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SK TU4-ECT-C

Part number: 275 281 167

EtherCAT® – 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-ECT-C
4 x	Hexagonal socket screw	M4 x 40 mm
Accessories required:		
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 an **EtherCAT** 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. 8 digital inputs and 2 digital outputs are available.

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	V1.8 R0
Hardware version	BB
Dimensions [mm]*	H x W x D: 95 x 136 x 99

*bus interface fitted to bus connection unit
Depth: 108 mm with cover caps on M12 connection

Digital input - working range	Low: 0 V … 5 V, High: 15 V … 30 V
Digital input - specific data	R_i = 8 kΩ, input capacity: 10nF, sampling rate 1 ms, reaction time 1 ms, inputs according to EN 61131-2 type 1
Digital output - 24 VDC power supply	≤ 400 mA (input)
Digital output - working range	Low = 0 V, High = 24 V; max. 200 mA

Bus specification

EtherCAT	max. 100 MBaud
	electrical isolation 500 V_{eff}
Bus connection	2 x M12 sockets
Bus termination	performed automatically
Status display	6 LEDs
Topology	Linear bus
Process data	8 bytes per FI + 2 bytes for IOs Total length 2 ... 34 Bytes

Cable	Min. Ethernet CAT-5
Max. cable length	100 m between two bus interfaces
Shield	via M12 direct to PE
PE connection	via PE screw cap in terminal box

Power

Update interval of process data for 1000 devices	≈ 1 ms
Update interval for process data between bus interface and frequency inverter	≈ 1.5 ms
Parameter read access on the frequency inverter	≈ 15 ms
Parameter write access with storage in EEPROM	≈ 25 ms

Bus interface characteristics

Parametrisation	via CoE (CANopen over EtherCat)
Error Messages (Emergency Messages)	in acc. with CANopen DS-301
EtherCAT Addressing (Second Address)	DIP switch or bus interface parameters
Distributed Clocks	not supported
Access for NORD diagnosis tool via	diagnosis socket on the device (if available) and via frequency inverter

Installation

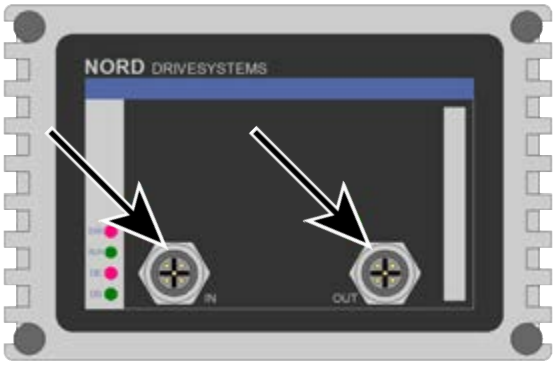
The bus interface must be attached to a suitable connection unit (SK TI4-TU…) and connected using the 4 provided M4 x 40 mm hexagon socket collar screws. Installation details can be found in the data sheet for the relevant connection units.

Connections

The two Ethernet lines are connected exclusively via the two M12 sockets on the front. If the bus interface is the final subscriber on the line, one M12 socket can remain unoccupied. The use of EMC cable glands is recommended.

PIN	Signal	Description
1	TX+	Transmission Data +
2	RX+	Receive Data +
3	TX-	Transmission Data -
4	RX-	Receive Data -

PIN assignment
M12-4 socket
("D"- coded)

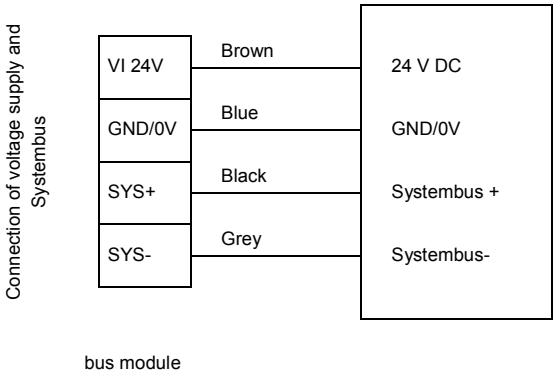


The connection to other signal and control lines takes place via the bus connection unit **SK TI4-TU-BUS(-C)**.

