Installation manual

English

SMX / SCU Series
Field buses

Modbus TCP/IP
EtherNet/IP
PROFINET
EtherCAT

PROFIBUS
DeviceNet

CANopen

Read and observe installation manual before initial commissioning/ initial startup/ integration of the module!

Observe safety instructions!

Keep for future use!

Installation manual of communication interface (COM) for SMX and SCU series.
Available fieldbuses:
Modbus TCP/IP, EtherNet/IP (CIP-Safety), PROFINET (PROFIsafe), EtherCAT (FSoE), PROFIBUS (PROFIsafe), DeviceNet and CANopen

Note:
The German version is the original version of the installation manual.

As of: 02/2022

Subject to technical change without notice.
The contents of this documentation have been collated with greatest possible care and corresponds with our present status of information.
Nevertheless, we draw your attention, that this document cannot always be updated at the same time as the technical development of our products.
Information and specifications can be changed at any time. Please keep yourself informed about the latest version at www.bbh-products.de.

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1 Important notes

Definition of individual target groups:

Project engineering for safe drive systems:
- Engineers and technicians

Assembly, electrical installation, maintenance and replacement of devices:
- Maintenance electricians and service technicians

Commissioning, operation and configuration:
- Technicians and engineers

1.1 Definitions

The designation SMX is used as generic term for all derivatives from the SMX product range. Wherever this description refers to a certain derivative, the complete designation is used.

The designation SCU is used as generic term for all derivatives from the SCU product range. Wherever this description refers to a certain derivative, the complete designation is used.

COM is the abbreviation for the universal communication interface for the SCU/SMX.

The term "**safe**" used in the following text in any case refers to freedom from unreasonable risks of physical injury or damage to human health, either directly or indirectly as a result of damage to goods or the environment - Definition according to IEC 61508-1: 2011

The programming software "SafePLC²" is used to configure and program the SMX / SCU modules.

1.2 Applicable documents

- Installation manuals series
  - ➔ *HB-37500-810-11-xxF-EN (SCU)*
  - ➔ *HB-37352-810-01-xxF-EN (SMX Gen2)*
  - ➔ *HB-37421-810-01-xxF-EN (SMX100)*
- Programming manual SafePLC²:
  - ➔ *HB-37480-820-01-xxF-EN Programming manual SafePLC²*
- Programming manuals series:
  - ➔ *HB-37500-820-10-xxF-DE SCU programming manual*
  - ➔ *HB-37350-820-01-xxF-DE SMX programming manual*
  - ➔ *HB-37420-820-01-xxF-DE SMX100 programming manual*
- Application description Memory Card:
  - ➔ *HB-374250-820-01-xxF-EN COM application description SD-Card Slot*

- Error lists series:
  - ➔ *TS-37350-130-40-xxF EN Error list SMX*
  - ➔ *TS-37420-130-41-xxF EN Error list SMX100*
  - ➔ *HB-37500-813-02-xxF EN Error list SCU*

xx = Placeholder for the currently valid version

Always use the latest release of the documentation and software.
In case of uncertainties or need for further information, contact the publisher directly.

If required, you can also obtain the documentation in printed form from BBH Products GmbH.

⚠ **Note:**

- Thoroughly read the manuals carefully before you start the installation and the commissioning of the devices.
- Paying attention to the documentation is a prerequisite for trouble-free operation and fulfilment of possible warranty claims.

1.3 Abbreviations used

Abbreviation	Meaning
AC	Alternating voltage
IL	Instruction list
ELIA	Employer's liability insurance association
CLK	Clock (cycle)
CPU	Central Processing Unit
DC	Direct voltage
DIN	Deutsches Institut für Normung (German Institute for Standardization)
EDS	Electronic Data Sheet - EtherNet/IP
EMC	Electromagnetic compatibility
EN	European Standard
ESI	EtherCAT XML Device Description
ETG	EtherCAT Technology Group
GSD	General Station Description
GSDML	General Station Description Markup Language
IPxx	Degree of protection for housing
ISO	International Organisation for Standardisation
LED	Light Emitting Diode
PLC	Programmable Logic Controller
POR	Power on Reset
SDDC	Safe Device To Device Communication
SafePLC²	Program for programming PLC, programming interface of BBH for assemblies.
SELV	Safety Extra Low Voltage
SSI	Synchronous Serial Interface
VDE	Verband der Elektrotechnik, Elektronik und Informationstechnik e. V. (association for electrical engineering, electronics and information technology)

