

SK TU4-CAO-C

Part number: 275 281 151

CANopen® – External Bus Interface

The bus interface may only be installed and commissioned by qualified electricians. An electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- Switching on, switching off, isolating, earthing and marking power circuits and devices,
- Proper maintenance and use of protective devices in accordance with defined safety standards.

⚠ DANGER

Danger of electric shock

The frequency inverter carries hazardous voltage for up to 5 minutes after being switched off.

- Work must not be carried out unless the frequency inverter has been disconnected from the voltage and at least 5 minutes has elapsed since the mains was switched off!

NOTICE

Validity of document

This document is only valid in conjunction with the operating instructions of the respective frequency inverter and the bus communication manual for this bus interface (📖 See overview at end of document). These documents contain all of the information that is required for safe commissioning of the bus interface module and the frequency inverter.

Scope of delivery

| | | |
|------------------------------|-------------------------------------|--|
| 1 x | Bus interface | SK TU4-CAO-C |
| 4 x | Hexagonal socket screw | M4 x 40 mm |
| <i>Accessories required:</i> | | |
| 1 x | Bus connection unit TI 275280500 | SK TI4-TU-BUS-C (Part No.: 275 280 500) |



Usage area

External technology unit for connecting a decentralised frequency inverter (SK 180E...SK 2xxE) to a **CANopen** field bus. The bus interface can be mounted on, or in the immediate vicinity of the frequency inverter. This is connected to the inverter via the system bus, and can directly access up to 4 frequency inverters. 4 digital inputs and 2 digital outputs are available.

| Technical Information / Datasheet | SK TU4-CAO-C | | | |
|-----------------------------------|--------------|-------|------|----|
| CANopen Bus module | TI 275281151 | V 1.0 | 4116 | EN |

Technical Data

Bus interface

| | |
|-------------------|---|
| Temperature range | -25 °C...50 °C |
| Temperature class | Class 3K4 |
| Protection class | IP66 |
| Supply voltage | 24 V ± 20 %, ≈ 100 mA Reverse polarity protected |

| | |
|----------------------|--------------------------|
| Vibration resistance | 3M7 |
| Firmware version | V2.2 R2 |
| Hardware version | AA |
| Dimensions [mm]* | H x W x D: 95 x 136 x 91 |

* bus interface fitted to bus connection unit

| | |
|--------------------------------------|--|
| Digital input - working range | Low: 0 V ... 5 V, High: 15 V ... 30 V |
| Digital input - specific data | $R_i = 8 \text{ k}\Omega$, input capacity: 10 nF, response time 1 ms, inputs as per EN 61131-2 type 1 |
| Digital output - 24 VDC power supply | ≤ 400 mA (input) |
| Digital input - working range | Low = 0 V, High = 24 V; max. 200 mA |

