SK TU3-ECT

Part number: 275 900 180

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 TU3-ECT

Usage area

Technology unit for connecting one frequency inverter (firmware version V1.8 R0 and above: four frequency inverter) of type SK 5xxE to an **EtherCAT®** field bus. The bus interface must be directly plugged into the technology slot of the frequency inverter.

Technical Information / Datasheet		**SK TU3-ECT**			
EtherCAT Bus module		TI 275900180	V 1.4	3517	en

Technical Data

Bus interface

Temperature range	0 °C … 40 °C
Temperature class	Class 3K3
Protection class	IP20
Supply voltage	24 V ± 20 %, ≈ 100 mA Reverse polarity protected

Vibration resistance	2M1
Firmware version	V1.8 R2
Hardware version	AA
Dimensions [mm]	H x W x D: 27 x 73 x 101

Bus specification

EtherCAT	max. 100 MBaud
	electrical isolation 500 V_{eff}
Bus connection	2 x RJ45
Bus termination	performed automatically
Status display	6 LEDs
Topology	Linear bus
Process data	12 Byte static

Cable	Min. Ethernet CAT-5
Max. cable length	100 m between two modules
Shield	via RJ sockets, high-impedance and capacitive to PE
PE connection	via PE plug pin (rating less than 24 V)

Power

Update interval of process data for 1000 devices	≈ 1.0 ms
Update interval for process data between bus interface and frequency inverter	≈ 1.5 ms
Parameter read access on the frequency inverter	≈ 25 ms
Parameter write access with storage in EEPROM	≈ 70 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

ℹ **Information**   **Installing the SK TU3-... technology unit**

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

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

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

1. Switch off the mains voltage, observe the waiting period.
2. Push the control terminal cover down slightly or remove.
3. Remove the **dummy cover** by activating the release mechanism at the lower edge and removing it with an upwards rotating movement.
4. Hook the **technology unit** onto the upper edge and press in lightly until it engages.

   Take care that the plug connection bar is properly contacted and if necessary fix it with a suitable screw (self-tapping screw 2.9 mm x 9.5 mm, included in the scope of delivery of the frequency inverter).

5. Close the control terminal cover again.

Connections

The two Ethernet lines are connected exclusively via the two RJ45 sockets on the front. If the bus interface is the final subscriber on the line, one RJ45 socket can remain unoccupied.
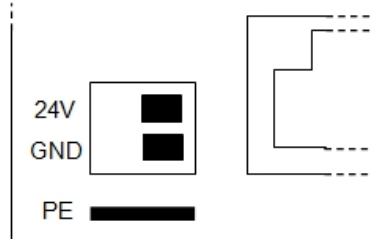
(1) RJ45 socket detail

RJ45 Pin	Signal	Description
1	TX+	Transmission Data +
2	TX-	Transmission Data -
3	RX+	Receive Data +
6	RX-	Receive Data -
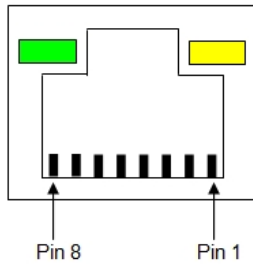
(2) Power supply detail

Terminal	Name	Description
45	+ 24 V	24 V supply
46	GND	Earth

Product Code

As of firmware version V1.8 R0 the module supports the connection of up to four frequency inverters via the system bus (CANopen).
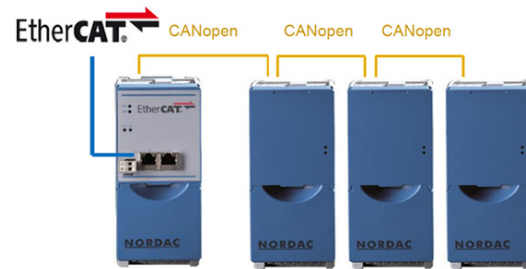
In association with this a new XML device description file has been developed, which is not compatible with the previous versions. A new product code has been introduced for better differentiation between the two device description files.

The EtherCAT product codes form a part of the product ID with which the control unit assigns the device description files to the corresponding devices. The previous device description file had the product code (**0x100**), the new device description file with system bus functionality has been given the product code (**0x500**).