Table 1: Abbreviations

2 Safety regulations

2.1 Intended use

The universal communication interface COM is an option for the modules of the following series:

SCU
SCU-x-EC/NM and SDU-x

SMX
SMX1x/2/x and SMX1xx/2/x

and their variants for non-safe data transfer via an Ethernet or CAN or RS485 based protocol.

The COM interface has the following additional options:

- Safe data transfer via safe fieldbus protocols
- **SDDC** ETH (decentral) "**S**afe **D**evice – **D**evice **C**ommunication" over Ethernet. Safe Remote Communication
- **SMMC** "**S**afe **M**aster – **M**aster **C**ommunication" Safe cross communication
- SD bus communication

These options are described in separate manuals.

The option: Memory Card (SDHC) is described in "COM application description SD-Card".

2.2 General safety regulations

safety instruction:

- In order to avoid damage to persons and property only qualified personnel is entitled to work on the device. The term qualified personnel refers to persons who have successfully completed electro technical training and are fully familiar with the applicable rules and standards of electrical engineering.

  The qualified person must become familiar with the operating instructions (see standards series IEC60364, DIN VDE0100). The entitlement to a qualified person in Germany, accordance with TRBS 1203 is also given here.

- The qualified person must have profound knowledge of the national accident prevention regulations

- The use of the device must be strictly limited to the intended use as specified in the following list. The values of technical data listed under section *"3. Description and function of device*". must also be observed.

- The contents of this installation manual is restricted to the basic function of the device or its installation. The "Programming manual SafePLC²" contains a more detailed description of the programming and re-parameterization of the devices.

Exact knowledge and understanding of these instructions is mandatory for a new installation or modification of device functions or device parameters.

- Commissioning (i.e. starting up the intended operation) is only permitted in strict compliance all other applicable European standards.
- The wiring and connecting instructions in chapter ”*4. Device equipment and settings*” and “5.*Connection and installation”* must be strictly followed.
- The valid VDE regulations and other special safety regulations of relevance for the application are to be followed.
- Do not install or operate damaged products. Report damages immediately to the responsible forwarding agent.
- Never open the housing and/or make unauthorized conversions.
- Inputs and outputs for standard functions or digital and analog data transmitted via communication modules must not be used for safety relevant applications.

⚠ DANGER:

Using our devices contrary to the rules and conditions specified hereunder can lead to injuries or fatalities as well as damage to connected devices and machines! This will also lead to the loss of all warranty and compensation claims against BBH Products GmbH.

2.3 Operation and service

The module must always be deenergized before installation and removal, or before disconnecting signal lines. For this purpose, all live supply lines to the device must be checked for safe isolation from supply.

During installation and removal of the module appropriate measures must be used to avoid electrostatic discharge to terminal or plug connections routed to the outside. Contact with such terminals should be reduced to a minimum and earthing should by means of e.g. an earthing wrist strap should take place before and during these procedures.

2.4 Transport/Storage

Information concerning transport, storage and proper handling must be strictly followed. The climate related specifications are in chapter "8. Technical data”.

3 Description and function of device

The universal communication interface COM is permanently integrated into every base module with the option /DNM, /xNM, /NM or /DBM, /xBM.
In this connection the COM interface is responsible for non-safe communication based on Ethernet or CAN respectively RS485 bus protocols. Optionally, a safe fieldbus connection such as PROFIsafe, FSoE and CIP-Safety can also be used.

Depending on the option /DNM, /xNM, /NM (Modbus TCP/IP, EtherNet/IP, PROFINET, EtherCAT) or /DBM, /xBM (PROFIBUS, DeviceNet, CANopen), all on the options associated fieldbus protocols are deposited in the COM interface.