Bus specification

| CANopen | Max. 1 MBit/s | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------|---|------------------------------|--------------------------------|---------------|---------------|------------|---------|--------------------------------|----------|-----------|---------|--------------------------------|------------|-----------|-----------|--------------------------------|------------|------------|-----------|-------------------------------|------------|-------------|-----------|--------------------------------|------------|--------------|-----------|------------------------------|-----------|
| | electrical isolation 500 V _{eff} | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bus connection | Connection terminals | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bus termination | via DIP switch on the bus interface | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Status display | 4 LEDs | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Topology | Linear bus | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cable | twisted, shielded two-conductor cable | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cable length | depending on transmission speed: | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <table border="1"> <thead> <tr> <th>Bus cable length</th> <th>Resistance</th> <th>Cross-section</th> <th>Transfer rate</th> </tr> </thead> <tbody> <tr> <td>Up to 25 m</td> <td>70 mΩ/m</td> <td>≥ 0.25 mm², AWG23</td> <td>1 Mbit/s</td> </tr> <tr> <td>25...50 m</td> <td>70 mΩ/m</td> <td>≥ 0.25 mm², AWG23</td> <td>800 KBit/s</td> </tr> <tr> <td>50...80 m</td> <td>< 60 mΩ/m</td> <td>≥ 0.34 mm², AWG22</td> <td>500 KBit/s</td> </tr> <tr> <td>80...230 m</td> <td>< 40 mΩ/m</td> <td>≥ 0.5 mm², AWG21</td> <td>250 KBit/s</td> </tr> <tr> <td>230...480 m</td> <td>< 26 mΩ/m</td> <td>≥ 0.75 mm², AWG18</td> <td>125 KBit/s</td> </tr> <tr> <td>480...1000 m</td> <td>< 20 mΩ/m</td> <td>≥ 1 mm², AWG...</td> <td>50 KBit/s</td> </tr> </tbody> </table> | Bus cable length | Resistance | Cross-section | Transfer rate | Up to 25 m | 70 mΩ/m | ≥ 0.25 mm ² , AWG23 | 1 Mbit/s | 25...50 m | 70 mΩ/m | ≥ 0.25 mm ² , AWG23 | 800 KBit/s | 50...80 m | < 60 mΩ/m | ≥ 0.34 mm ² , AWG22 | 500 KBit/s | 80...230 m | < 40 mΩ/m | ≥ 0.5 mm ² , AWG21 | 250 KBit/s | 230...480 m | < 26 mΩ/m | ≥ 0.75 mm ² , AWG18 | 125 KBit/s | 480...1000 m | < 20 mΩ/m | ≥ 1 mm ² , AWG... | 50 KBit/s |
| | Bus cable length | Resistance | Cross-section | Transfer rate | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | 50...80 m | < 60 mΩ/m | ≥ 0.34 mm ² , AWG22 | 500 KBit/s | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 80...230 m | < 40 mΩ/m | ≥ 0.5 mm ² , AWG21 | 250 KBit/s | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 230...480 m | < 26 mΩ/m | ≥ 0.75 mm ² , AWG18 | 125 KBit/s | | | | | | | | | | | | | | | | | | | | | | | | | |
| 480...1000 m | < 20 mΩ/m | ≥ 1 mm ² , AWG... | 50 KBit/s | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shield | via metal cable lead-in to PE | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PE connection | via PE screw cap in terminal box | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Power

| | |
|---|-----------------------|
| Update interval for process data between bus interface and frequency inverter | ≤ 8 ms ^{1,2} |
| Parameter read/write access on the frequency inverter | > 20 ms ² |

¹ depending on bus utilisation

² depending on the setting of the **P153 min. system bus cycle** parameter

Bus interface characteristics

| | |
|-------------------------------------|--|
| Parametrisation | CANopen via SDO |
| Addressing | via DIP switch |
| Setting the baud rate | via DIP switch |
| Supported CANopen profile | Communication profile DS -301 |
| | Drive profile DS -402 |
| Error Messages (Emergency Messages) | to CANopen communication profile DS-301 |
| Access for NORD diagnosis tool via | diagnostics socket on the device (if available) and via frequency inverter |

Installation

The bus interface must be attached to a suitable connection unit (SK TI4-TU...) and connected using the 4 provided M4 x 40 mm hexagon socket collar screws. Installation details can be found in the data sheet for the relevant connection units.

Connections

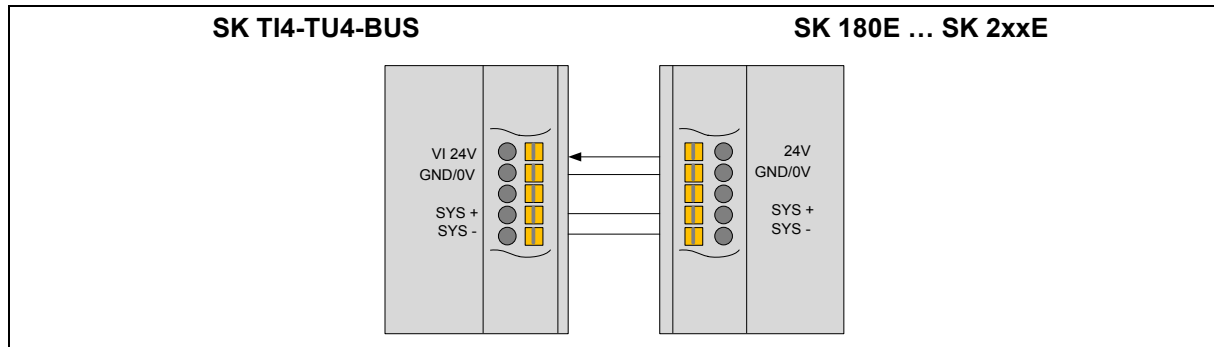
The connection of the field bus lines, signal lines and control lines takes place via the bus connection unit.

