Operating manual

CANnord / CANopen

for NORDAC frequency inverters

SK CU1-CAN, SK CU1-CAN-RJ	→	SK 700E, SK 750E
SK TU1-CAN, SK TU1-CAO	→	SK 700E
SK TU2-CAN, SK TU2-CAO	→	trio SK 300E, SK 750E
CAN / CANopen on board, SK TU3-CAO	→	SK 5xxE, (entire SK500E series)
CANnord mc, CANopen mc	→	vector mc

CANnord

CANopen

Illustration of devices with options

BU 0060 GB

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NORD DRIVESYSTEMS

NORDAC frequency inverters

Safety and operating instructions for drive power converters

(as per: Low voltage directive 73/23/EEC) { XE „Low voltage directive“ }

1. General

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

Unauthorised removal of covers, improper use, incorrect installation or operation leads to the risk of serious personal injury or material damage.

Further information can be found in this documentation.

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

For the purposes of these basic safety instructions, qualified personnel are persons who are familiar with the erection, 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 98/37/EEC (machine directive); EN 60204 must also be complied with.

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

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

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

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

3. Transport, storage

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

4. Installation

The installation and cooling of the equipment must be implemented as per the regulations in the corresponding documentation.

The drive power converter must be protected against unpermitted loads. During transport and handling in particular, 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 that can be easily damaged by incorrect handling. Electrical components must not be mechanically damaged or destroyed (this may cause a health hazard!).

5. Electrical connection

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

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

Information about EMC-compliant installation – such as shielding, earthing, location of filters and installation of cables can be found in the drive power converter documentation. These instructions must be complied with even with CE marked drive power converters. Compliance with the 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.

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

All covers must be kept closed during operation.

7. Maintenance and repairs

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

Further information can be found in this documentation.

These safety instructions must be kept in a safe place!

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

Documentation

Designation: BU 0060 DE
Mat. No.: 607 06 02
Device series: CANnord / CANopen for SK 300E, SK 5xxE, SK 700E, SK 750E, vector mc

Version list

Designation of previous issues	SW Status	Comments
BU 0060 DE, May 2005 Mat. No. 607 06 01 / 1005	V. 1.1 R0	First issue
BU 0060 DE, November 2006 Mat. No. 607 06 01 / 4606	V. 1.2 R1	Modification of SK 500/520/530E parameters, correction of recommended M8/M12 connector and IW2/3 modification, inclusion of CANnord data
BU 0060 DE, May 2007 Mat. No. 607 06 01 / 1807	V. 1.2 R1	Combination of BU 0030 + BU 0060 – BU 0060. Now includes CANnord (nord-specific CANbus) and CANopen
BU 0060 DE, May 2010 Mat. No. 607 06 01 / 2010	V. 1.2 R1	Correction of errors (e.g. (P748) "CANopen NMT State"), RJ45 adapter module supplemented

Publisher

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Intended use of the frequency inverter

Compliance with the operating instructions is the requirement for error-free operation and means that possible warranty claims will be successful. You must first read these operating instructions before working with the device!

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

The CANopen module can only be used for the specifically defined frequency inverter series, use across series is only possible with the SK TU2-… module with SK 300E or SK 750E and the SK CU1-… module with SK 700E or SK 750E. The use of these modules with other devices is not permitted and can lead to their destruction.

The CANopen modules and the corresponding frequency inverters are devices for stationary installation in control cabinets or decentralised structures. All data 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 Introduction

1.1 General information

This CANnord / CANopen documentation is valid for the device series NORDAC trio SK 300E, SK 5xxE (entire SK 500E series), SK 700E/750E and vector mc.

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

To establish communication via CANnord / CANopen, a CANnord / CANopen technology module must be used.

The only exceptions are the SK 511, SK 520E and SK 53xE types; with these, the CANnord / CANopen functionality is integrated as standard and can be used with an RJ45 connector.

NOTE

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

By means of optionally available shielding terminals SK8, the field bus cables of the frequency inverter can be connected to the shielding bracket of the frequency inverter.

1.2 The CANbus system

The CANbus enables powerful automation systems to be realised with distributed intelligence. The reason for the broad application of the CANbus protocol is mainly the availability of very reasonably priced protocol components.

CANbus is based on linear topology. Using repeaters, branch-like topologies are possible. Solutions based on fibre optic conductors as well as double wire lines can be used. The collision recognition and resolution, as well as error recognition, integrated in the CANbus 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 of several participants, the participant with the highest priority receives the access rights. The priority is assigned according to the identifier of the messenger in CANbus.

1.3 The CANopen bus system (CANopen)

CANopen is an open communications profile for various industrial automation systems. It is based on the CANbus system (Controller Area Network), developed by Bosch, and describes the layers 1 (physical layer) and 2 (data transmission) 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.

Alongside 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.

The CANopen specifications DS-301 and DS-402 (not for SK 520E/530E with internal RJ 45 connection) of the CiA are supported.

1.4 The Nord CANbus system (CANnord)

… is a Getriebebau NORD-specific bus system; details can be found in Section 5.

[1] In systems, electrical equipment is usually connected to a ***functional earth***. This serves as a method of conducting transient and interference currents in order to ensure the EMC properties and should implemented in accordance with high-frequency aspects.

1.5 Physical - CAN Bus

- Electrically isolated bus interface
- Transfer rate from 10 kBit/s to 500 kBit/s (optionally up to 1 Mbit/s)
- Connection to frequency inverter via Sub-D9 connector, M12 system connector, RJ45 connector or screw/plug-in terminals (depending on option/device)
- CAN interface as per specifications 2.0A and 2.0B
- Up to 110 nodes (e.g. frequency inverters) on one bus
- Additional termination resistor (depending on option/device)
- Status display with 2 or 4 LEDs (not with SK 500E/520E/530E)
- External 24V supply required (~70mA for SK 300E/ SK 5x0E/ 700E/ 750E with technology unit CANopen, ~30mA for SK 520E/ 530E via internal RJ45 connection CANnord/ CANopen)
- TO supports 29 Bit + 11 Bit Identifier
- Internal SK 520/530E only 11 Bit Identifier

1.6 CANopen features

- Programming of all frequency inverter parameters using SDO
- Supports DS-301 communications profile and DS-402 drive profile (with technology units)
- Dynamic mapping (4 TPDOs und 4 RPDOs) with technology units
- Heartbeat/ Node Guarding

1.7 CANnord features

- Programming of all frequency inverter parameters using SDO
- Setpoint/actual values read/write
- Error messages
- Time out function

2 Modules

2.1 NORDAC SK 5xxE

By combining different modules for display, control and parameterisation, the NORDAC SK 5xxE can be easily adapted to various requirements.

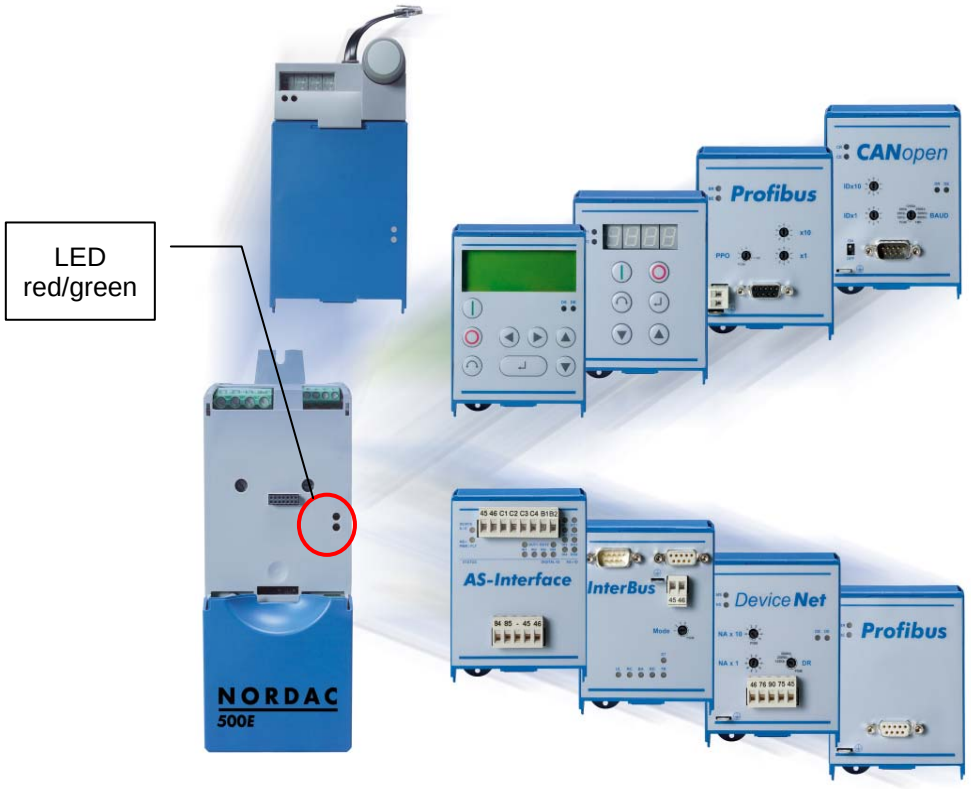
Alphanumerical display and operating modules can be used for simple commissioning. For more complex tasks, various connections to a PC or an automation system can be selected.

The technology unit (Technology Unit, SK TU3-…) is connected externally to the frequency inverter and is therefore easy to access and replace at any time.

In the delivery condition (without technology unit) 2 LEDs (green/red) are visible externally. These signal the actual device status.

The green LED signals that the mains voltage is present and operational, while a flashing code that increases in speed shows the degree of overload at the frequency inverter output.

The red LED signals actual error by flashing according to the number code of the error (Manual BU 0500, Section 6).



WARNING

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

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

NOTE

Possible CANnord / CANopen configuration with SK 5xxE	
SK 5xxE (entire series)	SK 511E/520E/53xE
CANopen with the SK TU3-CAO	**CANnord** or **CANopen** via internal RJ45
	
SUB D9 connector	Input/output via RJ45 sockets
Additional termination resistor	Additional termination resistor
External 24V +/- 25% voltage supply, approx. 80mA	External 24V +/- 25% voltage supply, approx. 30mA
Rotary coding switch for baud rate and address	Parameter P514 / P515 for baud rate and address
Drive profile DS 301 and DS 402	Drive profile DS 301
Section 2.1.2	Section 2.1.1

NOTE

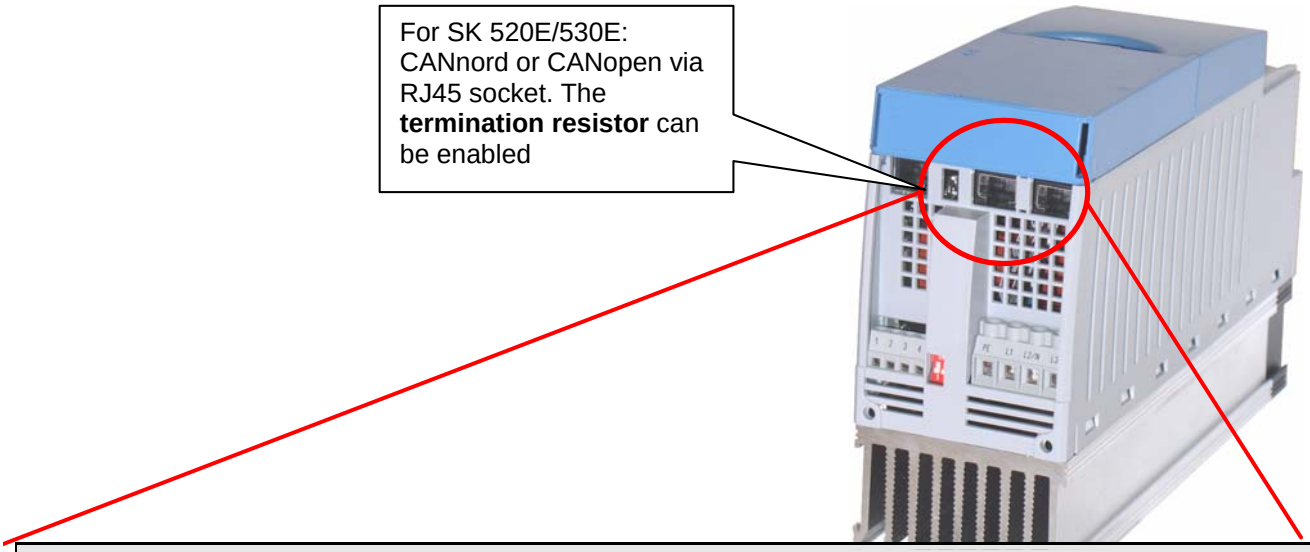
By means of appropriate measures, ensure that no vibrations or tensile forces act on the cabling.
In particular, the RJ45 connector cabling must be free of any tension.

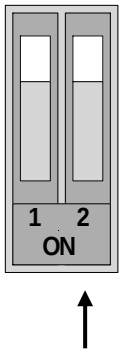
2.1.1 Integrated CANnord/CANopen with SK 511E/520E/53xE

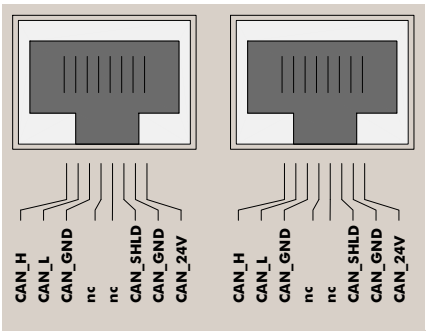
In the SK 511E/520E/53xE series, CANnord/CANopen is always integrated via the RJ45 connections and they can therefore be easily used for control.

To use the CANnord/CANopen, an external 24V voltage supply must be provided. The CAN participant can therefore be identified by the master system even without a voltage supply to the frequency inverter.

	CANnord (P509 = 3)	**CANopen (P509 = 6)**
Baud rate (P514)	The baud rate is set in the frequency inverter parameter P514. Transfer rates of up to 500 kbit/s can be used. (Optionally up to 1 Mbit/s)	
Supply voltage	The supply voltage is 24V DC ±25% (pin 8 = 24V, pin 7 = GND, approx. 30mA) and is implemented via the RJ45 connector.	
Termination resistor	The termination resistor R=120Ω for the last bus subscriber is located next to the BUS connection. Switch No. 2 = ON.	
BUS address (P515)	The BUS address is set in the frequency inverter parameter P515.	
	0…255	**0…127**
BUS connection	2x RJ45 sockets are parallel connected internally.	

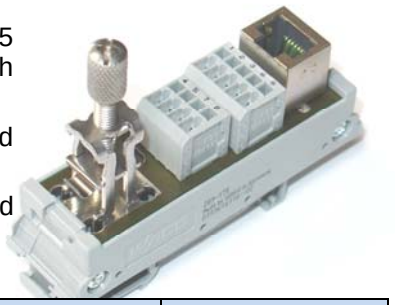


DIP switch and plug block 2xRJ45, CANnord/CANopen (SK 520E/530E only)			
1	CAN_H	CANnord/CANopen Signal	 DIP switch 2 for CANnord/CANopen termination resistor
2	CAN_L		
3	CAN_GND	CAN GND	
4	nc	No function	
5	nc		
6	CAN_SHD	Cable shield	
7	CAN_GND	GND/0V	
8	CAN_24V	Ext. 24VDC +/- 25% voltage supply	



RJ45: Pin No. 1 … 8

RJ45 WAGO adapter module



This adapter module can be used for the simple wiring of functions of the RJ45 connection (24V supply voltage, CANopen absolute encoder, CANbus) with normal cables.

Pre-assembled RJ45 patch cables are connected to the spring-loaded terminals (1-8 + S) with this adapter.

The shield clamp should be used in order to ensure the correct connection and relief of tension on the shield.

Supplier	**Designation**	**Article no.**
WAGO Kontakttechnik GmbH	Ethernet connection module with CAGE CLAMP connection RJ45 transfer module	289-175
WAGO Kontakttechnik GmbH	Accessories: WAGO shield clamp	790-108
Alternative, complete connection module and shield clamp		**Mat. No.**
Getriebebau NORD GmbH & Co.KG	Adapter module RJ45/terminal	278910300

2.1.2 CANopen, SK TU3-CAO

This CANopen module can be used for all SK 500E devices. It occupies the technology slot which can then no longer be used for control and display modules. Alternatively, the SimpleBox SK CSX-0 can be connected to the CANopen module and connected via the RS232/485 interface with the frequency inverter.

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

Baud rate:

Transfer rates of up to 500 kbit/s can be used (optionally up to 1Mbit/s).

Supply voltage:

The supply voltage is 24V DC ±25% (pin 9 = 24V, pin 3 = GND, approx. 80mA). The connection is made via the SUB-D9 connector.