These can be selected and configured in SafePLC². Type and number of data are also specified in SafePLC². For SMX100-x/2/ (DNM, xNM, DBM, xBM) - systems it can also be additionally chosen between 3 different transmission profiles. Note here the notes in the corresponding chapters in "Programming manual SafePLC²".

The COM module receives data from the application program which is running on the SCU/SMX and forwards them to a higher-level standard control system via the bus protocol selected and configured in the programming system SafePLC².

There, the data can be further processed. The non-safe diagnostic data consist of logic and process data.

The process data can include position, speed and other analogue values of the safe drive monitoring modules which are either integrated in the base module (SMX1x/2/x) or are connected to them via the backplane bus (SMX100-x/2/x).

In addition, up to 32BIT non-safe functional inputs are available on the SMX/SDU and 144BIT on SU/SIO, which can be used to receive digital information from the higher-level PLC.
In the function scheme of the "SafePLC²", these inputs can be ANDed with a safe input and then used as required.

The exact breakdown of the diagnostic data and the preselect able profiles can be found in the chapter *“9.Input/Output* Data*”*.

The base module equipped with a COM interface must always be configured as a slave in the network.

A corresponding device description file (EDS, GSDML, ESI, GSD) is often required for the configuration within the programming system of the higher-level controller.
With EtherNet/IP, the base module can also be configured as a generic Ethernet device.

3.1 Field bus characteristic data

3.1.1 Modbus TCP/IP

Reaction time	Processing time incoming fieldbus protocols: min.1 ms; Response time depending on SMX/SCU system SMX1x/2: 8ms SMX1xx/2: 16-32ms SCU-x-EC/NM: 16 ms SDU-x/NM: 8 ms	
Protocol	TCP/IP	
Address range (1)	260 Byte	
	Coils	1..32
	Discrete Inputs	-
	Input Register	1..64
	Holding Register	1..130
Max number of connections	1	
Supported objects	Read Coils (01), Read Holding Register (03), Read Input Register (04), Write Single Coil (05), Write Single Register (06), Write Multiple Coils (15), Write Multiple Register (16),	
Baud Rates	10 and 100 MBits/s	
Duplex modes	Half Duplex, Full Duplex, Auto-Negotiation	
Data transport layer	Ethernet II, IEEE 802.3	
Modbus Port	502	
Tooling Port	50000	
Integrated switch	supported	
IP settings		
	DHCP	supported
	BOOTP	supported
	Fixed	supported

Table 2: Field bus specific data for Modbus TCP/IP

(1) Memory Layout:

Byte	Content	Holding Register	Input Register	Coil	Access	Supported Function Codes
0	Functional Inputs 0..7	1	-	1..8	r/w	Read Coils, Read Holding Register, Write Single Coil, Write Single Register, Write Multiple Coils, Write Multiple Register
1	Functional Inputs 8..15			9..16	r/w	
2	Functional Inputs 16..23	2	-	17..24	r/w	
3	Functional Inputs 24..31			25..32	r/w	
4	Device Diagnosis	3	1	-	r	Read Holding Register, Read Input Register (Starting with Address 0)
5	Device Diagnosis			-	r	
...	Device Diagnosis	4..66	2..64	-	r	
131	Device Diagnosis			-	r	
132	SD Bus Request Master	67	-	-	r/w	Read Holding Register, Write Single Register, Write Multiple Register
134	SD Bus Request Slave 0	68	-	-	r/w	
..	SD Bus Request Slave n	69..97	-	-	r/w	
195	SD Bus Request Slave 30	98	-	-	r/w	
196	SD Bus Response Master	99	-	-	r	Read Holding Register
198	SD Bus Response Slave 0	100	-	-	r	
…	SD Bus Response Slave n	101..129	-	-	r	
259	SD Bus Response Slave 30 / State Table Content	130	-	-	r	

HINT Due to the Modbus limitation of 260 Byte per PDU, a maximum of 125 registers can be read or written with a single request.