For compatibility reasons SK TU3-ECT modules with firmware version V1.8 R0 and above support both device description files. The new technology units are supplied with the product code (**0x100**) as the factory setting. This ensures that the technology units in existing systems can be replaced without the need to modify the planned device description file in the controller. If the factory setting of the XML device description file in the EEPROM does not correspond to the required system bus functionality, the device description file must be updated once in the EEPROM on commissioning.
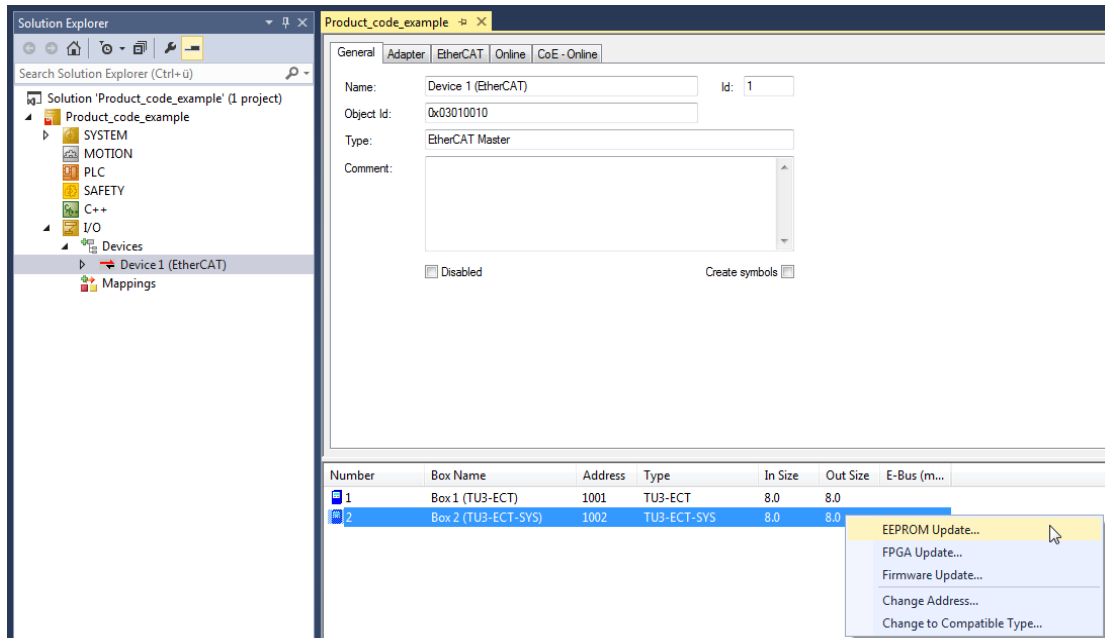
Firmware	Device description file in the EEPROM on delivery			XML Exchangeable
	XML file	**Product Code**	**System bus**	
Up to V1.7R0	NORD_TU3_ECT.xml	0x100	No	No
V1.8R0 – V1.8R1	NORD_TU3_ECT_SYS.xml	0x500	Yes	Yes
V1.8R2 and above	NORD_TU3_ECT.xml	0x100	No	Yes