| Potential | Contact | Designation | Description | |
|-----------|-------------------------------------|-------------|-------------|--|
| 1 | CANopen | 1 | 24V-B CAO | External 24 V supply CANopen field bus |
| | | 2 | 24V-B CAO | External 24 V supply CANopen field bus |
| | | 3 | CAO+ IN | CANopen Data cable + (Receive) |
| | | 4 | CAO+ OUT | CANopen Data cable + (Transmit) |
| | | 5 | CAO- IN | CANopen Data cable - (Receive) |
| | | 6 | CAO- OUT | CANopen Data cable - (Transmit) |
| | | 7 | GND B CAO | Bus reference potential |
| | | 8 | GND B CAO | Bus reference potential |
| | | 9 | SHLD | Bus shield |
| | | 10 | SHLD | Bus shield |
| 2 | System bus level and digital inputs | 11 | 24 V | Supply voltage (+24 V) |
| | | 12 | 24 V | Supply voltage (+24 V) |
| | | 13 | 24 V | Supply voltage (+24 V) |
| | | 14 | Sys + | System bus data line + |
| | | 15 | GND | Reference potential (0 V/GND) |
| | | 16 | Sys - | System bus data line - |
| | | 17 | GND | Reference potential (0 V/GND) |
| | | 18 | GND | Reference potential (0 V/GND) |
| | | 19 | DIN1 | Digital input 1 |
| | | 20 | DIN3 | Digital input 3 |
| | | 21 | GND | Reference potential (0 V/GND) |
| | | 22 | GND | Reference potential (0 V/GND) |
| | | 23 | 24 V | Supply voltage (+24 V) |
| | | 24 | 24 V | Supply voltage (+24 V) |
| | | 25 | DIN2 | Digital input 2 |
| | | 26 | DIN4 | Digital input 4 |
| | | 27 | GND | Reference potential (0 V/GND) |
| | | 28 | GND | Reference potential (0 V/GND) |
| | | 29 | 24 V | Supply voltage (+24 V) |
| | | 30 | 24 V | Supply voltage (+24 V) |
| 3 | Digital outputs | 31 | 24V o DO | Supply voltage (+24 V) |
| | | 32 | GND o DO | Reference potential (0 V / GND) of the digital outputs |
| | | 33 | DO 1 | Digital output 1 (+24 V, 500 mA) |
| | | 34 | DO 2 | Digital output 2 (+24 V, 500 mA) |
| | | 35 | GND o DO | Reference potential (0 V / GND) of the digital outputs |
| | | 36 | GND o DO | Reference potential (0 V / GND) of the digital outputs |
| 4 | Diagnostics | RJ12 - 1 | RS485_A | Data cable RS485 |
| | | RJ12 - 2 | RS485_B | Data cable RS485 |
| | | RJ12 - 3 | GND | Reference potential (GND) |
| | | RJ12 - 4 | RS232_TxD | Data cable RS232 |
| | | RJ12 - 5 | RS232_RxD | Data cable RS232 |
| | | RJ12 - 6 | 24 V | Supply voltage (+24 V) |



Schematic diagram - electrical connection

(Terminal designation for the example of NORD frequency inverters SK 180E ... SK 2xxE)

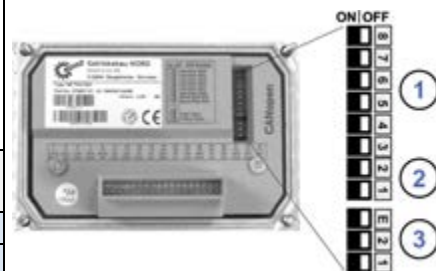


Configuration

The bus address (node ID), the bus interface (1) and the baud rate (2) are set via the DIP switches. The DIP switch setting results in the node identifier, which is read in after a "Power On" of the bus interface.