Terminals	Double-sprung terminal bar	2 x 18 contacts
Cable cross section	AWG 14-26	rigid: 0,14 … 2,5 mm flexible: 0.14 … 1.5 mm with wire end sleeves
PE connection	Via housing	
RJ12	RJ45 - socket	Interface for connecting a parameterisation tool

Potential		Contact	Designation	Description
1	Digital inputs	1	24 V	Supply potential (+24 V, ≤ 200 mA)
		2	24 V	Supply potential (+24 V, ≤ 200 mA)
		3	DIN5	Digital input 5
		4	DIN7	Digital input 7
		5	DIN6	Digital input 6
		6	DIN8	Digital input 8
		7	0 V	Reference potential (0 V / GND)
		8	0 V	Reference potential (0 V / GND)
		9	24 V	Supply potential (+24 V, ≤ 200 mA)
		10	24 V	Supply potential (+24 V, ≤ 200 mA)
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	0 V	Reference potential (0 V / GND)
		16	SYS -	System bus data line -
		17	0 V	Reference potential (0 V / GND)
		18	0 V	Reference potential (0 V / GND)
		19	DIN1	Digital input 1
		20	DIN3	Digital input 3
		21	0 V	Reference potential (0 V / GND)
		22	0 V	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	0 V	Reference potential (0 V / GND)
		28	0 V	Reference potential (0 V / GND)
		29	24 V	Supply voltage (+24 V)
		30	24 V	Supply voltage (+24 V)
3	Digital outputs	31	VI 24V2	Supply potential (+24 V - in) of the digital outputs
		32	0V2	Reference potential (0 V / GND) of the digital outputs
		33	DOUT1	Digital output 1 (+24 V, ≤ 200 mA)
		34	DOUT2	Digital output 2 (+24 V, ≤ 200 mA)
		35	0V2	Reference potential (0 V / GND) of the digital outputs
		36	0V2	Reference potential (0 V / GND) of the digital outputs
4	Diagnosis	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)

Connection examples



Configuration

No settings need to be made on the device. However, the bus interface can be configured with a fixed address because of the “Hot Connection Group” functionality, the so-called “Second Address”. This takes place using the DIP switches of the bus interface. The DIP switch settings are read after a "Power On" of the bus interface.

DIP switch												Meaning
12	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	Address
X	X	0	0	0	0	0	0	0	0	0	X	0
X	X	0	0	0	0	0	0	0	0	1	X	1
X	X	0	0	0	0	0	0	0	1	0	X	2
X	X	-	-	-	-	-	-	-	-	-	X	-
X	X	1	1	1	1	1	1	1	1	1	X	511
											0	System bus terminating resistor not set.
											1	System bus terminating resistor set.
Access rights for remote maintenance												
	0											Only read access to parameters possible.
	1											Read and write access to parameters possible.
0												No control possible.
1												Control is possible.

1. System bus (DIP 1)

   The system bus must be terminated at both physical ends.

2. Second Address (DIP 2…10)

   The „Second Address“ can be set via this switch and controlled in parameter **P181**.

   If all DIP switches 2…10 are moved to the “OFF” position, the „Second Address“ can be set via parameter **P160**.

3. Access rights for remote maintenance (DIP 11…12)

   The bus interface and the connected frequency inverter can be accessed via remote maintenance using the TCP Ethernet protocol. The type of access is defined via the DIP switch with inputs 10 to 11.

Factory settings DIP switches: **OFF**

LED indicators

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

No.	Name	Colour	Meaning
1	RUN	green	Ethernet State
	ERR	red	Ethernet Error
	DS	green	Device State
	EN	red	Device error
2	Link/Act	green	Link/Activity

EtherCAT-specific LED

RUN	State	Meaning
OFF	**Init**	• No communication of process data and parameters
Flashing	**Pre-Operational**	• Parameter communication active • No process data communication
Single Flash	**Save Operational**	• Parameter communication active • Restricted process data communication • No restrictions to actual values • Setpoints not evaluated
ON	**Operational**	• Parameter communication active • Unrestricted process data communication

ERR	State	Meaning
OFF	**No Error**	• EtherCAT functioning normally on the bus interface
Flashing	**Invalid Configuration**	• General EtherCAT configuration error, may be generated because of an erroneous XML file
Single Flash	**Unsolicited State Change**	• Bus interface has changed the EtherCAT state without authorisation
Double Flash	**Application Watchdog Timeout**	• EtherCAT or FI timeout (P513 or P151)