Termination resistor:

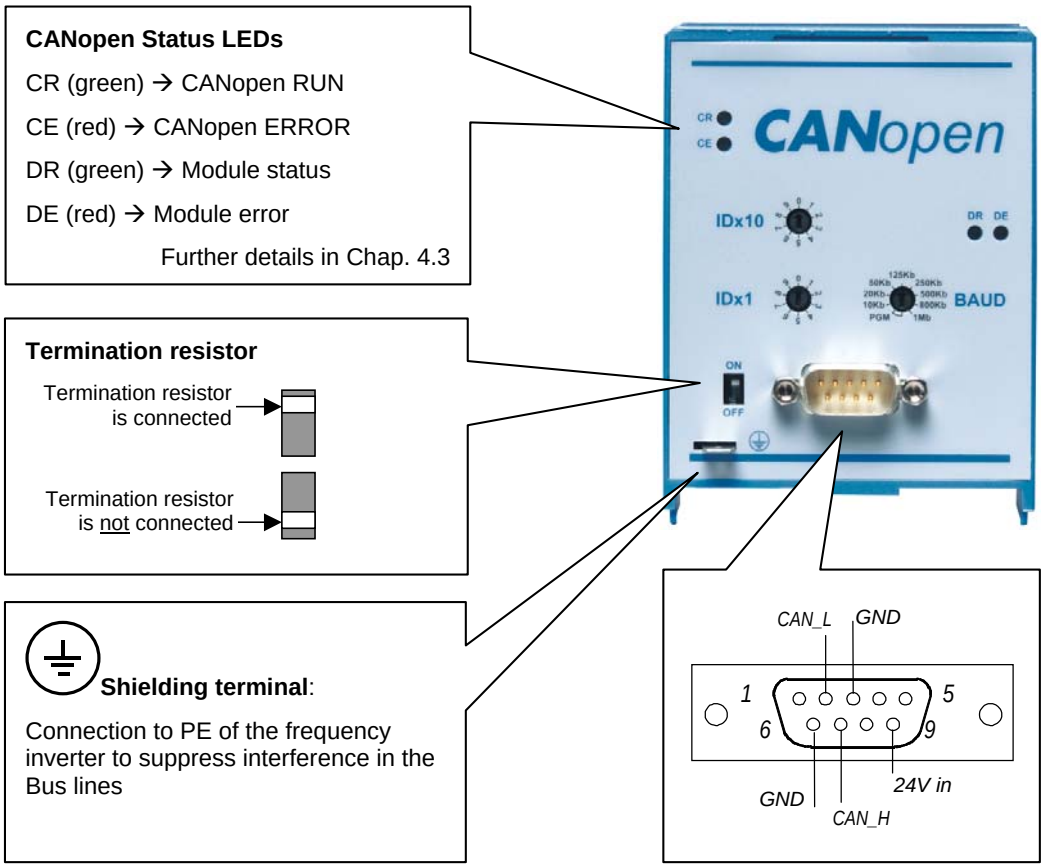
The termination resistor for the last Bus participant is located on the CANopen Bus module.

CAN address:

The rotary switches "IDx1" and "IDx10" can be used to set the node identifier dec-coded in the range 1…99dec.

If BAUD is set to PGM, the value from parameter 515 of the frequency inverter is used as the node identifier. (See also Section 5.4)

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



2.1.3 Installing the TU3 technology unit

The technology units must be mounted as follows:

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

Further detailed information can be found in the device manual BU 0500.

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2.2 NORDAC SK 700E/750E

Technology units, customer units and special extension units

By combining different modules for display, control and parameterisation, the NORDAC 700E/750E can be easily adapted to various requirements.

Modules are available for processing analog and digital signals and all common Bus systems.

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

WARNING

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

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

NOTE

Further detailed information can be found in the device manual BU 0700 / BU 0750.

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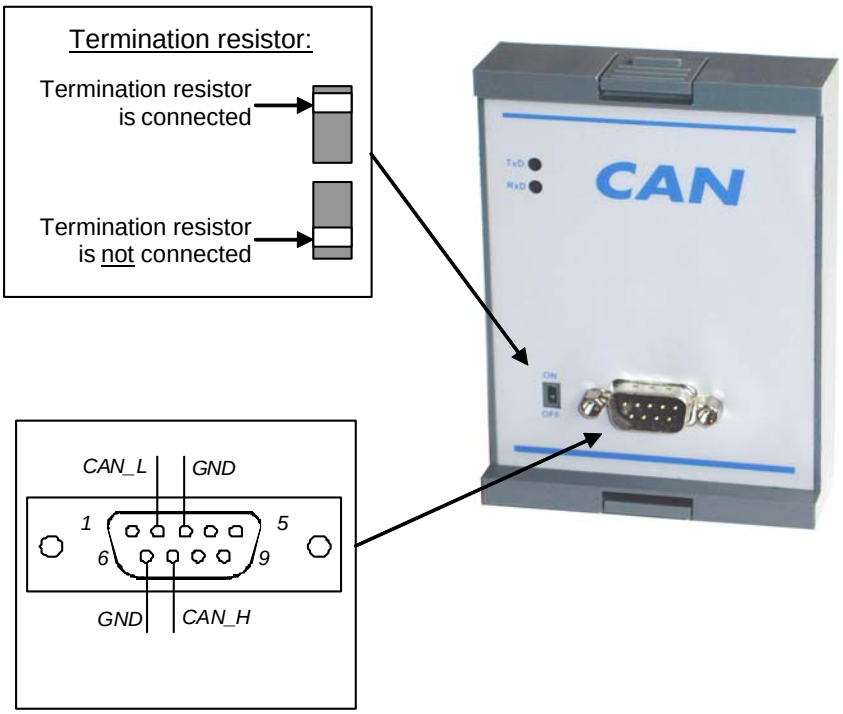
2.2.1 CANnord, SK TU1-CAN

The CANnord interface on NORDAC frequency inverters enables parameterisation and control of the device as per the CAN specifications 2.0A and 2.0B. Up to 110 nodes can be addressed on a single Bus. Termination resistors are integrated and can be switched in.

The transfer rate can be set to between 10 kBit and 500 Kbit/s. (Section 5 Bus parameters)

The conflict and error recognition integrated in the CANnord protocol enables maximum Bus usage and data security.

CANnord Status LEDs	
TxD (green)	Transmitting CAN data
RxD (green)	Receiving CAN data



2.2.2 CANopen, SK TU1-CAO

The CANopen communication modules SK TU1-CAO , are for connecting drives from the SK 700 device series to higher level automation systems via CANopen.

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

Setting the ID:

The node identifier can be set with the rotary switches IDx1 and IDx10 (01…99).

Example: Node ID = 64 → IDx10 = 6, IDx1 = 4

Setting the baud rate:

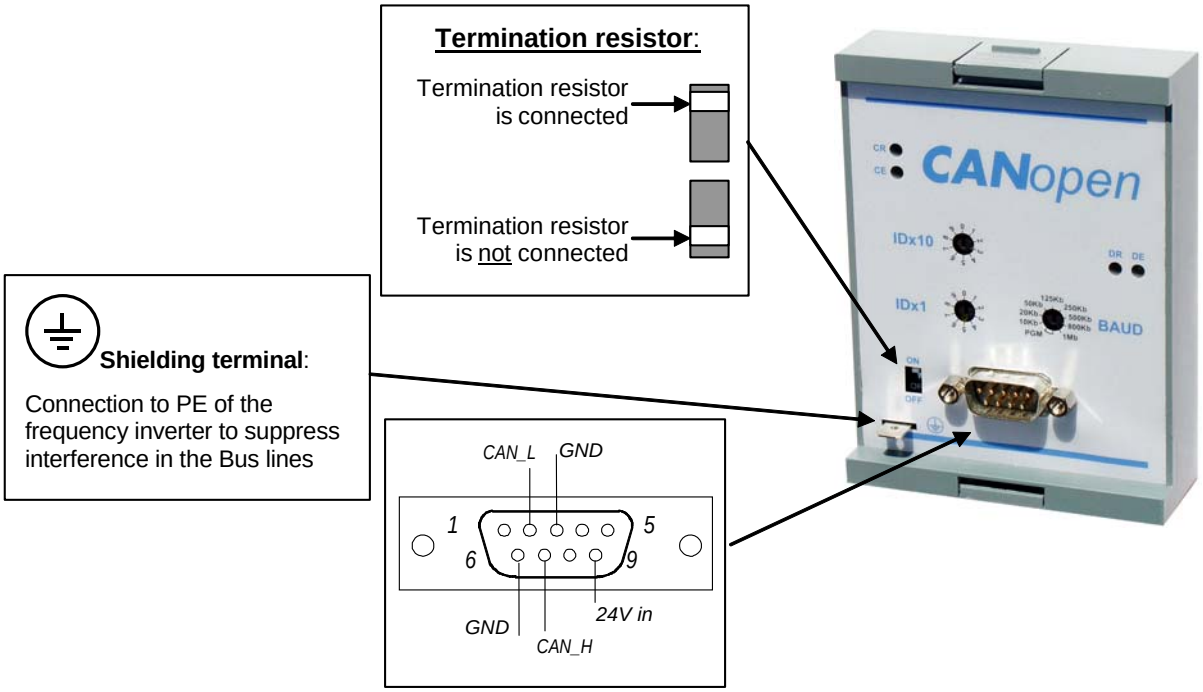
The rotary coding switch BAUD can be used to set the baud rate (10kBit/s...1Mbit/s).

If this rotary coding switch is set to PGM , the value from parameter P514 and the address from P515 of the frequency inverter is used as the baud rate. (See also Section 5.4)

Note: The settings made using the rotary coding switch are not transferred to the frequency inverter.

CANopen Status LEDs (Chap. 4.3)	
CR (green)	CANopen RUN LED (status machine)
CE (red)	CANopen ERROR LED

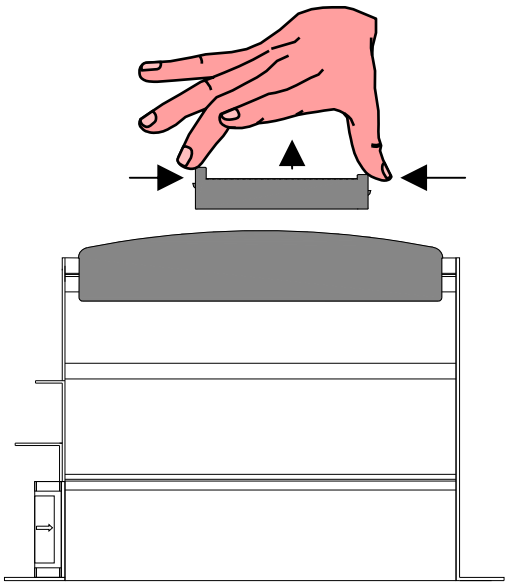
Module Status LEDs (Chap. 4.3)	
DR (green)	Module status
DE (red)	Module error



2.2.3 SK TU1-CAO installation

The technology units must be installed as follows:

1. Switch off the mains voltage, observe the waiting period.
2. Remove the dummy cover by actuating the unlocking device on the top and bottom edge.
3. Audibly engage the technology unit by pressing lightly on the installation surface.



WARNING

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

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

NOTE

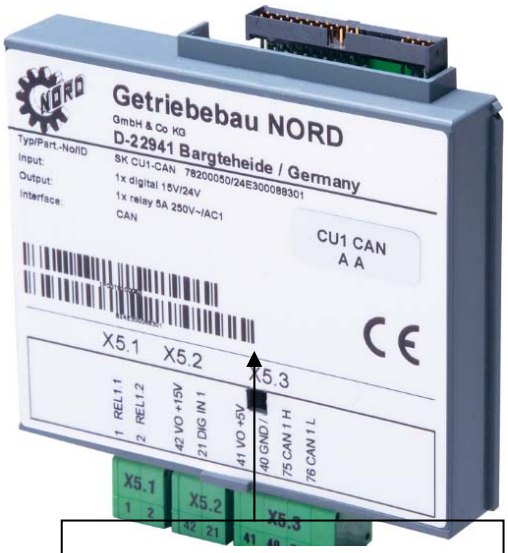
2.2.4 CANnord, SK CU1-CAN

In addition to data connections, all Bus customer units also have conventional digital inputs and outputs.

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

The digital input has a 2.5V switching threshold for the evaluation of the temperature sensor. The input can, however, also be used for an emergency stop function.

Cabling can be implemented using Western connectors and commercial network cables (twisted pair, modular connector 8P8C, RJ45), networking of several devices is possible with T-connectors.



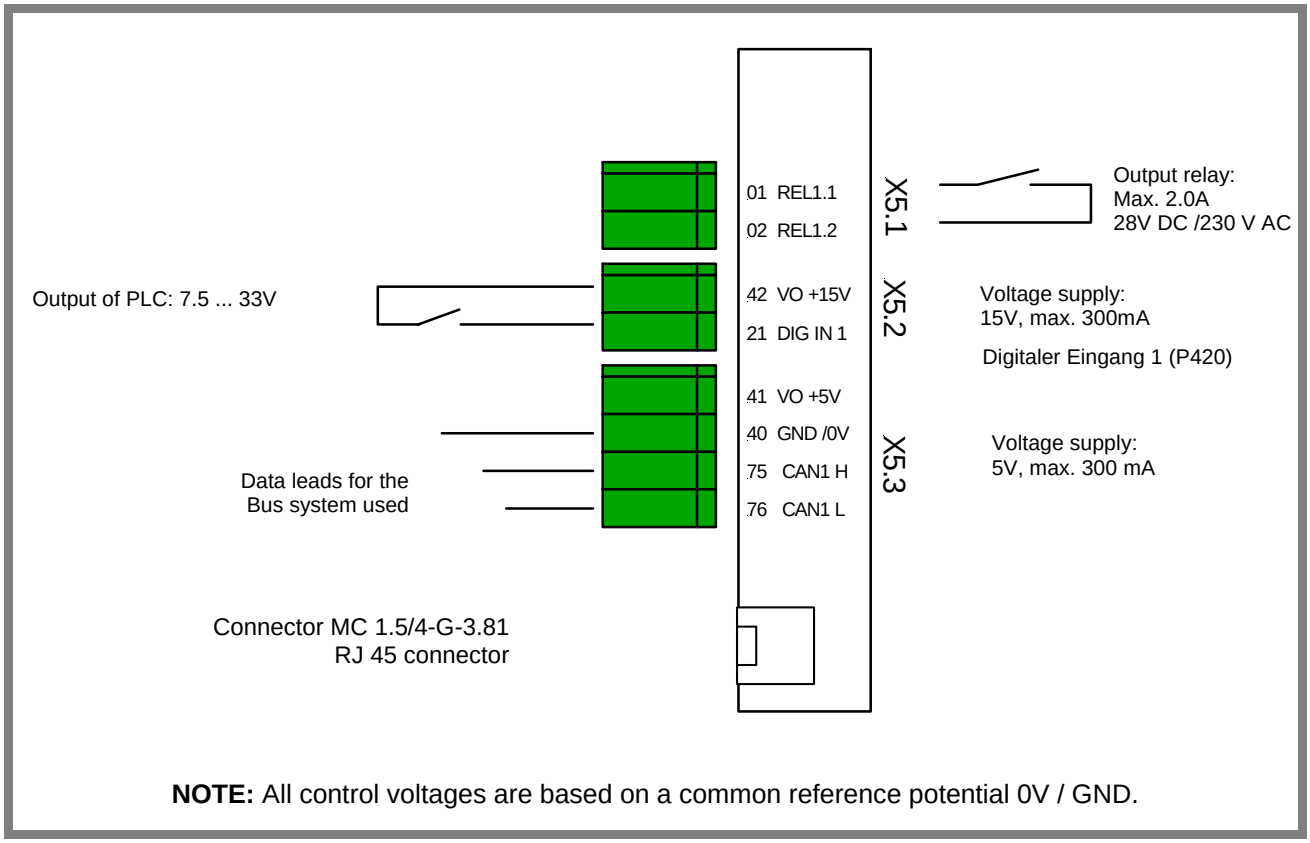
Terminals, SK CU1-CAN	Functions	Max. cross-section	Parameter
X5.1	Output relay	1.5 mm^2	P434
X5.2	Digital input	1.5 mm^2	P421
X5.3	Data cables	1.5 mm^2	P514/P515

RJ45 contact assignment	Functions
4	CAN_L (-)
5	CAN_H (+)
3, 6	GND
Housing	PE (shield)

Termination resistor

Termination resistor connected

Termination resistor not connected



NOTE: All control voltages are based on a common reference potential 0V / GND.

2.2.5 CANnord, SK CU1-CAN-RJ

The customer interface (customer unit) CANnord with RJ45 connector offers high functionality of digital signal processing and 2 parallel switched data connections. 5 digital inputs are available to control the frequency inverter.