If the bus interface is the final subscriber on the CANopen field bus or the NORD system bus, the terminating resistor (3) must be activated.

| DIP switch | Meaning | Department | Meaning |
|------------|------------------|--------------|--|
| 8 | Identifier bit 5 | Addressing | Bus address (Node ID) of bus interface |
| 7 | Identifier bit 4 | | |
| 6 | Identifier bit 3 | | |
| 5 | Identifier bit 2 | | |
| 4 | Identifier bit 1 | | |
| 3 | Identifier bit 0 | Baud rate | Bus interface baud rate |
| 2 | Baud rate bit 1 | | |
| 1 | Baud rate bit 0 | Bus terminal | Not used |
| E | — | | Termination resistor for CANopen field bus |
| 2 | CAN Term. | | Termination resistor for NORD system bus |
| 1 | S-Bus Term. | | |



1. Addressing (DIP 8 ... 3)

The setting of the node ID takes place with binary coding using DIP switches 8...3.

Address area "1"..."63".

2. Baud rate (DIP 2 ... 1)

The setting of the node ID takes place with binary coding using DIP switches 2...1.

| DIP switch 2 | DIP switch 1 | Baud rate |
|--------------|--------------|-----------|
| OFF | OFF | 125 kBaud |
| OFF | ON | 250 kBaud |
| ON | OFF | 500 kBaud |
| ON | ON | 1 MBaud |

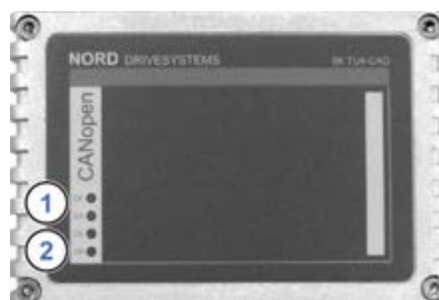
3. Termination resistor (DIP E... 1)

Set DIP switch 2 to the "ON" position if the bus interface is the final subscriber on the field bus. Set DIP switch 1 to the "ON" position if the bus interface is the final subscriber on the NORD system bus.

LED indicators

The operating statuses of the bus interface are visualised using LED indicators.

| No. | Name | Colour | Meaning |
|-----|------|--------|---------------|
| 1 | EN | red | Device error |
| | DS | green | Device State |
| 2 | CE | red | CANopen Error |
| | CR | green | CANopen State |



CANopen-specific LED

| CR (CANopen State) | Meaning |
|------------------------------------|--|
| OFF | No operating voltage, initialisation |
| Flashing green (1 s) | CANopen operating state "stopped" |
| Flashing green (0.5 s) | CANopen operating state "pre-operational" |
| Flashing green (0.25 s) | No other subscribers on the bus or wiring defective (only if the "CE" LED is flashing) |
| Green ON | CANopen operating state "operational" |

| CE (CANopen Error) | Meaning |
|-----------------------|--|
| OFF | No error |
| Flashing red | Bus warning, error counter of the CANopen controller has reached or exceeded the warning limit. → Check wiring / shielding / termination resistors. |
| | CANopen error → there is no physical connection to another subscriber |
| Red ON | CANopen controller disconnected from bus, since a serious error has occurred such as <ul style="list-style-type: none"> Wiring error Incorrect baud rate set |