L/A (Green LED)	State	Meaning
OFF	**No Connection**	• Bus interface not ready, no control voltage, • No bus connection (check cable connection)
Flashing	**Active**	• Bus interface connected and active
ON	**Inactive**	• Bus interface ready for operation, but no bus activity present

NORD-specific LEDs

DS (**D**evice **S**tate)	**EN** (**D**evice **E**rror)	**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 • 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 • 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" • 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" • 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" • The 24V voltage supply of the system bus is missing
Long flashing	**Short flashing** Flash interval **4** x - 1s pause	Bus interface error • See parameter **P170**
OFF	**Short flashing** Flash interval **1…7** - 1s pause	System error, internal program sequence interrupted • 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 bus interface 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
102.0	Timeout	via P151/P513 monitoring
103.0	System bus BUS OFF	No 24 V supply to the bus, connections not correct
104.0	Bus interface temperature > 91 °C	only SK CU4-…, permissible internal temperature of the bus interface exceeded for approx. 60 sec
550.1	DIP switch error	The DIP switches (IP address) could not be read correctly
560.0 ... 560.9	Internal error	Bus interface not ready
561.0	General network error	
561.1	Ethernet Watchdog timeout	
561.2	Bus cable fault	Bus cable connection interrupted
561.3	IP address error	IP address of bus interface has been doubly assigned
563.0	Firmware version incompatible	The firmware version cannot be used for the device
564.0	MAC address defective	

Errors which occur in relation to the bus interface are depicted as follows in the error memory of the frequency inverter (P700 / P701).

Error (E010)	Meaning	Remarks
10.0	Connection error	Contact to SK xU4 lost
10.1	ASIC error	Communication with Ethernet ASIC lost • Supply voltage shut-off • Reduce temperature of bus interface to less than 91 °C (SK CU4-… only)
10.2	Ethernet Watchdog timeout	Telegram transfer error • Check the connections and links, program sequence and Bus Master
10.3	Timeout by P151/P513	Telegram transfer error • Check the connections and links • Check the Watchdog time
10.4	IP address error	IP address of bus interface has been doubly assigned
10.5	Internal error	Module not ready for operation, configuration error
10.6	Bus cable fault	Bus cable connection interrupted
10.8	The connection between inverter and bus interface had timeout	SK TU3 bus interface only
10.9	Bus interface missing (P120)	SK xU4 bus interface only

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 from and written to by the bus master via EtherCAT.

Parameter [-Array]	Meaning	Remarks	-TU3-	-TU4-	-CU4-
P150	Set relays	Set DOUT directly or control via bus		X	
P151	External bus time-out	Monitoring of SK xU4 bus interface		X	X
P152	Factory setting	Reset bus interface parameters	X	X	X
P153 [-01 …-02]	Minimum system bus cycle	Reduction of bus load on the system bus caused by the bus interface (SK xU4 only)		X	X
P154 [-01 …-02]	Access to option card I/O	Administration of read and write permissions to the IOs of the bus interface		X	X
P170 [-01 … -02]	Present errors	Display bus interface errors	X	X	X
P171 [-01 … -03]	Software version	Firmware version/Revision	X	X	X
P172	Configuration	Bus interface type	X	X	X
P173	Module status	Status of system bus or connected FC	X	X	X
P174	Status of digital inputs	Image of the switching status of DIN		X	X
P175	Digital output state	Image of the switching status of DOUT		X	
P176 [-01…]	Process data bus In	Information parameter	X	X	X
P177 [-01…]	Process data bus Out	Information parameter	X	X	X
P178	Internal temperature	Information parameter			X
P180	NMT State	Information parameter	X	X	X
P181	Second Address	Information parameter	X	X	X
P182	EtherCat Watchdog	Watchdog Supervision Time	X	X	X
P183 [-01…-04]	EtherCAT transfer error	Transmission error at EtherCAT level	X	X	X
P184	SPI error counter	Information parameter	X	X	X

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
XML-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

Document	Description
BU 2300	EtherCAT bus communication manual
TI 275280500	Bus connection unit SK TI4-TU-BUS-C
TI 275274505	SK TIE4-M12-SYSM System bus connection expansion exit
TI 275274506	SK TIE4-M12-SYSS System bus connection expansion entrance