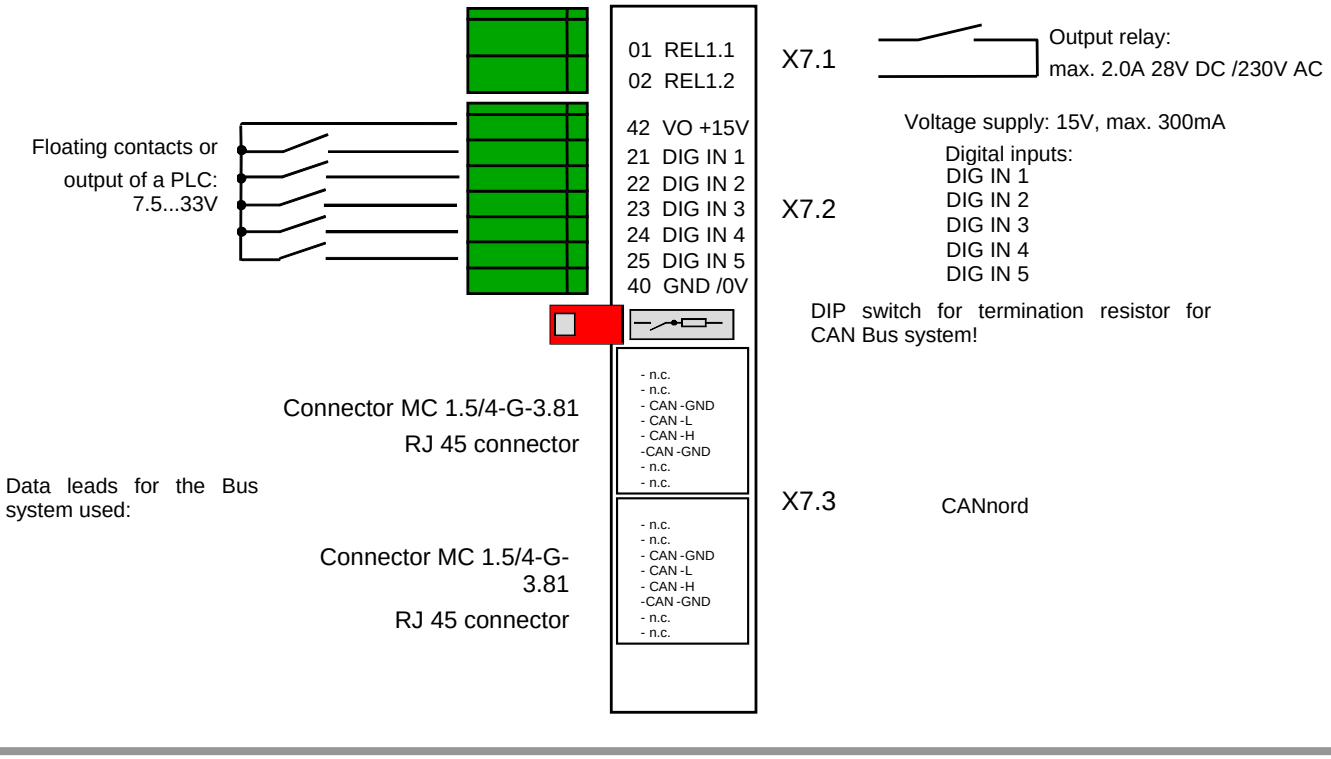
By means of a relay contact, brake control and even warnings to another system can be initiated.

The digital inputs of the CANnord module cannot process analog setpoints! (See also Section 5.1.5, P420-P425 in BU 0700)

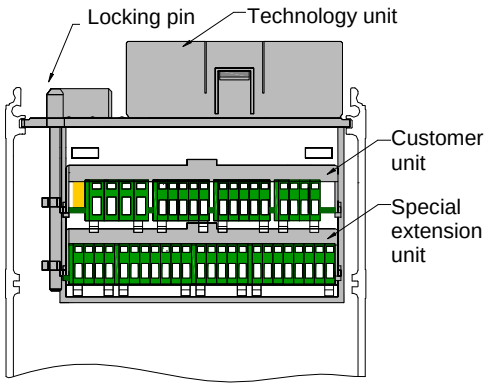
Cabling can be implemented using Western connectors and commercial network cables (twisted pair, modular connectors 8P8C, RJ45).

2 x RJ45 contact assignment	Functions
1, 2	n.c.
3, 6	GND
4	CAN_L (-)
5	CAN_H (+)
7, 8	n.c.
Housing	PE (shield)

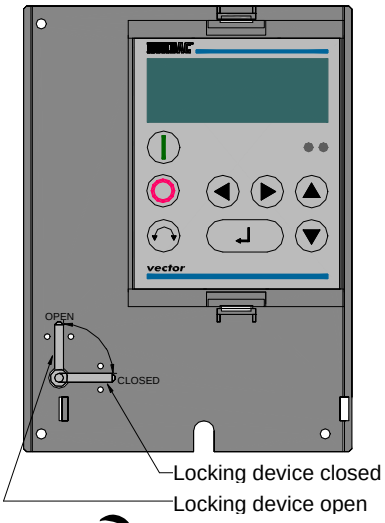
Connector	Functions	Maximum cross-section	Parameter
X7.1	Output relay	1.5 mm^2	P434 ... P436
X7.2	Digital inputs	1.0 mm^2	P420 ... P424
X7.3	Data cables	2 x RJ45 sockets	P509 ... P515



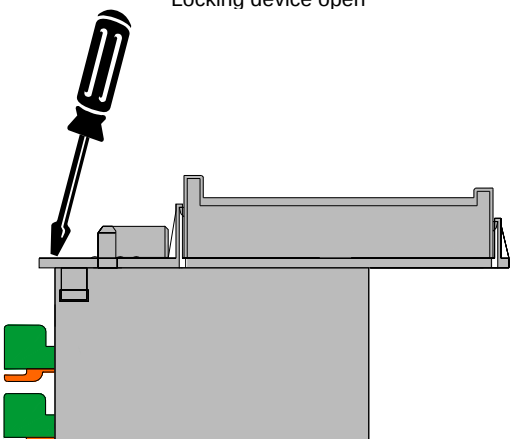
2.2.6 Mounting the customer unit



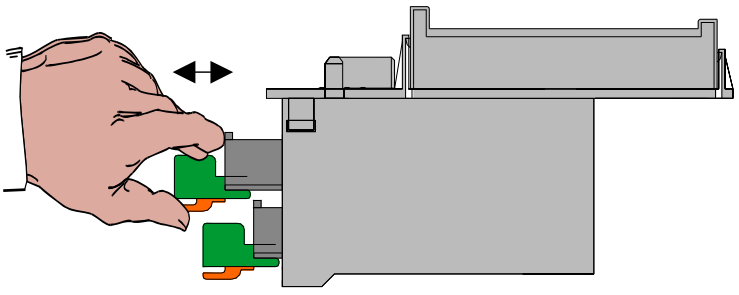
1. Switch off the mains voltage, observe the waiting period.
2. Remove cover by lifting off (use screwdriver if necessary).
3. Remove the cover grid from the connection area by loosening the 2 screws and levering out the device cover (slot) or simply pull it off.
4. Locking lever in the "open" position.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



2.2.7 Removing the customer unit



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



NOTE

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

Modules must not be replaced or inserted when the mains voltage is switched on!

2.3 NORDAC trio SK 300E/ 750E

Technology units are optional modules with which additional functions in the frequency inverter can be added depending on requirements. The high level of protection of the SK 300E/750E remains with all technology units.

The SK 300E/750E must have at least software version 1.6 R1 (see P707) so that it is fully compatible with the CANopen protocol.

Technology unit SK TU2-...	Description	Data
CANnord module **SK TU2-CAN**	This interface enables control of the SK 300E/750E via the serial CANnord port.	1 CANnord interface 2x 5 pin M12 system connectors
CANopen module **SK TU2-CAO**	This interface enables control of the SK 300E/750E via the serial CANopen port.	1 CANopen interface 2x 5 pin M12 system connectors
DeviceNet module **SK TU2-DEV**	This interface enables control of the SK 300E/750E via the serial DeviceNet port.	1 DeviceNet interface 1x 5 pin M12 system connector

2.3.1 CANnord, SK TU2-CAN

Features:

- Electrically isolated bus interface
- Default transfer rates between 10 kBit/s and 500 kBit/s (Section 5 Bus parameters)
- Connection to frequency inverter via 5 pin M12 connector
- CANnord protocol

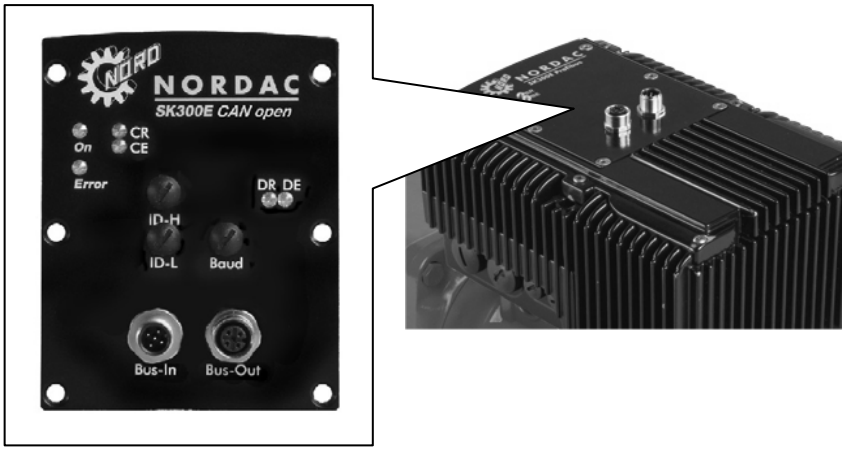
CANnord Status LEDs	
TxD (green)	Transmitting CAN data
RxD (green)	Receiving CAN data

2.3.2 CANopen, SK TU2-CAO

The CANopen communication module SK TU2-CAO, is for connecting drives from the trio SK 300E/750E device series to higher level automation systems via CANopen.

The CANopen module is supplied with voltage by an external 24V connection. The participant is therefore identified by the system even without power supply to the frequency inverter. The data required for this purpose are set using a rotary coding switch.

The data is read in when the 24V are applied.



Termination resistor:

The termination resistor for the last bus subscriber can be switched to the output of the final frequency inverter as the termination connector.

Rotary coding switch:

The rotary coding switches are located under the respective screw covers.

Setting the ID:

The node identifier can be set with the rotary switches IDx1 and IDx10 (01…99).

Example: Node ID = 64 → IDx10 = 6, IDx1 = 4

Setting the baud rate:

The baud rate can be set using the rotary switch BAUD (10kBit/s...1Mbit/s).

If this rotary coding switch is set to PGM , the value from parameter P514 and the address from P515 of the frequency inverter is used as the baud rate. (See also Section 5.4)

Note: The settings made using the rotary coding switch are not transferred to the frequency inverter.

LEDs:

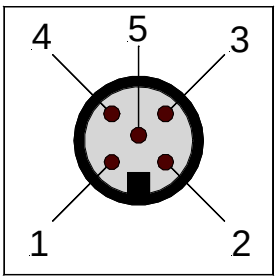
CANopen status LEDs (Section 4.3)	
CR (green)	CANopen RUN LED (status machine)
CE (red)	CANopen ERROR LED

Module status LEDs (Section. 4.3)	
DR (green)	Module status
DE (red)	Module error

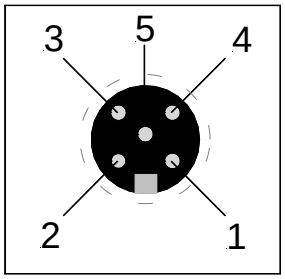
2.3.3 M12 connector assignment

The following connector assignments apply for the input and output of the CANopen connection.

M12	Functions
1, housing	PE (shield)
2	+ 24V
3	GND
4	CAN-H
5	CAN-L



Pin (bus in)

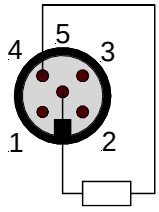


Socket (bus out)

(coded A for components)

The following connector components are recommended:

Terminating resistor, coded A



R = 120 Ω

Supplier	Designation	Article no.
MURR Elektronik	Bus terminating resistor M12	7000-13461-0000000
LUMBERG	Bus terminating resistor M12	RST ST

If required, ready-made CANopen cables can be obtained from the manufacturers listed here.

2.3.4 Installation SK TU2-...

WARNING

NOTE

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

Only install technology units when the device is voltage-free.

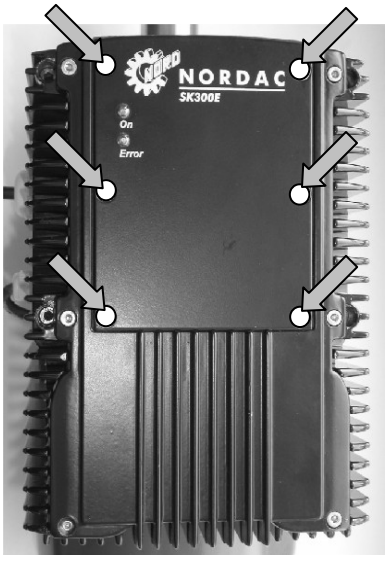
Installation of a technology unit separate to the frequency inverter is not possible. It must be connected directly to the frequency inverter.

The technology units must be installed as follows:

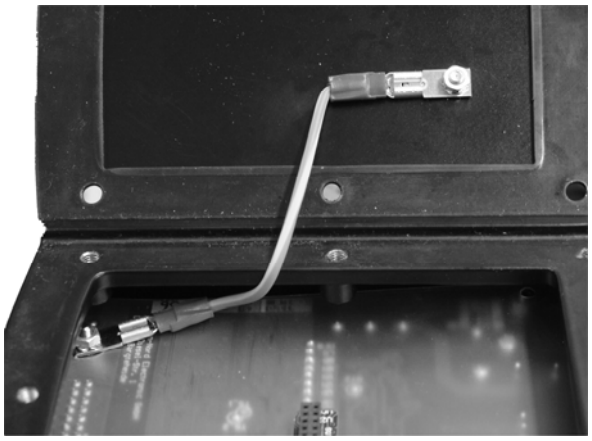
1. Switch off the mains voltage, observe the waiting period.
2. Remove the dummy cover by unscrewing the 6 hexagon socket screws.
3. Make sure that the plug-in connections are firmly in place and that the lid is sealed.
4. Insert the technology box and screw in place.

Earthing line

Make sure the earthing line is plugged into the plate of the standard device and each technology unit. This line must be connected when installing the technology unit to ensure it is fully earthed.



Technology unit
fastening screws



Earthing the end plates

2.4 NORDAC vector mc

The NORDAC vector mc frequency inverter is delivered as standard without an operating module. Parameterisation can only be carried out via the RS 485 interface (control terminals) with the USS protocol.

One of the following options can also be selected:

RS 232 mc	Profibus mc
CANnord mc	ControlBox mc (parameterisation/ operating field)
CANopen mc	ParameterBox (plain text operating field)
DeviceNet mc	

Please note that further additional components or software may be required for the above modules.

NOTE

The required parameter settings can e.g. be made using the ControlBox mc (optional) or the RS485 customer interface with the NORD CON software The parameter numbers and values are displayed by a 4-digit 7-segment LED display or on the PC.

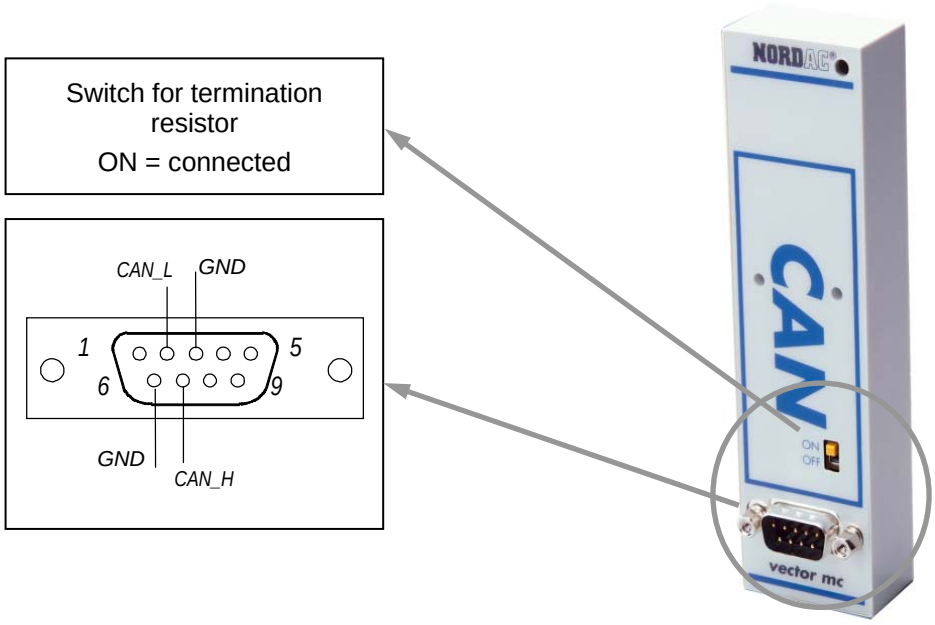
Installation of a CAN/CANopen mc module separate to the frequency inverter is not possible. It must be connected directly to the device.

2.4.1 CANnord mc technology unit

The CANnord interface on NORDAC frequency inverters enables parameterisation and control of the device as per the CAN specifications 2.0A and 2.0B. Up to 255 devices can be addressed on a single Bus. Termination resistors are integrated and can be switched in.

The transfer rate can be set to between 10 kBit/s and 500 Kbit/s. (Section 5 Bus parameters)

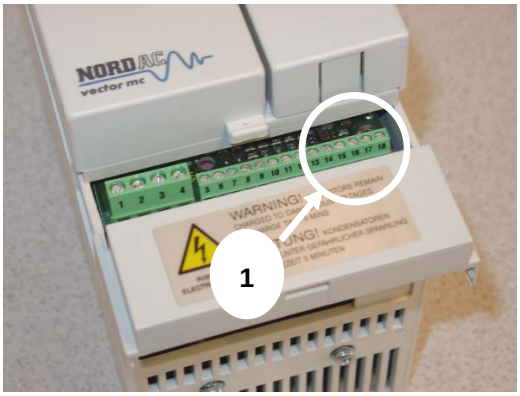
The conflict and error recognition integrated in the CANnord protocol enables maximum Bus usage and data security.



