GND	Earth
HW	Hardware
I16	16 bit value (integer)
I/O	IN / OUT, input and output
IND	Index
IW	Actual value
NMT	Network Management
P	Parameter which depends on a parameter set
PPO	Process data object
PZD	Process data
RO	Read Only
RW	Read and Write
SDO	Service Data Object
STR	String value
STW	Control word
SW	Software / Setpoint
TU	Technologie Unit (external technology unit)
U8 (U16 / U32)	8 bit (16 / 32 bit) value, unsigned (without prefix)
ZBG	Additional module
ZSW	Status word

10 Keyword index

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