NORD-specific LEDs

| DS (Device State) | EN (Device Error) | Meaning |
|----------------------|---|--|
| | | long flashing = 0.5 s on / 1 s off short flashing = 0.25 s on / 1 s off |
| OFF | OFF | Bus interface not ready, no control voltage |
| ON | OFF | Bus interface ready, no error, at least one frequency inverter is communicating via the system bus |
| ON | Short flashing | Bus interface ready, but <ul style="list-style-type: none"> One or more of the connected frequency inverters has fault status |
| Long flashing | OFF | Bus interface ready and at least one other subscriber is connected to the system bus, but <ul style="list-style-type: none"> No frequency inverter on the system bus (or connection interrupted) One or more system bus subscriber has an address error Software incompatible (bus interface software and FI software incompatible - update required) |
| Long flashing | Short flashing Flash interval 1 x - 1s pause | System bus is in status "Bus Warning" <ul style="list-style-type: none"> Communication on system bus disrupted No other subscribers present on system bus Module not inserted correctly or no connection to system bus Frequency inverter has no supply voltage |
| Long flashing | Short flashing Flash interval 2 x - 1s pause | System bus is in status "Bus Off" <ul style="list-style-type: none"> The system bus 24 V power supply has been interrupted during operation |
| Long flashing | Short flashing Flash interval 3 x - 1s pause | System bus is in status "Bus Off" <ul style="list-style-type: none"> The 24V voltage supply of the system bus is missing |
| Long flashing | Short flashing Flash interval 4 x - 1s pause | Bus interface error <ul style="list-style-type: none"> See parameter P170 |
| OFF | Short flashing Flash interval 1...7 - 1s pause | System error, internal program sequence interrupted <ul style="list-style-type: none"> EMC interference (observe the wiring guidelines!) Bus interface defective |

Error messages

Error messages from the bus interface - current or archived message relating to the last fault - can be read out via module parameter **P170**. The error messages are lost if the bus interface is switched off.

| Error | Meaning | Remarks |
|-------|-------------------------|---|
| 100.0 | EEPROM error | EMC faults, bus interface defective |
| 101.0 | System bus 24 V missing | No 24 V voltage on bus, connections not correct |
| 102.0 | Bus timeout P151 | By means of timeout supervision parameter P151/P513 |
| 103.0 | System bus BUS OFF | No 24 V supply to the bus, connections not correct |
| 511.0 | CANopen BUS OFF | Bus subscriber not connected to bus |
| 511.1 | CANopen warning | Bus error |
| 511.2 | CANopen overrun | Message buffer of bus interface overwritten with new telegram before processing |
| 511.3 | Invalid CANopen address | Incorrect/duplicated bus address |
| 512.0 | CANopen timeout | Telegram transfer error |

Bus interface-related errors are depicted as follows in the error memory of the frequency inverter (**P700 / P701**).

| Error (E010) | Meaning | Remarks |
|--------------|---|--|
| 10.2 | External bus interface telegram timeout | Telegram transfer error <ul style="list-style-type: none"> Check the connections and links, program sequence and Bus Master. |
| 10.3 | Timeout by P151/P513 | System bus supervision has triggered. <ul style="list-style-type: none"> Check time setting of parameter P151/P513. The release bit is missing in the control word. |
| 10.4 | External bus interface initialisation error | Unable to address bus interface. <ul style="list-style-type: none"> Check power supply of bus interface. |
| 10.8 | External bus interface communication error | SK TU3-CAO bus interface only: Connection between bus interface and frequency inverter interrupted. |
| 10.9 | Bus interface missing (P120) | Only bus interfaces SK CU4-CAO and SK TU4-CAO: Connection between bus interface and frequency inverter interrupted (see setting of parameter P120). |

Parameters

Frequency inverter: The following frequency inverter parameters must be adapted for setting up communication between the frequency inverter and the bus interface (for details please refer to the frequency inverter manual).




| Parameter [-Array] | Meaning | Remarks |
|--|-----------------------------------|--|
| P120 [-01] | Option monitoring | "Auto" (default setting) Only SK xU4 |
| P509 | Source Control Word | SK TU3-... on SK 5xxE: "Ethernet TU" SK xU4-... on SK 180/SK 2xxE: "System bus" |
| P510 [-01]...[-02] | Setpoint source | "Auto" (default setting) |
| P513 | Time-out | Monitoring of the SK TU3 bus interface Only SK 5xxE |
| P543 [-01]...[-03] ([-05]) and P543 ... P545 | Bus actual value (1...3 (...5)) | Possible settings according to P418 |
| P546 [-01]...[-03] ([-05]) and P546 ... P548 | Bus setpoint value (1...3 (...5)) | Possible settings according to P400 |
| P700 [-01]/ P701 | Current/last faults | Information parameter |
| P740 / P741 | Process data bus In / Out | Information parameter |
| P745 | Module version | Information parameter Only SK TU3 |
| P746 | Module status | Information parameter Only SK TU3 |
| P748 | CANopen/System bus status | Information parameter |