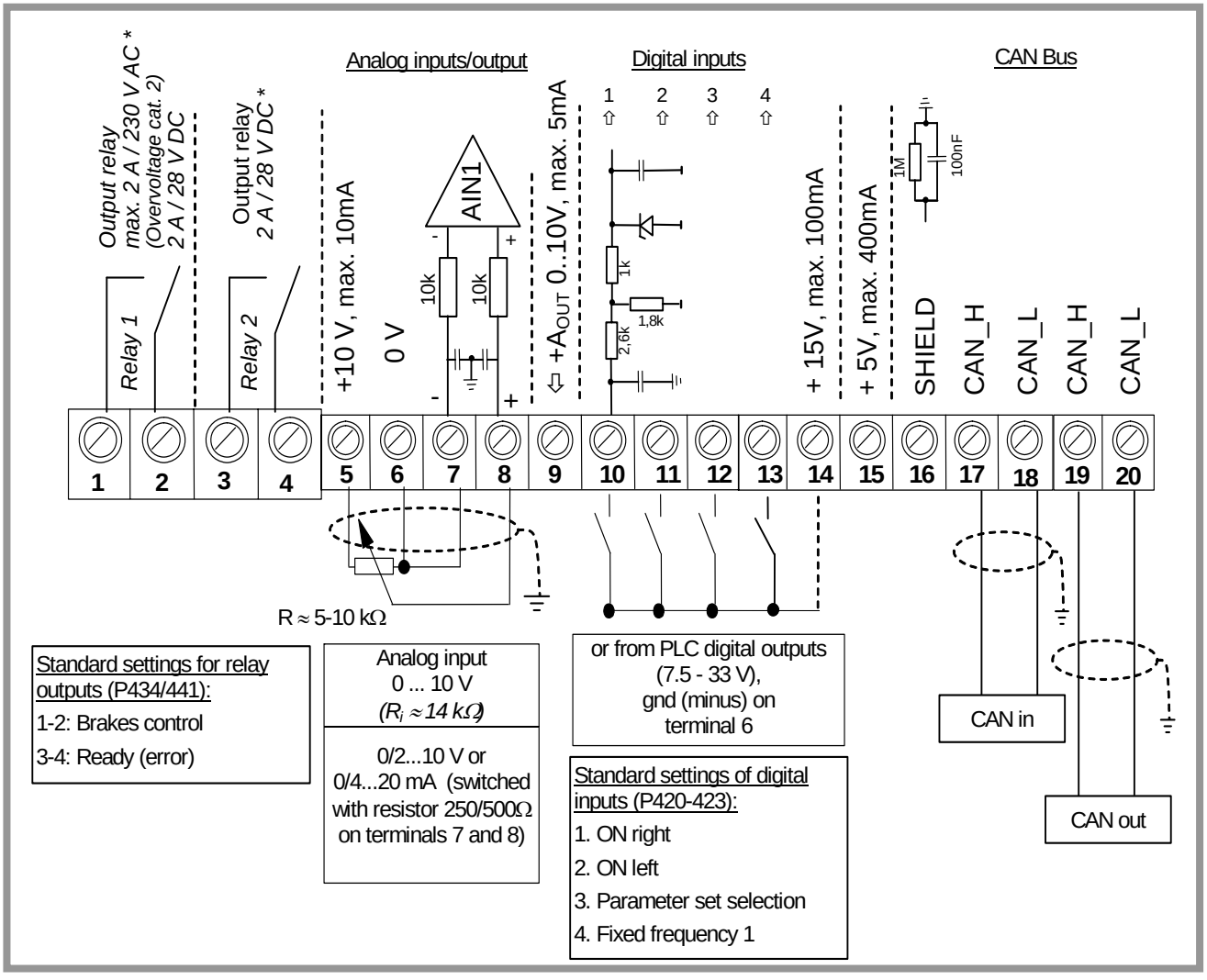
2.4.2 CANnord, SK … FCTC devices

With the NORDAC vector mc, a CANnord interface (Detail 1) is available on the 20 pin control terminal strip of the special design version SK…FCTC. This replaces the RS485 interface in the standard device.

A CANnord termination resistor must be installed if necessary; it is not integrated here.



Terminal (Detail 1)	Functions	Maximum cross-section	Parameter
15	+5V	1.5 mm^2	-
16	0V, GND	1.5 mm^2	-
17	CAN_H in	1.5 mm^2	P509 ... P515
18	CAN_L in	1.5 mm^2	
19	CAN_H out	1.5 mm^2	
20	CAN_L out	1.5 mm^2	

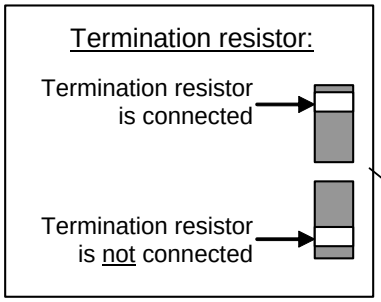


2.4.3 CANopen mc module

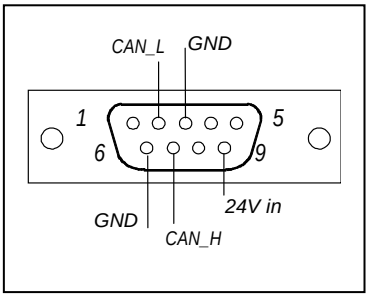
The CANopen communication module CANopen mc is for connecting drives from the vector mc device series to higher level automation systems via the CANopen protocol.

The CANopen module is supplied with voltage by an external 24V connection. Thus the participant is identified by the system even without power supply to the frequency inverter. The data required for this purpose are set using a rotary coding switch.

The data is read in when the 24V are applied.



Note: The settings made using the rotary coding switch are not transferred to the frequency inverter.



Connector assignment: SUB-D9

Setting the ID:

The node identifier can be set using the rotary switches ID-L and ID-H (1...127).

Example: Node ID = 100 dec = 64 hex → ID-H=6, ID-L=4

If ID-H is set to a greater value than 7, the value from parameter 515 of the frequency inverter is used as the node identifier. (See also Section 5.4)

Setting the baud rate:

The baud rate can be set using the rotary switch BAUD (10kBit/s...1Mbit/s). If a value in the PGM range is set, the value from parameter 514 of the frequency inverter is used as the baud rate. (See also Section 5.4)

LEDs:

CANopen status LEDs (Section 6.4)	
CR (green)	CANopen RUN LED (status machine)
CE (red)	CANopen ERROR LED

Module status LEDs (Section. 6.4)	
DR (green)	Module status
DE (red)	Module error

NOTE

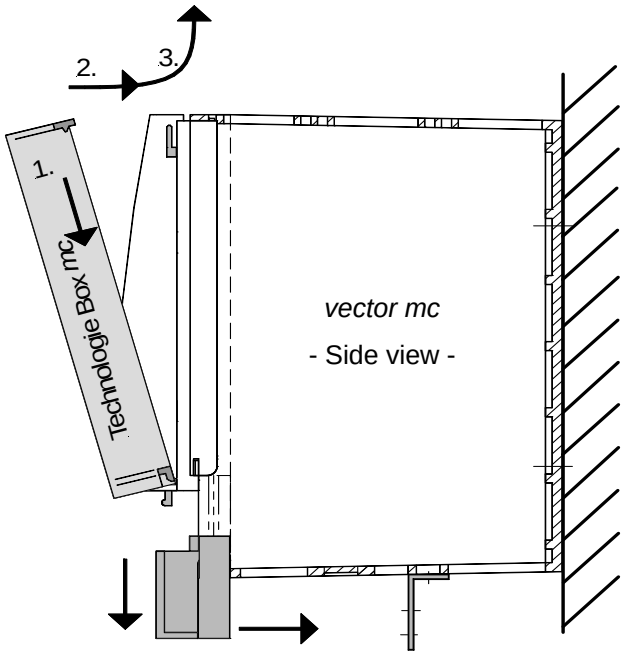
Modules must not be inserted or removed unless the device is free of voltage. The slots may only be used for the applicable modules. The slots are coded to prevent them from incorrectly connected.

2.4.4 Installation CANnord/CANopen mc

The CANnord/CANopen mc technology unit must be mounted as follows:

1. Switch off the mains voltage, observe the waiting period.
2. Remove the dummy cover by simply pulling the upper edge.
3. First hook the CANnord/CANopen mc module on the bottom end and then press lightly on the top end towards the installation surface until it audibly clicks into place.

The device is ready for operation shortly after the mains power has been switched on.



3 CAN/CANopen Bus structure

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 line is used for data transfer.

3.1 Laying the Bus cable

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.

3.2 Cable material

The frequency inverter is usually connected to the CANnord 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.

Bus cable length	Resistance	Cable cross-section	Possible transfer rates
Up to 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, AWG22	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 complies with ISO 11898. The maximum permissible voltage on the CAN_L and CAN_H cables is -8V … +8V.

3.3 Cable layout and shielding (EMC measures)

If EMC measures are not in place, high-frequency interference which is principally brought about by switch procedures 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. You achieve the best shielding qualities with the following measures

- Connect the Bus subscribers with the shortest amount of cable possible.
- The shielding on the Bus line must be applied completely on both sides.
- Avoid using tap lines to connect field devices to the Bus.
- Avoid extending the Bus lines using plug connectors.

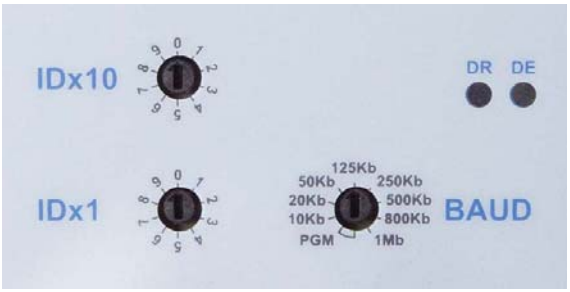
Bus lines should be laid with a minimum spacing of 20cm to other lines which carry a voltage higher than 60V. This applies to lines laid inside and outside of control cabinets.

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 using sufficient potential equalisation.

4 Display and operating elements

4.1 Rotary coding switch for SK TUx-CAO

a) BAUD: Baud rate setting
b) BAUD **PGM**: Baud rate from P514
c) IDx1: Bus address one digit
d) IDx10: Bus address ten digit



4.2 LED display CANnord

The status of the CANnord technology unit is signaled by 2 LEDs, TxD and RxD.

NOTE: When using the internal RJ45 interface of the SK 520E/ 530E or the SK TU1-CAN or …-CAN-RJ (SK 700E/750E), no LEDs are available.

CANnord Status LEDs (data transfer)	
TxD (green)	Transmitting CAN data
RxD (green)	Receiving CAN data

4.3 LED display CANopen

The status of the CANopen technology unit is shown by 4 LEDs:

- CR/CE CANnord status
- DR/DE: Module status

NOTE: When using the internal RJ45 interface of the SK 511E520E/53xE, no LEDs are available.

CR (green): CANopen RUN LED (status machine)

Display	Significance
Single flashing (1s)	CANopen status STOPPED
Flashing (0.5s)	CANopen status PRE-OPERATIONAL
Flashing (0.25s)	No other subscriber is in the bus or the wiring is faulty. (only possible when flashing with CE)
On	CANopen status OPERATIONAL

CE (red): CANopen Error LED:

Display	Significance
Off	No error
Flashing	Bus warning, CAN controller error counter has reached or exceeded the warning limit. Check wiring / shielding / termination resistors No other subscribers available
On	Bus off, CAN controller has disconnected from the bus because a serious error has occurred, e.g.: • Wiring error • Incorrect baud rate set

DR (green): Module status

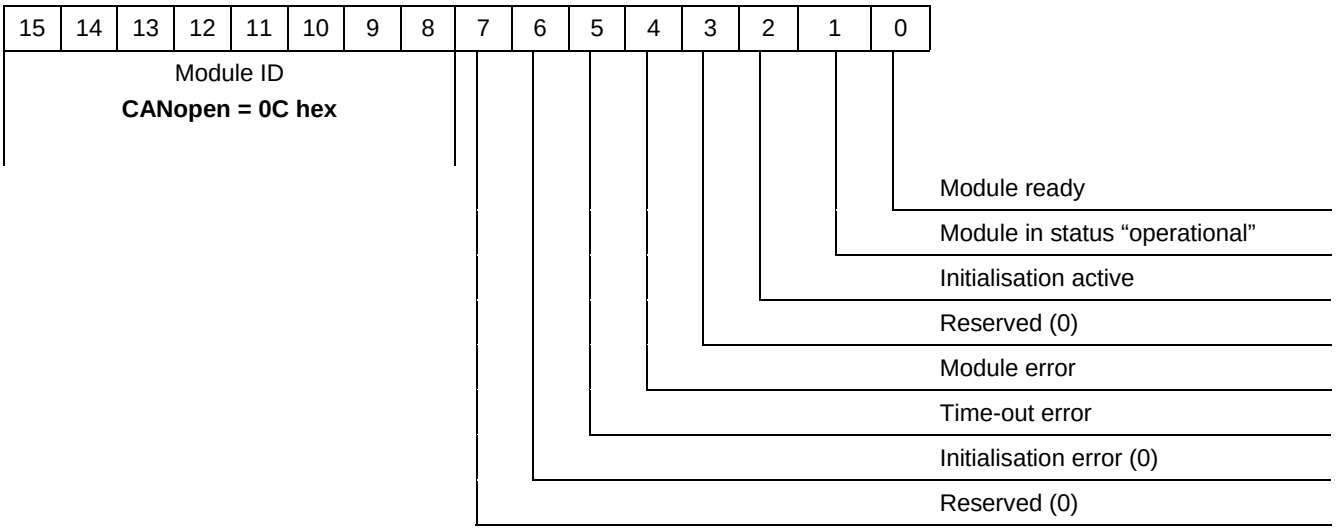
Display	Significance
Off	No voltage supply
Flashing	Initialisation (init. phase)
On	Module OK

DE (red): Module status

Display	Significance
Off	No error
Flashing (0.2s)	Initialisation phase
Flashing (0.5s)	Time-out error
Single flashing (1s)	Inverter error (see frequency inverter instructions)
On	System error, e.g. plug contact not correct

4.4 Module status of technology unit

The current status of the CANopen technology unit (possibly Array -01) can be read out in parameter P746.
The parameter contains binary coded information which is displayed in hexadecimal format:



4.5 Status of internal CANnord/CANopen, SK 511E/520E/53xE

When using the internal RJ45 CANnord/CANopen interface of the SK 511E/520E/53xE, no LEDs are available to display the device status. The parameter P748 Array -01 (sub-index) can be used for this purpose.
The display is hexadecimal, the individual bits are listed below:

<table>
<tr><td>Bit 0 =</td><td>24V Bus supply voltage</td></tr>
<tr><td>Bit 1 =</td><td>CAN Bus in "Bus Warning" status</td></tr>
<tr><td>Bit 2 =</td><td>CAN Bus in "Bus Off" status</td></tr>
<tr><td>Bit 3 ... 5 =</td><td>vacant</td></tr>
<tr><td>Bit 6 =</td><td>Protocol of CAN module is
0 → CAN or 1 → CANopen</td></tr>
<tr><td>Bit 7 =</td><td>vacant</td></tr>
<tr><td>Bit 8 =</td><td>"Bootsup Message" sent</td></tr>
<tr><td>Bit 9 =

Bit 10 =</td><td>CANopen NMT State
<table>
<tr><td></td><td>Bit 10</td><td>Bit 9</td></tr>
<tr><td>Stopped =</td><td>0</td><td>0</td></tr>
<tr><td>Pre- Operational =</td><td>0</td><td>1</td></tr>
<tr><td>Operational =</td><td>1</td><td>0</td></tr>
</table></td></tr>
<tr><td>Bit 11 = 0</td><td>reserved</td></tr>
<tr><td>Bit 12 ... 14 = 0</td><td>reserved</td></tr>
<tr><td>Bit 15 = 0</td><td>reserved</td></tr>
</table>

5 The CANnord protocol

5.1 Message objects

The control and parameterisation of the NORDAC frequency inverter is implemented via CANnord using four message objects. The message objects are identified by different identifiers. The following services are available for a logic master (client):

1. Transmit process data (control word and target value) – confirmed or broadcast
2. Receive process data (status word and actual value)
3. Transmit parameter order (read or write)
4. Receive parameter order response identifier / parameter value
5. Transfer of setpoint positions with SK 700E / SK 53xE with PosiCon option
6. Transfer of the current frequency inverter status during operation

(The data directions "transmit", "receive" are based on the logic master or client)

The process objects (1. + 2.) can be 4 Bytes (transfer of setpoint) or 8 Bytes (transfer of several setpoints) long. Parameter objects are always 8 Bytes long.

5.2 Identifier

The standard CAN (2.0A) permits maximum 2048 different identifiers. Each identifier represents the address for a message object, whereby a frequency inverter uses at least 4 different message objects. In addition, so-called broadcast identifiers can be assigned (see below).