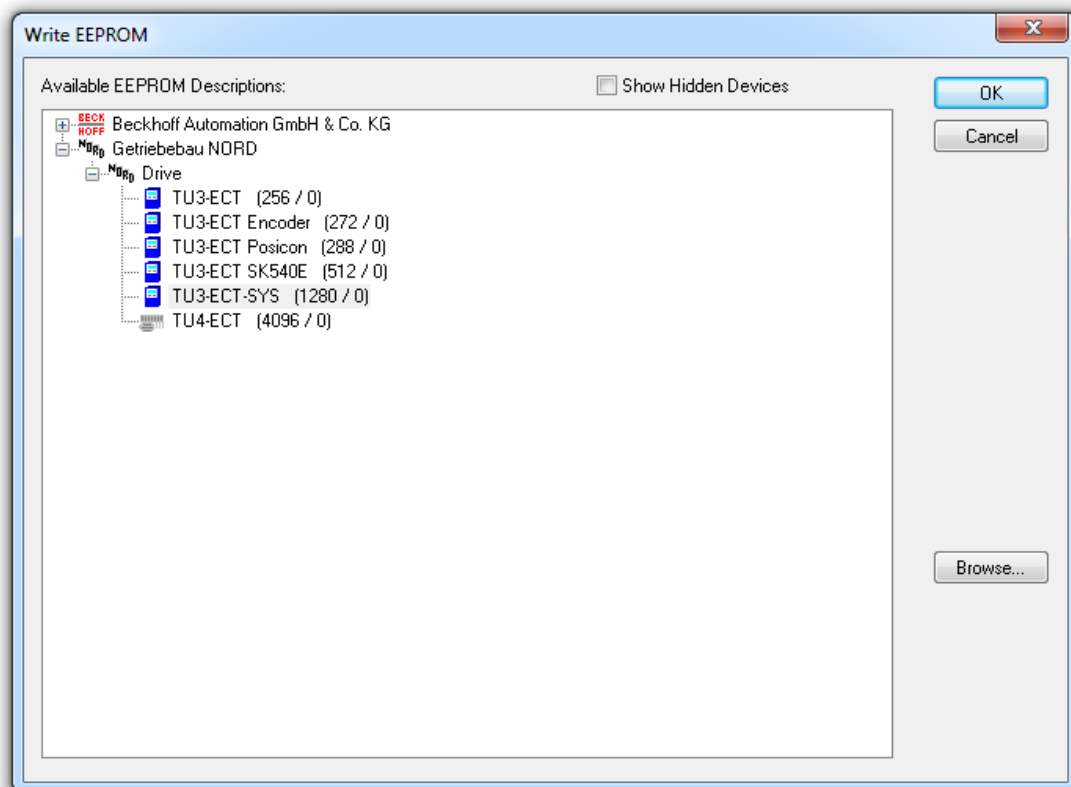**Figure 1: Overview of factory settings**

Update of device description file (example)

In the control software TwinCAT v3.1.0 from Beckhoff, the device description file in the EEPROM is updated as follows:

1.   Selection of the EEPROM updates in the TwinCAT v3.1.0 Project Explorer

2.   Selection of the XML device description file for the EEPROM update

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	No functiom	0	0	0	0	0	0	0	0	0	0
X	X		0	0	0	0	0	0	0	0	1	1
X	X		0	0	0	0	0	0	0	1	0	2
X	X		-	-	-	-	-	-	-	-	-	-
X	X		1	1	1	1	1	1	1	1	1	511
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. Second Address (DIP 1…9)

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

   If all DIP switches 1…9 are moved to the "OFF" position, the „Second Address" can be set via parameter **P160**.

2. 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 11 to 12.
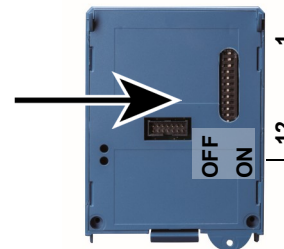
LED indicators

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
	DE	red	Device Error
2	Link/Act	green	Link/Activity
		yellow	No function
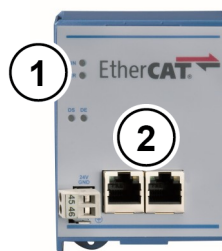
EtherCAT-specific LED

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).
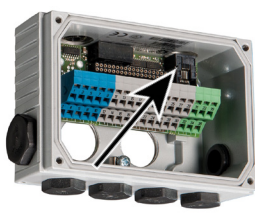
Parameter [-Array]	Meaning	Remarks	
P120 [-01]	Option monitoring	**"Auto"** (default setting)	Only SK xU4
P509	Source Control Word	SK TU3-… on SK 5xxE: **"Ethernet TU"** SK xU4-… on SK 180/SK 2xxE: **"System bus"**	
P510 [-01]…[-02]	Setpoint source	**"Auto"** (default setting)	
P513	Time-out	Monitoring 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 0500	Frequency inverter manual SK 500E…SK 535E

Document	Description
BU 0505	SK 54xE frequency inverter manual
BU 2300	EtherCAT bus communication manual