Bus interface: The bus interface provides a selection of appropriate parameters for setting or displaying special operating values. Parameters can be adapted using the NORDCON software or an SK PAR-3H / -3E parameter box. All parameters can still be read and written by the bus master via CANopen.

| Parameter [-Array] | Meaning | Remarks |
|--------------------|---------------------------|---|
| P150 | Set relays | Set DOUT directly or control via BUS |
| P151 | External bus time-out | Monitoring of SK xU4 bus interface |
| P152 | Factory setting | Reset bus interface parameters |
| P153 [-01]...[02] | Minimum system bus cycle | Reduction of bus load on the system bus caused by the bus interface |
| P154 [-01]...[-02] | Access to option card I/O | Administration of read and write rights to the IO of the module |
| P160 [-01]...[-10] | COB-ID On/Off | Assignment of process data and service data objects |
| P161 [-01]...[-19] | COB-ID | Assignment of COB-ID for process data and service data objects |
| P162 [-01]...[-10] | PDO transmission type | Confirm transmission type for process data objects |
| P163 [-01]...[-05] | TxPDO Inhibit time | Confirm transmission break for process data objects |
| P164 [-01]...[-05] | TxPDO Event time | Confirm delay time for process data transfer |
| P165 [-01]...[-34] | PDO Mapping Para | Specify PDO objects |
| P166 [-01]...[-02] | Timeout Control | Set supervision interval |
| P167 | Life time factor | Set supervision factor |
| P168 [-01]...[-17] | Drive profile | Set profile parameters (velocity mode) |
| P170 [-01]...[-02] | Present errors | Display bus interface errors |
| P171 [-01]...[-03] | Software version | Firmware version/Revision |
| P172 | Configuration | Bus interface type |
| P173 | Module status | Status of system bus or the connected FI |
| P174 | Status of digital inputs | Image of the switching status of DIN |
| P175 | Digital output state | Image of the switching status of DOUT |
| P176 [-01]...[-17] | Process data bus In | Information parameter |
| P177 [-01]...[-17] | Process data bus Out | Information parameter |
| P180 | CANopen address | Information parameter |
| P181 | CANopen baud rate | Information parameter |

Parameter access and diagnostics

The NORD CON software and optional control units such as the SK PAR-3H parameter box provide convenient access to the parameters of the bus interface and allow status information to be read out.

| SK TU3- | SK TU4- | SK CU4- / SK TU4- |
|---|--|--|
| Access via RJ12 diagnostics socket of the SK 5xxE | Access via RJ12 diagnostics socket of the bus connection unit SK TI4-TU-BUS(-C) | Access via RJ12 frequency inverter diagnostics socket, if connected to the bus interface via the system bus. |
|  |  |  |

Further documentation and software (www.nord.com)

| Software | Description |
|--------------------------|---------------------------------------|
| EDS-file | Device characteristics and parameters |

| Software | Description |
|--------------------------|---|
| NORD CON | Parametrisation and diagnostic software |

| Document | Description |
|-------------------------|--|
| BU 0000 | Description of NORD CON software |
| BU 0040 | Parameter box manual |
| BU 0180 | Frequency inverter manual SK 180E, SK 190E |
| BU 0200 | Frequency inverter manual SK 2xxE |
| BU 2500 | Description of CANopen bus communication |

| Document | Description |
|------------------------------|---|
| TI 275280500 | Bus connection unit SK T14-TU-BUS-C |
| TI 275274505 | SK TIE4-M12-SYSS System bus connection expansion exit |
| TI 275274506 | SK TIE4-M12-SYSS System bus connection expansion entrance |
| TI 275274515 | SK TIE4-M12-CAO-OUT CANopen connection expansion output |
| TI 275274501 | SK TIE4-M12-CAO CANopen connection expansion entrance |