The identifier of the message object can be derived from the CANnord address (P515):

1 *	Process data Master → Frequency inverter	(CAN address*2) + 0
2	Process data inverter → Master	(CAN address*2) + 1
3	Parameter order Master → Inverter	(CAN address*2) + 512
4	Parameter response inverter → Master	(CAN address*2) + 513
5	Broadcast process data Master → Inverter	1024 - 1032 (1)

*) 1: Only when broadcast set in frequency inverter

The identifier also specifies the priority in the CANnord protocol (the higher the identifier, the lower the priority). Process data therefore always automatically have higher priority.

In "Extended Frame Telegrams", a constant part is added to the identifier. The Extended ID is generated by adding 18 null bits, so that the identifier for extended and standard formats can be the same. The identifier format is automatically recognised.

5.3 Broadcast telegrams

To control several frequency inverters simultaneously (e.g. same enable and same setpoint), it is possible to address frequency inverter groups or all frequency inverters using broadcast telegrams. This means that, in addition to the identifiers described above, additional broadcast identifiers for each frequency inverter are also valid. A range of 32 addresses is assigned to one broadcast identifier. All connected frequency inverters can be controlled using the broadcast identifier 1032.

CAN address (P515)	Broadcast identifier
00 - 31	1024 (400h)
32 - 63	1025 (401h)
64 - 95	1026 (402h)
96 - 127	1027 (403h)
128 - 159	1028 (404h)
160 - 191	1029 (405h)
192 - 223	1030 (406h)
224 - 255	1031 (407h)
0 - 255	1032 (408h)

The broadcast function is activated when the interface parameter (P509=11) is set to CAN broadcast.

This assumes that the control data and setpoint are specified via CANnord.

Only process data can be transferred with broadcast telegrams. Status data are not returned (unconfirmed service).

5.4 Identifier example

In the frequency inverter, the CANnord address (P515) is set to the value 100.

This results in the following identifier:

CAN address	100dec
Process data Master → Frequency inverter	200dec
Process data frequency inverter → Master	201dec
Parameter order Master → Frequency inverter	712dec
Parameter response frequency inverter → Master	713dec
Broadcast identifier No. 4	1027dec
Broadcast identifier No. 9 (all)	1032dec

In the example above, the master transmits its process data to the frequency inverter with the identifier 200. As a response it receives the actual values with the identifier 201. A parameter with the identifier 712 is sent to the frequency inverter. The response by the frequency inverter is made with the identifier 713.

If P509 is set to 11, the broadcast identifiers 1027 and 1032 are also valid.

5.5 Sequence of data transfer

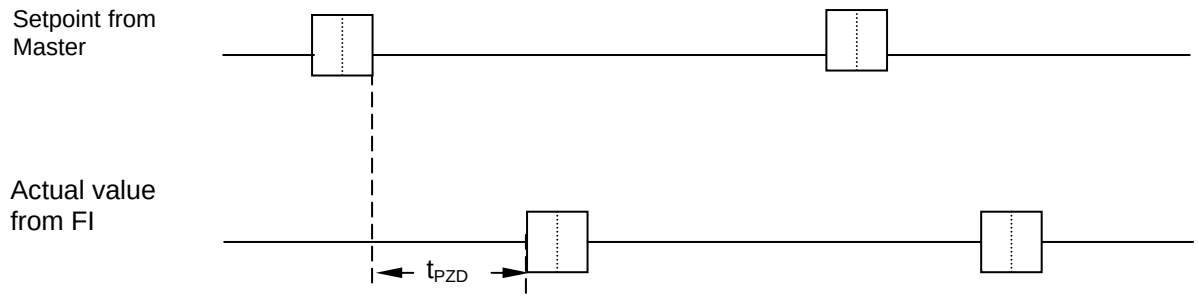
If the user sends process data to the frequency inverter, it responds via the appropriate message channel. It acts in the same way with parameter orders (see illustration).

The following delays occur between transmitting and receiving:

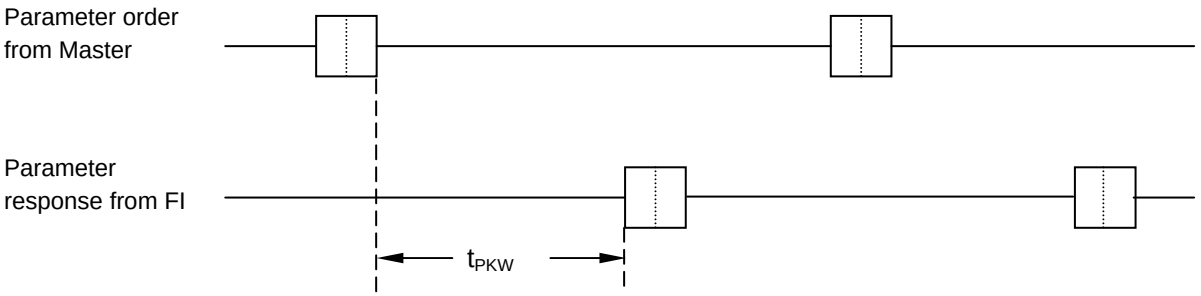
- Process data (t_{PZD}) approx. 1 to 3 ms
- Parameter data (t_{PKW}) approx. 5 to 10 ms

If an error occurs in the frequency inverter, it immediately transmits its status word and actual value via the PZD channel. The error state is indicated by the error bit in the status word. The current error number can then be read out via the PKW channel.

Timing process data



Timing parameter data



6 The CANopen protocol

Object index (OI)

The OI contains all objects of the device. Objects depict the visible functionality. They contain data, parameters or functions. Access is gained via SDOs. An object is addressed via the Index (16 Bit) and the SubIndex (8Bit). The OI is divided into the following areas:

0000h...1FFFh: Communication specific objects

2000h...5FFFh: Manufacturer-specific objects

6000h...9FFFh: Standardised device profile objects

A000h...FFFFh: Reserved

Service data obj. (SDO)

SDOs are used for confirmed transfer of data of any length between two network subscribers: The SDO client is the initiating subscriber and has direct access to the OI inputs of the SDO server (read and write). The SDO transfer is normally used for parameterisation and service purposes.

Process data obj. (PDO)

PDOs are used for transferring process data. The process data can contain a maximum of 8 bytes. Transfer is made without confirmation. The significance of the data transferred is determined by the identifier and the set PDO mapping. A PDO always has a producer (transmitter). Several consumers (receivers) may exist.

PDO mapping

In objects 1600h-1603h / 1A00h..1A03h it is possible to set which objects (setpoint/actual values) are transferred into the PDO telegrams.

Identifier

Every CAN message has an 11 bit identifier. This identifier is used for addressing and priority assignment.

CANopen defines a preset identifier assignment which facilitates communication between a higher level device and up to 127 other devices. The 11 bit identifier is broken down as follows:

10	9	8	7	6	5	4	3	2	1	0
Function code				Node identifiers (1-127)						

Object	Function code	Resulting COB-ID	OI entry
NMT	0000	0	
SYNC	0001	80h	1005h-1007h
Time stamp	0010	100h	1012h, 1013h
Emergency	0001	81h – FFh	1014h, 1015h
PDO1 (Tx)	0011	181h – 1FFh	1800h, 1A00h
PDO1 (Rx)	0100	201h – 27Fh	1400h, 1600h
PDO2 (Tx)	0101	281h – 2FFh	1801h, 1A01h
PDO2 (Rx)	0110	301h – 37Fh	1401h, 1601h
PDO3 (Tx)	0111	381h – 3FFh	1802h, 1A02h
PDO3 (Rx)	1000	401h – 47Fh	1403h, 1602h
PDO4 (Tx)	1001	481h – 4FFh	1803h, 1A03h
PDO4 (Rx)	1010	501h – 57Fh	1403h, 1603h
SDO (Tx)	1011	581h – 5FFh	1200h
SDO (Rx)	1100	601h – 67Fh	1200h
NMT Error Control	1110	701h – 77Fh	1016h, 1017h

6.1 Process data objects (PDO)

6.1.1 Control via PDOs

PDOs are used to transfer process data: The frequency inverter transmits its status data via transmit PDOs and receives control data via receive PDOs. NORDAC frequency inverters have up to 4 transmit and 4 receive PDOs which 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 is transferred.

6.1.2 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. These settings are set in objects 1400-1403 and 1800-1803. The following settings can be made with NORDAC frequency inverters:

Transmit PDO:

Transmission type	Value
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:

Transmission type	Value
0-240	Data from the receive PDO is not processed until the next SYNC command has been received.
252-253	Reserved
254, 255	Data from receive PDO is processed immediately (standard setting)

6.1.3 PDO mapping

The assignment of process data in the receive and transmit PDOs is set under PDO mapping (objects 1600-1603 and 1A00-1A03). Up to 8 bytes of data can be transferred in each PDO. Mapping determines where which pieces of data are placed in these 8 bytes, e.g.:

PDO data bytes			
1	2	3	4
Control Word (16 Bit)		Setpoint 1 (16 Bit)	

The control word, status word, the setpoint values and actual values can be set using the following object numbers:

Index	Sub-index	Control object
3000		Control word (STW)
3002	1	Setpoint 1 (SW1) 16 Bit
	2	Setpoint 2 (SW2) 16 Bit
	3	Setpoint 3 (SW3) 16 Bit
	4	Setpoint 1 (SW1) 32bit

Index	Sub-index	Status object
3001		Status word (ZSW)
3003	1	Actual value 1 (IW1) 16 Bit
	2	Actual value 2 (IW2) 16 Bit
	3	Actual value 3 (IW3) 16 Bit
	4	Actual value 1 (IW4) 32bit

An entry in the object index determines the setting (objects 1600-1603 and 1A00-1A03). This specifies which object of the device is transferred to which point of the PDO.

6.1.3.1 Mapping SK 300E, SK 5xxE (SK TU3-…), SK 700E, SK 750E and vector mc

	Length	Identifier
PDO1 (Tx)	4 Byte	180h + NODE-ID
PDO1 (Rx)	4 Byte	200h + NODE-ID
PDO2 (Tx)	8 Byte	280h + NODE-ID
PDO2 (Rx)	8 Byte	300h + NODE-ID
PDO3 (Tx)	8 Byte	380h + NODE-ID
PDO3 (Rx)	8 Byte	400h + NODE-ID
PDO4 (Tx)	2 Byte	480h + NODE-ID
PDO4 (Rx)	2 Byte	500h + NODE-ID

1st word	2nd word	3rd word	4th word
ZSW	IW1		
STW	SW1		
ZSW	IW1	IW3 *	IW2 *
STW	SW1	SW3 *	SW2 *
ZSW	IW1 (32 Bit)		IW2
STW	SW1 (32Bit)		SW2
ZSW			
STW			

*) In the SK 5xxE devices, the IW/SW 3/2 are assigned inversely to the words.
3. word = IW/SW2, 4th word = IW/SW3

The NORDAC frequency inverters support dynamic mapping and dummy mapping!

The data content of the PDO telegrams is described below.

When the drive profile is activated (P551 = On), objects 6040 - 6044 instead of 3000 - 3003 are relevant (see drive profile DS-402).

6.1.3.2 Mapping, SK 511E/520E/53xE (internal RJ45)

	Length	Identifier
PDO1 (Tx)	8 Byte	180h + NODE-ID
PDO1 (Rx)	8 Byte	200h + NODE-ID
PDO2 (Rx)	4 Byte	180h + NODE-ID + 1

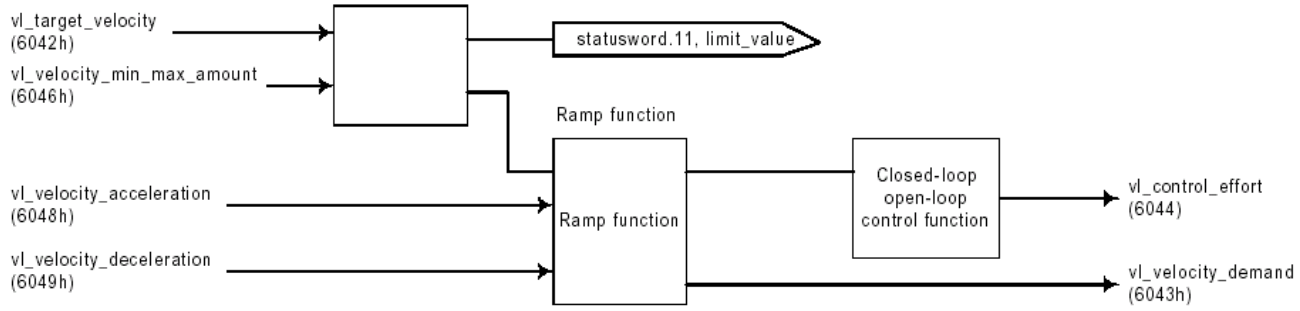
1st word	2nd word	3rd word	4th word
ZSW	IW1	IW2	IW3
STW	SW1	SW2	SW3
IW (32Bit) of an absolute encoder			

6.2 Drive profile DS 402

If the drive profile parameter (P551) is switched on in the frequency inverter, the device supports the profile as per DS402 velocity mode (speed profile).

The profile is only valid in parameter set 1.

Overview of the objects in the “speed” drive profile



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6.3 Structure of SDO telegrams

Access to all parameters of the frequency inverter and the CANopen Box is implemented 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.

Transmit and receive addresses for SDO access seen from the PLC

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

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

The Node ID of the frequency inverter is set via the "ID-H" and "ID-L" switches on the CANopen Box or in the PGM mode via parameter P515.

6.4 Transmitting parameter data via SDO

Transmitting 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

Sending 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

Sending 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 to a correct telegram is 0x60 in Byte 0. For other responses, please refer to Cancel parameter communication.

6.5 Loading parameter data via SDO

Loading 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

Loading 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.

6.6 Cancel 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)

Error Code	Description
0x0601 0001	Access to write-only parameter
0x0601 0002	Access to read-only object
0x0607 0010	Data type or parameter length do not match
0x0609 0030	Parameter value range overflow
0x0609 0031	Parameter value range overflow
0x0609 0032	Parameter value range undershot
0x0609 0011	Sub-Index of parameter does not exist

Description of possible error codes

6.7 PDO settings

All settings for the PDOs are implemented via the SDO parameter channel of the CAN Bus.

The settings made are not stored permanently in the device, i.e. a reset of the 24V power supply will reset the changed parameters to the default values.

6.7.1 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.

Each transmit and receive PDO has its own parameter for this setting, see the following illustration.

PDO	Receive PDO	Transmit PDO
PDO 1	0x1400 Sub 1	0x1800 Sub 1
PDO 2	0x1401 Sub 1	0x1801 Sub 1
PDO 3	0x1402 Sub 1	0x1802 Sub 1
PDO 4	0x1403 Sub 1	0x1803 Sub 1

Index table for transmit and receive PDOs of the inverter

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. The 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.

6.8 Inhibit Time

Each transmit PDO has a parameter "Inhibit Time" (0x1800 – 0x1803 Sub-Index 3). This can be used to set a minimum send interval between two PDO messages. In networks with numerous subscribers, the bus load can be influenced with this value. The default setting is 10 ms (Value x 100µs).

6.9 Event Timer

The Parameter Event Time (0x1800 – 0x1803 Subindex 5) can be used for all transmit PDOs. Once this value is exceeded, the PDOs are transmitted cyclically. The default setting is 250 ms (Value x 1ms).

6.10 Transmitting and receiving more than one setpoint/actual value

In the default setting, all receive PDOs are active. A decision is made when sending messages to the applicable identifier whether one setpoint or up to three setpoints can be evaluated.

With transmit PDOs, only PDO 1 is active, while PDOs 2 to 4 are deactivated. If the application requires the sending of several actual values, the corresponding PDO must be switched on. In the following example, transmit PDO 2 is activated, the default setting transmits a status word and three actual values. The following messages must be sent via the SDO parameter channel for this purpose:

Set the NMT status machine for the inverter to the state "Pre-Operational"

Deactivate PDO 1 → SDO telegram (Index=0x1800 / Subindex=1 / Data=0xc0000181)

Activate PDO 2 → SDO telegram (Index=0x1801 / Subindex=1 / Data=0x40000281)

Set the NMT status machine for the inverter to the state "Operational"

PDO 1 is deactivated to prevent the bus load from rising unnecessarily. The PDO is activated/deactivated via Bit 31 in the corresponding parameter, see Illustration 5.

7 Network Management (NMT)

CANopen has a relatively simple network management. It consists of three states which are described below.

Pre-Operational

The inverter enters this state after initialisation. This state is used for bus module configuration. Data traffic via SDO objects is possible. The PDO channel is blocked.

Operational

The bus is fully operational, SDO and PDO objects can be transmitted.

Stopped

Transfer of SDO and PDO objects is blocked, only NMT messages can be transferred.

The individual states can be activated with the following commands:

Set net to Operational:

Identifier = 0x00 // Data byte 0 = 0x01 // Data byte 1 = 0x00

Set net to Pre-Operational:

Identifier = 0x00 // Data byte 0 = 0x80 // Data byte 1 = 0x00

Set net to Stopped:

Identifier = 0x00 // Data byte 0 = 0x02 // Data byte 1 = 0x00

8 BUS parameters

8.1 BUS parameters for SK 300E, SK 700E, SK 750E and vector mc

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

With the CANopen protocol, the frequency inverter parameters are mapped in the range 2000_{hex} to $23E7_{hex}$ = 8192_{dec} to 9191_{dec}, i.e. when parameterisation is carried out via the bus, the parameter numbers must be added to the value 2000_{hex} (e.g. P508 → obj. 21FChex)

The frequency inverter can always be parameterised. Control of the device via CANopen can be activated by setting parameter P509 to value 15, 16 or 17. (see below)

Abbreviations used:
FI = Frequency inverter
SW = Software version stored in P707.
P = Parameter set, are visible or hidden dependent on P003.

Control terminals:

Parameter	Setting value / Description / Note	Available with option
P480 .. - 01 ... .. - 08	**Function Bus I/O In Bits**	**always visible**
0 ... 62 [0]	The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions as the digital inputs (P420…425 of the respective FI manual). **[01]=** Bus I/O In Bit 1 **[02]=** Bus I/O In Bit 2 **[03]=** Bus I/O In Bit 3 **[04]=** Bus I/O In Bit 4 **[05]=** Bus I/O Initiator 1 **[06]=** Bus I/O Initiator 2 **[07]=** Bus I/O Initiator 3 **[08]=** Bus I/O Initiator 4 The possible functions for the Bus In Bits can be found in the table of functions for the digital inputs P420...425.	
P481 .. - 01 ... .. - 08	**Function Bus I/O Out Bits**	**always visible**
0 ... 38 [0]	The Bus I/O Out Bits are perceived as multi-function relay outputs. They can be set to the same functions as the digital outputs (P434…443 of the respective FI manual). **[01]=** Bus I/O Out Bit 1 **[02]=** Bus I/O Out Bit 2 **[03]=** Bus I/O Out Bit 3 **[04]=** Bus I/O Out Bit 4 **[05]=** Bus I/O Actuator 1 **[06]=** Bus I/O Actuator 2 **[07]=** Flag 1 **[08]=** Flag 2 The possible functions for the Bus Out Bits can be found in the table of functions for the relay P434.	
P482 .. - 01 ... .. - 08	**Standardisation Bus I/O Out Bits**	**always visible**
-400 … 400 % [100]	Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative. When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens.	

Parameter	Setting value / Description / Note	Available with option
P483 .. - 01 ... .. - 08	**Hysteresis Bus I/O Out Bits**	**always visible**
1 … 100 % [10]	Difference between switch-on and switch-off point to prevent oscillation of the output signal.	

Additional parameters:

Parameter	Setting value / Description / Note	Available with option
P503	**Master function output**	**always visible**
0 ... 6 [0]	To use the *Master function output* the source of FI control must be selected in P509. Only the master frequency (setpoint 1 and control word) is transferred with **Mode 1**, while the actual values selected in P543, P544 and P545 are transferred in **Mode 2**. In **Mode 3** a 32Bit actual position and a 16Bit setpoint speed (after ramp) is output. Mode 3 is required for synchronous control with the PosiCon option. ***Mode 4*** can be used for curve control in torque-coupled vehicles. The status word (1st word), the actual setpoint frequency before the speed ramp (2nd word), the actual torque current standardised to the torque limit (3rd word) and the actual frequency without slip (4th word) are transmitted. **0 = Off** **1 = USS mode 1** **3 = USS mode 2** **5 = USS mode 3** **7 = USS mode 4** **2 = CAN mode 1** up to 250kBaud **4 = CAN mode 2** up to 250kBaud **6 = CAN Mode 3** **8 = CAN Mode 4** **Note:** Each USS mode prevents communication with a PC and NORDCON.	
P509	**Interface**	**Always visible**
0 ... 21 [0]	Selection of the interface via which the FI is controlled. (P503: Note *Master function output*!) **0 = Control terminals or keyboard control** **/*** with the **Control Box** (Option), the **Parameter Box** (Option, not *ext. p-box*), the **Potentiometer Box** (Option) or via **Bus I/O Bits.** **1 = Control terminals only */***,** the FI can only be controlled via the digital and analog inputs (→ a customer unit is necessary!) or via the **BUS I/O Bits**. **2 =** … 4 **5 = CAN setpoint */*** **6 = CAN control word *** **7 = CAN *** (Option) **8 =** … 10 **11 = CAN Broadcast *** **12 =** … 14 **15 = CANopen setpoint */*** **16 = CANopen control word *** **17 = CANopen *** **18 =** … 21 *) Keyboard control (ControlBox, ParameterBox, PotentiometerBox) is blocked, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will block without error message. ***) Permissible settings for using the AS interface.	

Parameter	Setting value / Description / Note	Available with option
P510	**Auxiliary interface setpoint**	**Always visible**
0 ... 8 [0]	Selection of the interface via which the FI is controlled. **0 =** Auto: The auxiliary setpoint value is automatically taken from the interface of the main setpoint value P509 >interface< **1 =** USS **2 =** CAN (CANnord) **3 =** Profibus **4 =** InterBus **5 =** CANopen **6 =** DeviceNet **7 =** Reserved **8 =** CAN Broadcast	
P513	**Telegram downtime**	**Always visible**
-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.	
For vector mc only, the following applies:		
0.1 ... 100.0 s [0,0]	Monitoring function of the active bus interface. If CANopen is used for control and the value is > 0, an inverter error is triggered with a NodeGuardingEvent. In all other bus modules, monitoring is switched off with the setting value 0.	
P514	**CANbus baud rate**	**Always visible**
0 ... 7 [4]	Setting the transfer rate (transfer speed). This setting is only valid if the rotary switch on the module is set in the PGM range, otherwise the setting is made using the rotary coding switch. (see Chap. 4.1) **0 =** 10kBit/s **1 =** 20kBit/s **2 =** 50kBit/s **3 =** 100kBit/s **4 =** 125kBit/s **5 =** 250kBit/s **6 =** 500kBit/s **7 =** 1MBit/s (Only for test purposes, safe operation cannot be guaranteed.) **NOTE:** The baud rate is only read after a Power On, a Reset Node message or a Power On of the 24V bus supply.	
P515	**CANbus address**	**Always visible**
0 ... 255 [50]	Setting the CANbus basic address. This setting is only valid if the rotary switch on the module is set in the PGM range, otherwise the setting is made using the rotary coding switch. (see Chap. 4.1)	
P543 (P)	**Actual bus value 1**	**Always visible**
0 ...11 [1]	The return value 1 (IW1) can be set for bus control in this parameter. **NOTE:** Further details can be found in the respective FI operating instructions or in the description of P418. **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current **5 =** Status of digital inputs and relay [2] **6 =** Actual position (with PosiCon only) **7 =** Setpoint position (with PosiCon only) **8 =** Setpoint frequency **9 =** Error number **10 =** Actual increment position [2] (with *PosiCon* only) **11 =** Setpoint increment position [1] (with *PosiCon* only)	
P544 (P)	**Actual bus value 2**	**Always visible**
0 ... 11 [0]	This parameter is identical to P543.	

[2] Displayed motor rpm, resulting from 8192 encoder increments.

Parameter		Setting value / Description / Note	Available with option
P545	**(P)**	**Actual bus value 3**	**Always visible**
0 ... 11 [0]		This parameter is identical to P543. This parameter is only visible when P546 ≠ 3.	
P546	**(P)**	**Bus setpoint 1**	**Always visible**
0 ... 6 [1]		In this parameter, a function is assigned to the delivered setpoint 1 (SW1) for bus control. **0 =** Off **1 =** Setpoint frequency (16 Bit) **2 =** 16-bit setpoint position (with PosiCon option only) **3 =** 32-bit setpoint position (only available with PosiCon option and when PPO type 2 or 4 is selected) **4 =** PosiCon control terminals (only available with PosiCon option, 16-bit) **5 =** Setpoint increment 1 position (16-bit) (with PosiCon only) **6 =** Setpoint increment 1 position (32-bit) (with PosiCon only)	
P547	**(P)**	**Bus setpoint 2**	**Always visible**
0 ... 16 [1]		In this parameter, a function is assigned to the delivered setpoint 2 (SW2) for bus control. **0 =** Off **1 =** Setpoint frequency **2 =** Torque current limit **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit **7 =** Maximum frequency **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque **11 =** Lead torque **12 =** PosiCon control terminals (only with PosiCon option) **13 =** Multiplication **14 =** Process controller actual value **15 =** Process controller setpoint **16 =** Process controller lead	
P548	**(P)**	**Bus setpoint 3**	**Always visible**
0 ... 14 [1]		This parameter is identical to P547. This parameter is only visible when P546 ≠ 3.	
P551		**Drive profile**	**Always visible**
0 ...1 [0]		Activation of the drive profile as per DS-402 in the CiA.	

NOTE

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

Information parameters:

Parameter	Setting value / Description / Note	Available with option
P740 ... - 01 ... ... - 06	**Process data Bus In**	**always visible**
0 ... FFFF hex	Displays the actual control word and the setpoints.	**...** - **01** = Control Word **... - 02** = Setpoint 1 (P546) **... - 03** = Setpoint 1 Highbyte **...** - **04** = Setpoint 2 (P547) **... - 05** = Setpoint 3 (P548) **... - 06** = Bus I/O In Bits (P480)
P741 ... - 01 ... ... - 06	**Process data Bus Out**	**always visible**
0 ... FFFF hex	Displays the actual status word and actual values.	**...** - **01** = Status Word **... - 02 =** Actual value 1 (P543) **... - 03** = Actual value 1 Highbyte **...** - **04** = Actual value 2 (P545) **...** - **04** = Actual value 3 (P545) **... - 06** = Bus I/O In Bits (P481)
P742	**Database version**	**always visible**
0 ... 9999	Displays the internal database version of the frequency inverter.	
P744	**Configuration**	**always visible**
0 ... 9999	The option modules recognised by the frequency inverter are displayed in this parameter. The display with the ParameterBox is in plain text. The possible combinations are displayed in code in the ControlBox. Both right digits indicate the customer unit used and the two left digits indicate the special extension unit. The options vary depending on the FI type.	

Customer Unit **SK CU1-**		Special Extension Unit **SK XU1-...**	
No IO	**XX00**	Encoder	**01XX**
Basic IO	**XX01**	PosiCon	**02XX**
Standard IO	**XX02**		
Multi IO	**XX03**		
USS IO	**XX04**		
CAN-IO	**XX05**		
Profibus-IO	**XX06**		

P745	**Module version**	**Always visible**
0 ... 32767	Software version of the installed module (CANopen technology unit array [01])	Array level: [01] Technology unit [02] Customer unit [03] Special extension unit
P746	**Module status**	**Always visible**
0000 ... FFFF hex	Status of the installed modules (see chap. 5.2) (CANopen technology unit array [01])	Array level: [01] Technology unit [02] Customer unit [03] Special extension unit

8.2 BUS Parameters SK 5xxE

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

With the CANopen protocol, the frequency inverter parameters are mapped in the range 2000_{hex} to $23E7_{hex}$ = 8192_{dec} to 9191_{dec}, i.e. when parameterisation is carried out via the bus, the parameter numbers must be added to the value 2000_{hex} (e.g. P508 → obj. $21FC_{hex}$).

The frequency inverter can always be parameterised. Control of the device via CANopen can be activated by setting parameter P509 to value 15, 16 or 17.

Abbreviations used:

FI = Frequency inverter

SW = Software version stored in P707.

S = Supervisor parameters, are visible or hidden dependent on P003.

Control terminals:

Parameter		Setting value / Description / Note	Device	Supervisor	Parameter set
P480	**... - 01 ... ... - 12**	**Function Bus I/O In Bits**		**S**	
0 ... 62 [0]		The Bus I/O In Bits are perceived as digital inputs. They can be set to the same functions as the digital inputs (P420…425, BU 0500 manual). **[01] =** Bus I/O In Bit 1 **[02] =** Bus I/O In Bit 2 **[03] =** Bus I/O In Bit 3 **[04] =** Bus I/O In Bit 4 **[05] =** Bus I/O Initiator 1 **[06] =** Bus I/O Initiator 2 **[07] =** Bus I/O Initiator 3 **[08] =** Bus I/O Initiator 4 **[09] =** Flag 1 **[10] =** Flag 2 **[11] =** Bit 8 BUS control word **[12] =** Bit 9 BUS control word			
P481	**... - 01 ... ... - 10**	**Function Bus I/O Out Bits**		**S**	
0 ... 38 [0]		The Bus I/O Out Bits are perceived as multi-function relay outputs. They can be set to the same functions as the digital inputs (P434...443 / P624...629, manual BU 0500 / BU 0510). **[01] =** Bus I/O Out Bit 1 **[02] =** Bus I/O Out Bit 2 **[03] =** Bus I/O Out Bit 3 **[04] =** Bus I/O Out Bit 4 **[05] =** Bus I/O Actuator 1 **[06] =** Bus I/O Actuator 2 **[07] =** Flag 1 **[08] =** Flag 2 **[09] =** Bit 10 BUS status word **[10] =** Bit 13 BUS status word			
P482	**... - 01 ... ... - 08**	**Standardisation Bus I/O Out Bits**		**S**	
-400 … 400 % [100]		Adjustment of the limit values of the relay functions/Bus Out Bits. For a negative value, the output function will be output negative. When the limit value is reached and the setting values are positive, the relay contact closes, with negative setting values the relay contact opens.			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P483 **... - 01** **...** **... - 08**	**Hysteresis Bus I/O Out Bits**		**S**	
1 … 100 % [10]	Difference between switch-on and switch-off point to prevent oscillation of the output signal.			

Additional parameters:

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P502 **... - 01** **...** **... - 03**	**Master function value**		**S**	**P**
0 ... 21 [0]	Selection of up to 3 master values: **[01] =** Master value 1 **[02] =** Master value 2 **[03] =** Master value 3 Selection of possible setting values for master values: **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current **5 =** State of digital inputs and outputs **6 =** reserved **7 =** reserved **8 =** Setpoint frequency **9 =** Error message **10 =** reserved **11 =** reserved **12 =** Digital Out Bit 0…7 **13 =** reserved **14 =** reserved **15 =** reserved **16 =** reserved **17 =** Value analog input 1 **18 =** Value analog input 2 **19 =** Setpoint frequency master value **20 =** Setpoint frequency after master value ramp **21 =** Actual frequency without slip master value			
P503	**Master function output**		**S**	
0 ... 3 [0]	To use the Master function output, the inverter controller source must be selected in P509. The master value to be transmitted is determined via the BUS interface in parameter P502. **0 = Off** **1 = USS** **2 = CAN** (up to 250kBaud) **3 = CANopen**			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P509	**Control word source**			
0 ... 10 [0]	Selection of the interface via which the FI is controlled. **0 =** **Control terminals or keyboard control** ** with the **Control Box** (when P510=0), the Parameter Box (not *ext. p-box*) or via Bus I/O Bits. **1 =** **Only control terminals** *, the FI can only be controlled via the digital and analog input signals or via the Bus I/O Bits. **2 =** **USS control word ***, the control signals (enable, rotation direction, etc.) are transferred via the RS485 interface, the setpoint via the analog input or the fixed frequencies. **3 =** **CAN** control word * **4 =** **Profibus** control word * (Option) **5 =** **InterBus** control word * **6 =** **CANopen** control word * **7 =** **DeviceNet** control word * **8 =** reserved **9 =** **CAN Broadcast** * **10 =** **CANopen Broadcast *** *) Keyboard control (ControlBox, ParameterBox) is blocked, parameterisation is still possible. **) If the communication during keyboard control is interrupted (time out 0.5 sec), the FI will block without error message.			
P510 **... - 01** **... - 02**	**Setpoint source**		**S**	
0 ... 10 [0]	Selection of the setpoint source to be parameterised. **[01] =** **Main setpoint** source **[02] =** **Auxiliary setpoint** source Selection of the interface via which the FI receives the setpoint. **0 =** **Auto:** 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 =** **CAN** **4 =** **Profibus** **5 =** **InterBus** **6 =** **CANopen** **7 =** **DeviceNet** **8 =** reserved **9 =** **CAN Broadcast** **10 =** **CANopen 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.			

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P514	**CAN baudrate**			
0 ... 7 [4]	Setting of the transfer rate (transfer speed) via the CANnord interface. All bus participants must have the same baud rate setting. **0 =** 10kBaud **3 =** 100kBaud **6 =** 500kBaud **1 =** 20kBaud **4 =** 125kBaud **7 =** 1MBaud * (test purposes only) **2 =** 50kBaud **5 =** 250kBaud **NOTE:** The baud rate is only read after a Power On, a Reset Node message or a Power On of the 24V bus supply. *) Safe operation cannot be guaranteed			
P515	**CAN address**			
0 ... 255 [50]	Setting the CANbus basic address This setting is only valid if the rotary switch on the module is set in the PGM range, otherwise the setting is made using the rotary coding switch. (see Chap. 4.1)			
P523	**Factory setting**			
0 ... 2 [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. **2 = Factory settings without bus:** All parameters of the frequency inverter, with the exception of the bus parameter, are reset to the factory setting.			
P541	**Set Output**		**S**	
0000 ... 3F1F (hex) [0000]	This function provides the opportunity to control the relay and the digital outputs independently of the frequency inverter status. To do this, the relevant output must be set to the function "External control". This function can either be used manually or in combination with a bus control. **Bit 0 = Output 1 (K1)** **Bit 4 = Dig. AOut 1 (Analog output 1)** **Bit 10 = Bus Out Bit 2** **Bit 1 = Output 2 (K2)** **Bit 5 … 7 =** reserved **Bit 11 = Bus Out Bit 3** **Bit 2 = Output 3 (DOUT1)** **Bit 8 = Bus Out Bit 0** **Bit 12 = Bus Out Bit 4** **Bit 3 = Output 4 (DOUT2)** **Bit 9 = Bus Out Bit 1** **Bit 13 = Bus Out Bit 5**			

	Bits 13 -12	Bits 11 -8	Bits 7 -4	Bits 3 -0	
Min. value	00 **0**	0000 **0**	0000 **0**	0000 **0**	Binary **hex**
Max. value	11 **3**	1111 **F**	0001 **1**	1111 **F**	Binary **hex**

BUS: The corresponding hex value is written into the parameter, thereby setting the relay and digital outputs.

ControlBox: The hexadecimal code is entered directly when the ControlBox is used.

ParameterBox: Each individual output can be separately called up in plain text and activated.

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P542	**Set analog output**		**S**	
0.0 ... 10.0 V [0.0]	The analog output of the FI can be set with this function, independently of the actual operating state. To do this, the relevant analog output must be set to the function "External control" (P418 = 7). This function can either be used manually or in combination with a bus control. The value set here will, once confirmed, be produced at the analog output.			
P543	**Actual bus value 1**		**S**	**P**
0 ... 22 [1]	The return value 1 can be selected for bus actuation in this parameter. **NOTE:** Further details can be found in the respective FI manual or in the description of P418. **0 =** Off **1 =** Actual frequency **2 =** Actual speed **3 =** Current **4 =** Torque current (100% = P112) **5 =** State of digital inputs and outputs [3] **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 slip master value **22 =** Speed from encoder (only possible with SK 520E/53xE and encoder feedback)			
P544	**Actual bus value 2**		**S**	**P**
0 ... 22 [0]	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			
P545	**Actual bus value 3**		**S**	**P**
0 ... 22 [0]	This parameter is identical to P543. Condition is PPO 2 or PPO 4 type (P507).			

[3] The assignment of the dig. inputs in P543/ 544/ 545 = 5

Bit 0 = DigIn 1	Bit 1 = DigIn 2	Bit 2 = DigIn 3	Bit 3 = DigIn 4
Bit 4 = DigIn 5	Bit 5 = DigIn 6 (SK 520/53xE)	Bit 6 = DigIn 7 (SK 520/53xE)	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 = Out 3 (SK 520/53xE)	Bit 15 = Out 4 (SK 520/53xE)

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P546	**Bus setpoint 1**		**S**	**P**
0 ... 47 [1]	In this parameter, a function is allocated to the output setpoint 1 during bus actuation. **NOTE:** Further details can be found in the respective FI manual or in the description of P400. **0 =** Off **1 =** Setpoint frequency (16 Bit) **2 =** Torque current limit (P112) **3 =** Actual frequency PID **4 =** Frequency addition **5 =** Frequency subtraction **6 =** Current limit (P536) **7 =** Maximum frequency (P105) **8 =** Actual PID frequency limited **9 =** Actual PID frequency monitored **10 =** Torque servo mode (P300) **11 =** Lead torque (P214) **12 =** reserved **13 =** Multiplication **14 =** PI process controller actual value **15 =** PI process controller setpoint **16 =** PI process controller lead **17 =** Digital In Bits 0...7 **18 =** reserved **19 =** Status output (P434/441/450/455=38) **20 =** Value analog output (P418=31) **21 =** ... 45 reserved **46 =** Setpoint torque process controller **47 =** reserved			
P547	**Bus setpoint 2**		**S**	**P**
0 ... 47 [0]	This parameter is identical to P546.			
P548	**Bus setpoint 3**		**S**	**P**
0 ... 47 [0]	This parameter is identical to P546.			
P551	**Drive profile**		**S**	
On / Off [0]	This parameter is used, depending on the option, to activate the CANopen profile DS401 or the Interbus Drivecom profile. **0 =** Process data USS (CANnord) **1 =** Process data DS 401 (CANopen)			
P560	**Save in EEPROM**		**S**	
0 ... 1 [1]	**0 =** Changes to the parameter settings will be lost if the FI is disconnected from the mains supply. **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 USS 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.			

NOTE

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

Information parameters:

Parameter	Setting value / Description / Note		Device	Supervisor	Parameter set
P740 **... - 01** **...** **... - 13**	**Process data Bus In**			**S**	
0000 ... FFFF (hex)	This parameter informs about the actual control word and the setpoints that are transferred via the bus systems.	**...** - **01** = Control Word		Control word, source from P509.	
		... - 02 = setpoint 1 **...** - **03** = setpoint 2 **...** - **04** = setpoint 3 (P547)		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.	
		... - **11** = setpoint 1 **...** - **12** = setpoint 2 **...** - **13** = setpoint 3		Setpoint data from auxiliary setpoint P510 - 02.	
P741 **... - 01** **...** **... - 13**	**Process data Bus Out**			**S**	
0000 ... FFFF (hex)	This parameter provides information about the actual status word and the actual values which are transferred via the bus system.	**...** - **01** = Status Word		Status word, source from P509.	
		... - 02 = Actual value 1 (P543) **... - 03** = Actual value 2 (P544) **...** - **04** = Actual value 3 (P545)			
		... - 05 = Bus I/O In Bits (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 **... - 09 =** Parameter data Out 4 **... - 10 =** Parameter data Out 5		Data during parameter transfer.	
		... - 11 = actual value 1 master function **... - 12** = actual value 2 master function **... - 13** = actual value 3 master function		Actual value of master function 502/P503.	
P742	**Database version**			**S**	
0 ... 9999	Displays the internal database version of the FI.				
P744	**Configuration**				
0000 ... FFFF (hex)	This parameter displays the design status integrated in the FI. Display is in hexadecimal code (SimpleBox, ControlBox, Bus system). The display is in plain text when the ParameterBox is used.				
	SK 500E = 0000 **SK 510E/511E/515E = 0000**	**SK 520E = 0101**		**SK 530E/535E = 0201**	

Parameter	Setting value / Description / Note	Device	Supervisor	Parameter set
P745	**Module version**			
0.0 ... 999.9	Version status (software version) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. Have this data ready if you have a technical query.			
P746	**Module status**		**S**	
0000 ... FFFF (hex)	Actual status (readiness, error, communication) of the technology unit (SK TU3-xxx), but only when own processor is present, therefore not for SK TU3-CTR. Code details can be found in the respective BUS module manual. Different contents are shown depending on the modules.			
P748 **... - 01** **…** **... - 03**	**Status CANopen**	**SK 520E or higher**	**S**	
0000 ... FFFF (hex)	**[01] =** CANnord/CANopen Status Bit 0 = 24V bus voltage supply Bit 1 = CANbus in "Bus Warning" status Bit 2 = CANbus in "Bus Off" status Bit 3 ... 5 = vacant Bit 6 = Protocol of CAN module is 0 → CANnord or 1 → CANopen Bit 7 = vacant Bit 8 = "Bootsup Message" sent Bit 9 = CANopen NMT status Bit 10 = CANopen NMT status Bit 11 = reserved Bit 12 ... 14 = reserved Bit 15 = reserved	**[02] =** reserved	**[03] =** reserved	

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

9 USS process data

The following CAN profile specifications apply to process data transfer with all CANnord/CANopen interfaces in NORDAC frequency inverters. This protocol is used when P551 = 0 is set.

9.1 Process data (PZD)

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

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

- STW: Control word; length 16Bit, order telegram
  Contains control bits (e.g. Enable, Emergency Stop, Error Acknowledgement)
- ZSW: Status word; length 16Bit, response telegram
  Contains status bits (e.g. FI running, Error)
- SW1..3: Setpoints; maximum 3 possible, 16 or 32Bit, order telegram
  e.g. frequency setpoint, position setpoint, torque setpoint
- IW1..3: Actual values; maximum 3 possible, 16 or 32Bit, response telegram
  e.g. frequency actual value, position actual value, torque actual value

9.1.1 Process data for SK 300E/700E/750E/vector mc

	1. Word	2. Word	3. Word	4. Word
PZD area with 1x16-Bit setpoint	STW ZSW	SW1 IW1		
PZD area with up to 3 16-Bit setpoints	STW ZSW	SW1 IW1	**SW3** **IW3**	**SW2** **IW2**
PZD area with 1x 32-Bit setpoint and 1x 16-Bit	STW ZSW	SW1 IW1		SW2 IW2

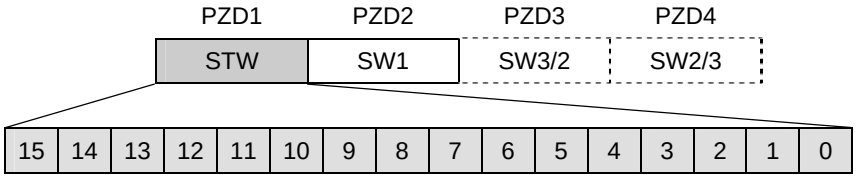
9.1.2 Process data for SK 500E/520E/530E

	1. Word	2. Word	3. Word	4. Word
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 consist of High and Low words (16-Bit each).

9.2 The 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).



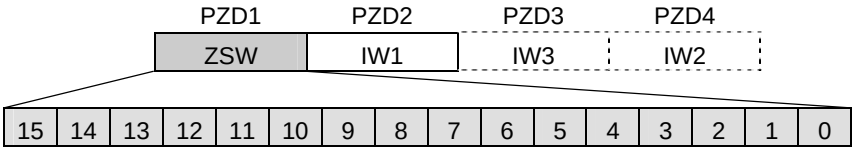
Significance of the individual bits:

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

* if BIT 12 = 0, the "rotational direction right ON" applies

9.3 The 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.



Significance of the individual bits:

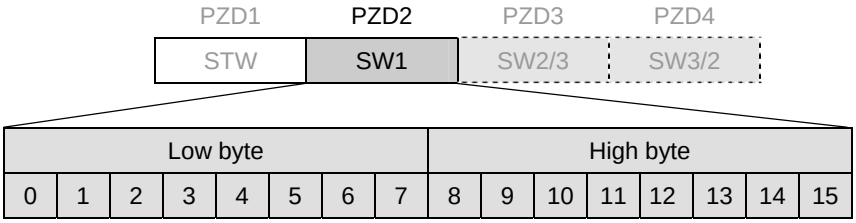
Bit	Value	Significance	Comments
0	0	Not ready to start	
	1	Ready to start	Initialisation completed, charging relay ON, output voltage disabled
1	0	Not ready for operation	Causes: No command has been activated, fault is signaled, OFF2 or OFF3 activated, starting disabled state activated
	1	Ready for operation	ON command activated, no faults present. The inverter can be started with the command ENABLE OPERATION
2	0	Operation disabled	
	1	Operation enabled	The output voltage is enabled; ramp to the setpoint applied
3	0	No fault	
	1	Error	Drive fault resulting in stoppage; this state is changed to starting disabled after the fault has been successfully acknowledged
4	0	OFF 2	OFF2 command applied
	1	No OFF 2	
5	0	OFF 3	OFF3 command applied
	1	No OFF 3	
6	0	Starting not disabled	
	1	Starting disabled	Switches first to OFF1, then to ready-to-start status
7	0	No warning	
	1	Warning	Drive operation continues, no acknowledgement necessary
8	0	Actual value not O.K.	Actual value does not match the setpoint (with posicon: Setpoint position not reached)
	1	Actual value O.K.	Actual value matches required setpoint (setpoint has been reached) (with *posicon*: Setpoint position reached)
9	0	Local guidance	Guidance on local device has been activated
	1	Guidance requested	The master has been requested to assume guidance.
10	0	Actual MFR 1 value below reference value	Programmed function of MFR 1 has not been executed or actual value < programmed reference value Only with SK 5xxE: Bus bit 10 from the control word is not set. (see P481)
	1	MFR 1 reference value has been reached (SK5xxE: Bit 10 active)	Programmed function of MFR 1 has been executed or actual value < programmed reference value Only with SK 5xxE: Bus bit 10 from the control word is set. (see P481)
11	0		
	1	Rotational direction: right	Inverter output voltage is rotating right
12	0		
	1	Rotational direction: left	Inverter output voltage is rotating left
13	0	Actual MFR 4 value below reference value	Only with SK 700E/750E with *posicon* extension: Status MFR 4 = 0 Only with SK 5xxE: Bus bit 13 from the control word is not set. (see P481)
	1	MFR 4 reference value has been reached (SK5xxE: Bit 13 active)	Only with SK 700E/750E with *posicon* extension: Status MFR 4 = 1 Only with SK 5xxE: Bus bit 13 from the control word is set. (see P481)
14	0/1	Currently active parameter set 0	00 = Parameter set 1 01 = Parameter set 2
15	0/1	Currently active parameter set 1	10 = Parameter set 3 11 = Parameter set 4

9.4 The setpoint 1 (SW1)

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

9.4.1 Setpoint frequency (16 Bit)

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



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

9.4.2 Setpoint position (16 or 32 Bit)

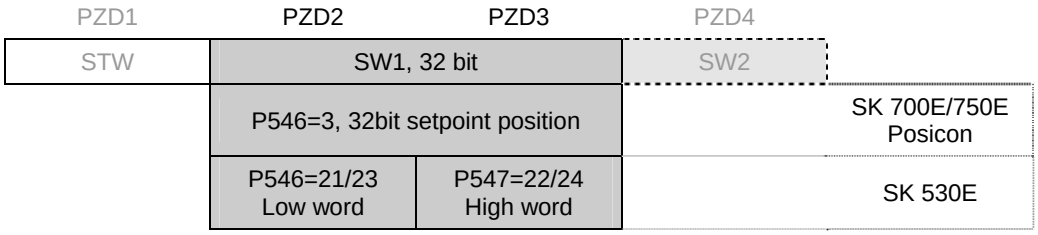
The absolute setpoint position can be transferred in setpoint 1 with the special extension unit **Posicon (SK XU1-POS) of the SK 700/750E** or the **SK 53xE**. It can be transferred as a 16 or 32 Bit value with a resolution of 1 = 0.001 revolutions at the motor. In addition, the control terminals (PosiCon control bits setting) can be transferred in binary.

16-Bit setpoint position setting:

A value range of +32767 (= 32.767 revolutions) to -32768 (= -32.768 revolutions) is possible as a 16 Bit value. The 16 Bit setpoint position is transferred as the second word in the process data area (like the setpoint frequency, see above)

32-Bit setpoint position setting:

The full position range of +/- 50,000.000 revolutions is available as a 32 Bit value. The 32 Bit setpoint position is transferred as the second and third word in the process data area.



Settings for control bits Posicon / digital In Bits 0…7 (700E/53xE):

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

The transferred bits have the following significance (see operating manual BU 0710 / BU 510):

SK 700E + SK TU1-POS		
	Bits 0 -5	Position array/position increment
	Bit 6	Reference point run
	Bit 7	Reference point
	Bit 8	Teach-in
	Bit 9	Quit teach-in
	Bit 10	Reset position

SK 530E		
	Bits 0 -3	Position array/position increment
	Bits 4 -7	Vacant
	Bits 8 - 15	no significance

9.5 Second and third setpoint SK 700E/750E (SW2/3)

In addition to setpoint 1, a second setpoint can be transferred in word PZD4 and a third setpoint in PZD3.

PZD1	PZD2	PZD3	PZD4
STW	SW1	SW3	SW2

A third setpoint can only be transferred if a 32 Bit setpoint is not transferred in the first setpoint.

PZD1	PZD2	PZD3	PZD4
STW	SW1		SW2

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

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

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

9.6 Second and third setpoint SK 53xE (SW2/3)

In addition to setpoint 1, a second setpoint can be transferred in word PZD3 and a third setpoint in PZD4.

PZD1	PZD2	PZD3	PZD4
STW	SW1	SW2	SW3

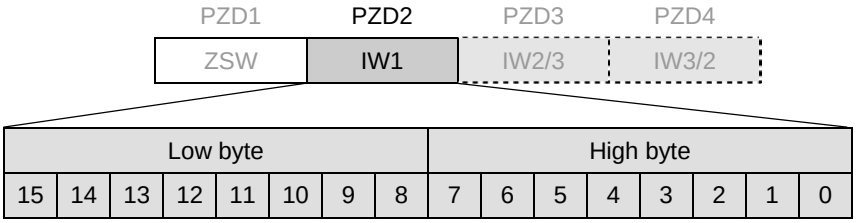
The second and third setpoints are always 16 Bit. The function of the second and third setpoints can be set in the inverter with parameter P547 ‘Setpoint 2 function’ and P548 ‘Setpoint 3 function’ respectively.

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

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

9.7 The actual value 1 (IW1)

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



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

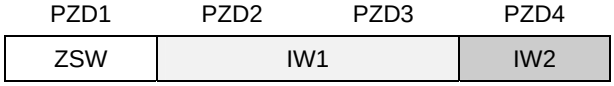
The settings ‘Actual frequency’, ‘Actual speed’, ‘Current’ and ‘Torque current’ are transferred as percentages of the respective nominal sizes. The value 16384 (4000 HEX) is equal to 100%. The value C000 HEX is equal to -100%. Actual values in the range –200% to +200% can be transferred.

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

SK 700E + SK TU1-POS		
	Bit	**Status**
	Bits 0 -5	Digital input 1-6
	Bit 6-11 for posicon special extension unit	Digital input 7-12
	Bit 6 for encoder special extension unit	Digital input 7
	Bits 12 -15	Multifunctional relay 1-4

SK 530E		
	Bit	**Status**
	Bits 0 -5	Digital input 1-6
	Bit 6-11 for posicon special extension unit	Digital input 7-12
	Bit 6 for encoder special extension unit	Digital input 7
	Bits 12 -15	Multifunctional relay 1-4

With the settings ‘Actual position’ and ‘Setpoint position’, the actual absolute position is transferred. The resolution is 1 = 0.001 revolutions. If the value ‘Setpoint position 32 Bit’ is set in parameter P546 ‘Setpoint 1 function’, the actual value of the setpoint or actual position is also transferred as a 32 Bit value in PZD2 and PZD3:



9.8 Actual value 2 and actual value 3 (IW2/3)

It is possible to forward two more actual values to the controller.

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

9.9 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.

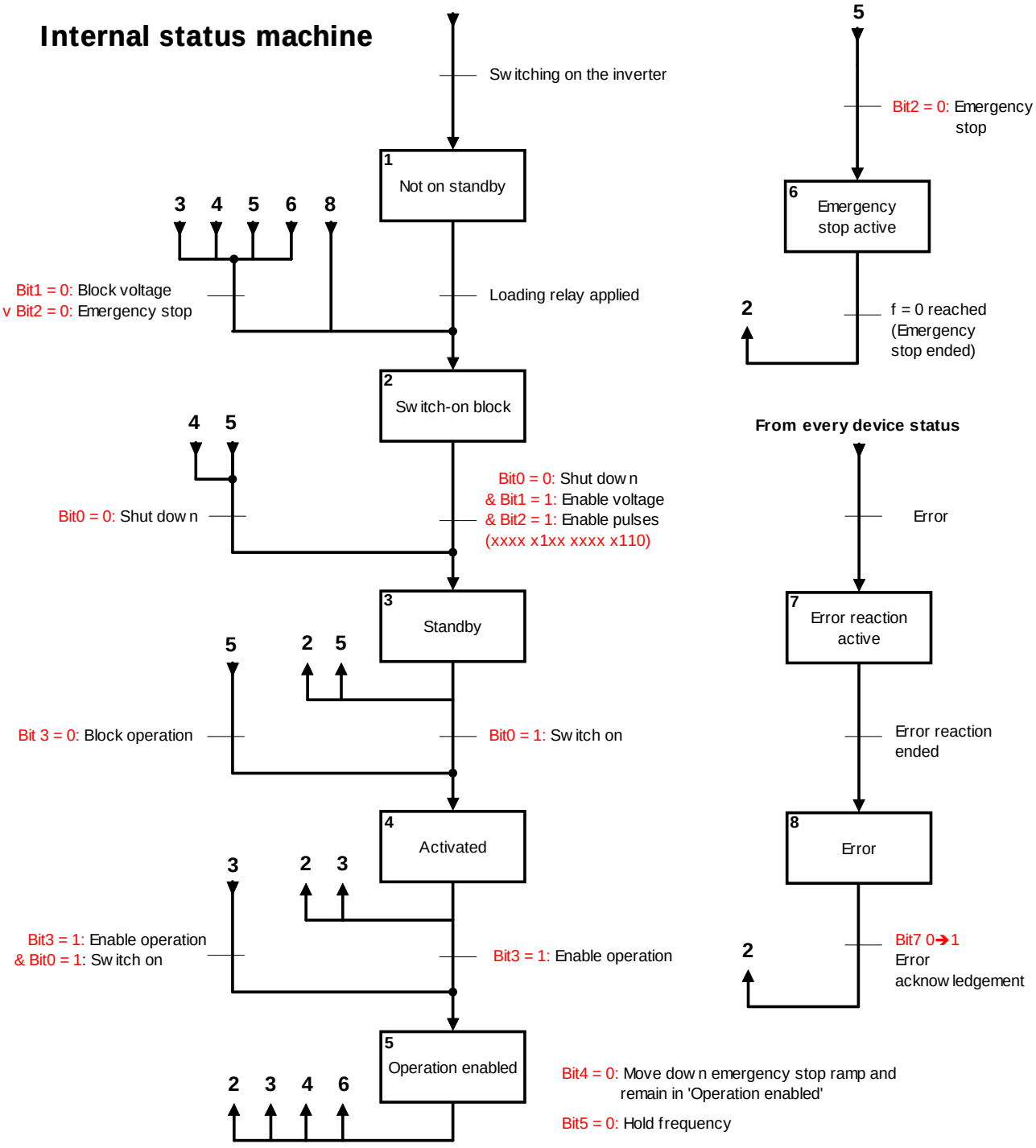
After switching on, the inverter is in switch-on block status. This status can only be ended by transmitting the “Shut down (Off 1)” command.

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

The following Bits indicate the status of the FI:

Status	**Bit6** Switch-on block	**Bit5** Quick stop	**Bit 4** Block voltage	**Bit3** Error	**Bit2** Operation enabled	**Bit1** Ready for operation	**Bit0** Standby
Not ready to start	0	X	X	0	0	0	0
Starting disabled	1	X	X	0	0	0	0
Ready to start	0	1	1	0	0	0	1
Activated	0	1	1	0	0	1	1
Operation enabled	0	1	1	0	1	1	1
Error	0	X	X	1	0	0	0
Error active	0	X	X	1	1	1	1
Quick stop active	0	0	1	0	1	1	1

Internal status machine



Control bits
0. Ready for operation / shut down
1. Block / enable voltage
2. Enable pulses / emergency stop
3. Block / enable operation
4. Operation condition / block RUE
5. Enable / stop RUE
6. Block / enable 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. Block voltage
2. Emergency stop
3. Shut down
4. Enable operation
5. Switch on
6. Block operation
7. Reset error

Designation of states:
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

10 Object dictionary

All available objects are contained in the NORDAC frequency inverter “Electronic data sheet” (eds file).

10.1 CANopen profile DS 301

10.1.1 Communication objects (1000-1200)

Index	Sub	Object	Description	Unit	Acc	Type
1000	-	Device Type	Device type and functionality		RO	U32
1001	-	Error Register	Error register		RO	U8
1002	-	Status Register	Status of the module		RO	U32
1003	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
1005	-	COB-ID SYNC	Identifier for SYNC messages (Default 80h)		RW	U32
1008	-	Device Name	Device name		RO	STR
1009	-	Hardware Version	Hardware version		RO	STR
100A	-	Software Version	Software version FI+CO		RO	STR
100C	-	Guard Time	Guard time (0=off)	ms	RW	U16
100D	-	Life Time Factor	Life time = life time factor * guard time		RW	U16
1014	-	COB-ID Emergency Object	Identifier Emergency Object (80h+Node-ID)		RW	U32
1015	-	Inhibit Time EMCY	Minimum repeat time	ms	RW	U16
1017	-	Producer Heartbeat Time	Cycle Time of Heartbeat	ms	RW	U16
1018	REC	Identity Object	General device information			U32
	0	Largest subindex	Number of elements		RO	U8
	1	Vendor ID	Manufacturer identification		RO	U32
	2	Product Code	Device version		RO	U32
	3	Revision number	Revision number		RO	U32
	4	Serial Number	Serial number		RO	U32
1200	REC	Default Server SDO	SDO server			0x22
	0	Largest subindex	Number of elements		RO	U8
	1	COB_ID Server>Client (rx)	Identifier receive SDO (600h +ID)		RO	U32
	2	COB_ID Server>Client (tx)	Identifier transmit SDO (580h +ID)		RO	U32

10.1.2 PDO objects (1400-1A03)

Index	Sub	Object	Description	Unit	Acc	Type
1400-1403	REC	Receive PDO Communication Parameter	Receive PDO characteristics		RW	0x21
	0	Largest subindex	Number of elements		RO	U8
	1	COB-ID used by PDO	Identifier receive PDO		RW	U32
	2	Transmission type	Receive PDO type (see Chap. 6.1.2)		RW	U8
	3	Not used	Not used		-	-
	4	Reserved	Reserved		-	-
	5	Not used	Not used		-	-
1600-1603	REC	Receive PDO Mapping Parameter	Receive PDO mapping (see Chap. 6.1.3)		RW	0x21
	0	Largest subindex	Number of elements		RW	U8
	1-4	PDO mapping	Mapped objects		RW	U32
1800-1803	REC	Transmit PDO Communication Parameter	Transmit PDO characteristics		RW	0x21
	0	Largest subindex	Number of elements		RO	U8
	1	COB-ID used by PDO	Identifier receive PDO		RW	U32
	2	Transmission type	Transmit PDO type (see Chap. 6.1.2)		RW	U8
	3	Inhibit Time	Minimum transmit time	100µs	RW	U16
	4	Reserved	Reserved		-	-
	5	Event Timer	Cyclic transmit timer	ms	RW	U16
1A00-1A03	REC	Transmit PDO Mapping Parameter	Transmit PDO mapping (see Chap. 6.1.3)		RW	0x21
	0	Largest subindex	Number of elements		RW	U8
	1-4	PDO mapping	Mapped objects		RW	U32

10.2 CANopen objects DS 402

The following parameters are only valid if the frequency inverter parameter drive profile (P551) is switched on. The objects remain valid for the 1st parameter set only.

Index	Sub	Object	Description	Unit	Acc	Type
603F	-	Error Code	Error description	-	RO	U32
6040	-	Control word	Control word	-	RW	U16
6041	-	Status word	Status word	-	R0	U16
6042	-	Vl_target_velocity	Speed setpoint	rpm	RW	I16
6043	-	Vl_velocity_demand	Setpoint speed after ramp	rpm	RO	I16
6044	-	Vl_control_effort	Actual speed value	rpm	RO	I16
6046	ARR	Vl_velocity_min_max_amount	Speed min/max amount	-	RO	ARR
	1	Vl_velocity_min_amount	Min. speed value	rpm	RW	U32
	2	Vl_velocity_max_amount	Max. speed value	rpm	RW	U32
6048	REC	Vl_velocity_acceleration	Speed acceleration	-	RO	REC
	1	Delta_speed	Delta speed	rpm	RW	U32
	2	Delta_time	Delta time	s	RW	U16
6049	REC	Vl_velocity_deceleration	Speed deceleration	-	RO	REC
	1	Delta_speed	Delta speed	rpm	RW	U32
	2	Delta_time	Delta time	s	RW	U16

10.3 Frequency inverter objects (2000-3003)

Index	Sub	Object	Description	Unit	Acc	Type
2000-23E7	-	Manufactor Spec. Parameter	FI parameters (see FI operating manual)	-	-	-
3000		Control word	Control word (STW)			U16
3001		Status word	Status word (ZSW)			U16
3002	0	Largest subindex	Number of elements			U8
	1	Setpoint 1	Setpoint 1 (SW1) 16 Bit			U16
	2	Setpoint 2	Setpoint 2 (SW2) 16 Bit			U16
	3	Setpoint 3	Setpoint 3 (SW3) 16 Bit			U16
	4	Setpoint 1 (long)	Setpoint 1 (SW1) 32bit			U32
3003	0	Largest subindex	Number of elements			U8
	1	Actual Value 1	Actual value 1 (IW1) 16 Bit			U16
	2	Actual Value 2	Actual value 2 (IW2) 16 Bit			U16
	3	Actual Value 3	Actual value 3 (IW3) 16 Bit			U16
	4	Actual Value 1 (long)	Actual value 1 (IW1) 32bit			U32

11 Inverter error messages (emergency object)

If an internal error occurs in the frequency inverter, an error message is sent automatically via the CANbus.

Error message		**Error Register**	**not used**				
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
0x00	0x81	0x01	0x00	0x00	0x00	0x00	0x00

Structure of error message (Time-out through P513)

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:

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

The Node ID of the frequency inverter is set via the "ID-H" and "ID-L" switches on the CANopen Box or in the PGM mode via parameter P515.

11.1 Error list

CANopen error	FI error number	Explanation
0x1000	General error	The error number transmitted by FI is not known to the TO. It must be read out via P700 or another actual value.
0x4210	1.0	Inverter overtemperature
0x4310	2.0 / 2.1	Motor overtemperature / … I^2t
0x2310	3.0	Inverter overcurrent
0x7112	3.1	Chopper overcurrent
0x2211	3.2	IGBT overcurrent (125%)
0x2212	3.3	IGBT overcurrent fast (150%)
0x2200	4.0 / 4.1	Module overcurrent / pulse switch-off overcurrent
0x3210	5.0	Overvoltage link voltage
0x3110	5.1	Overvoltage mains
0x3230	6.0	Link voltage undervoltage (charging error)
0x3120	6.1	Mains undervoltage
0x3130	7.0	Phase failure
0x6310	8.0	EEPROM parameter loss
0x5530	8.1 / 8.2	Invalid inverter type / copy error ext. EEPROM
0x8111	10.0 / 10.1 / 10.2 / 10.3 / 10.4 / 10.5 / 10.6 / 10.7	Telegram downtime, initialisation error, system error
0x5110	11.0	ADU customer unit error
0x9000	12.0 / 12.1 / 12.2	Watchdog – customer/switch-off limit reached
0x7305	13.0	Incremental encoder 1
0x8400	13.1	Speed slip error
0x8300	13.2	Slip error switch-off monitoring
0x8600	14.0 / 14.1	reserved
0x8612	14.2	Reference limit
0x7300	14.3	Sensor
0x7306	14.4	Incremental encoder 2
0x7310	14.5	Speed sensor
0x7320	14.6 / 14.7 / 14.8	Position sensor
0x6000	15.0 / 15.1 / 15.2 / 15.3 / 15.4 / 15.5 / 15.6 / 15.7 / 15.8 / 20.1 / 20.2 / 20.3 / 20.4 / 20.5 / 20.6 / 20.7 / 20.9 / 21.0	System error, device software
0x7120	16.0 / 16.1	Phase error motor / motor current monitoring during brake operation
0x5300	17.0	Control panel
0xFF10	18.0	Safety circuit
0xFF11	19.0	Parameter identification error
0x5510	20.0	RAM data memory
0x5520	20.8	EPROM error
0x5000	10.8	Communication error ext. module

12 Examples

12.1 CANopen with USS process data

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

- Node ID “4”
- Interface parameter P509 (21FDh) = 17/6 (CANopen control) P510=0
- Rx-PDO1 is used for control. The device transmits its actual values via Tx-PDO1
- The drive profile is switched off (P551=0)

Identifier:

Rx-PDO1: 200h + NODE-ID → 204h

Tx-PDO1: 180h + NODE-ID → 184h

Mapping:

Byte	1	2	3	4
Rx-PDO1	Obj 3000 (control word)		0bj. 3002 Sub1 (setpoint1)	

Byte	1	2	3	4
Tx-PDO1	Obj 3001 (status word)		0bj. 3003 Sub1 (actual value1)	

Note: Objects 3002 and 3003 can be used to specify which setpoint or actual value is to be transferred. The significance of the setpoints or actual values is set using the parameters P543-P548 in the frequency inverter.

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 block” status. It has to be switched to "Standby" status using a control command. To do so, the control word “0x047E” must be transmitted. The PDO telegram therefore has the following structure:

Byte	1	2	3	4
ID=204	7Eh	04h	00h	00h

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	7Fh	04h	00h	20h

13 Additional information

13.1 Electronic data sheet (eds file)

All available objects are contained in the (SK***E.eds) “Electronic data sheet” (eds file).

http://www2.nord.com/cms/de/documentation/software/software_detail_14558.jsp#top

Frequency inverter	CANnord	CANopen	DeviceNet
vector mc		SKMCCO.eds	SKMCDN.eds
SK 300E		SK300ECO.eds	SK300E.eds
SK 500E		SK500ECO_rel14.eds	SK500E.eds
SK 500E, from software version 1.5		SK500ECO_rel15.eds	
SK 520E/530E		SK520e_rel14.eds	SK520E.eds
SK 520E/530E, from software version 1.5		SK520e_rel15.eds	
SK 700E/750E		SK700ECO.eds	SK700E.eds

13.2 Further documentation

Internet:	www.can-cia.org www.drivecom.org
References:	CIA draft Standard 301 CIA Draft Standard 401

14 Repairs

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

Nord Electronic Drivesystems GmbH
Tjüchkampstr. 37
26605 Aurich, Germany

For queries about repairs, please contact:

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

If a frequency inverter or accessories are sent in for repair, no liability can be accepted for any added components, e.g. such as line cables, potentiometer, external displays, etc.!
Please remove all non-original parts from the frequency inverter.

15 Abbreviations/Foreign words

FI.....Frequency inverter
SW.....Software
P .....Parameter set
PDO.....Process Data Object (exchange of status and control data)
PZD.....Process data, control word and setpoint to be transmitted
rev.....revolution (usually referring to motor)
SDO.....Service Data Objects (access to parameter data of FI)

Broadcast.....all slaves addressed simultaneously
Identifier.....Address of CAN message box, a node can have several identifiers.
Node .....Bus participant, e.g. an FI, I/O module, etc.
Repeater.....Amplifier

16 Key word index

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