3.1.2 EtherNet/IP

Reaction time	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16 – 32ms SCU-x-EC/NM: 16 ms SDU-x: 8 ms
Output Data Size (O -> T)	68 Byte (1)
Input Data Size (T -> O)	192 Byte (2)
Safety Producer (Output)	12 Byte (Extended Format) (3)
Safety Consumer (Input)	12 Byte (Extended Format) (3)
Safety Properties	Unicast, Safety Open Type 2
IO Connection Types	Exclusive Owner, Listen Only, Input Only, Safety
Max number of connections	8 (sum of connected explicit and implicit) connections)
Supported Standard Objects	Identity Object (0x01) Message Router Object (0x02) Assembly Object (0x04) Connection Manager (0x06) Safety Supervisor (0x39) Safety Validator (0x3A) DLR Object (0x47) QoS Object (0x48) TCP/IP Interface Object (0xF5) Ethernet Link Object (0xF6) Time Sync Object (0x43)
Baud Rates	10 and 100 MBits/s
Duplex modes	Half Duplex, Full Duplex, Auto-Negotiation
Data transport layer	Ethernet II, IEEE 802.3
ACD (Address Conflict Detection)	supported
DLR V2 (Device Level-Ring topology)	supported
Quick Connect	supported
CIP sync	supported
Integrated switch	supported
DHCP	supported
BOOTP	supported
Assemblies	100: Functional Inputs 101: Functional Outputs / Diagnosis 121: Safety Input (T->O) 122: Safety Output (O->T) 123: Safety Config 124: Safety Input Time Coordination (O->T) 125: Safety Output Time Coordination (T->O)

Table 3: Field bus specific data for EtherNet/IP

(1) Outputs: 4 Byte; SD-Bus-Outputs: 64 Byte; Safety Outputs: 12 Bytes
(2) Diagnostic Inputs: 128 Byte; SD-Bus-Inputs: 64 Byte; Safety Inputs: 12 Bytes
(3) 32 Byte Total; 12 Byte Safety Data + 22 Byte Extended Format Safety Encapsulation

3.1.3 PROFINET

Reaction time	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16 – 32ms SCU-x-EC/NM: 16 – 32 ms SDU-x/NM: 8 ms
Cyclic Output Data Size	80 Byte (1)
Cyclic Input Data Size	204 Byte (2)
Baud Rate	100 MBit/s
Safety I/O data (output)	12 Byte (Extended format) (3)
Safety I/O data (input)	12 Byte (Extended format) (3)
Supported Protocols	RTC – **R**eal **t**ime **c**yclic protocol (Class 1, Class 2, Class 3) RTA – **R**eal **t**ime **a**cyclic protocol DCP – **D**iscover and **C**onfiguration **P**rotocol LLDP – **L**ink **L**ayer **D**iscovery **P**rotocol
Topology recognition	LLDP, SNMP V1, MIB2, physical device
Duplex modes	Half Duplex, Full Duplex, Auto-Negotiation
Data transport layer	Ethernet II, IEEE 802.3

Table 4: Field bus specific data for PROFINET

(1) Outputs: 4 Byte; SD-Bus-Outputs: 64 Byte; Safety Outputs: 12 Byte
(2) Diagnostic Inputs: 128 Byte; SD-Bus-Inputs: 64 Byte; Safety Inputs: 12 Byte
(3) 12 Byte user data + 12 Byte CRC + 2 Byte Connection ID + 1 Byte Master Command

3.1.4 EtherCAT

Reaction time	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16-32ms SCU-x-EC/NM: 16 – 32 ms SDU-x/NM: 8 ms
Cyclic Output Data Size	95 Byte (1)
Cyclic Input Data Size	219 Byte (2)
Safety I/O data (output)	12 Byte (Extended format) (3)
Safety I/O data (input)	12 Byte (Extended format) (3)
Type	Complex Slave
No. Of Sync Manager	4 (2 Acyclic, 2 Cyclic)
Distributed Clock	Supported, 32 Bit
Supported Protocols	CoE EoE
Duplex modes	Half Duplex, Full Duplex, Auto-Negotiation
Data transport layer	Ethernet II, IEEE 802.3

Table 5: Field bus specific data for EtherCAT

(1) Outputs: 4 Byte; SD-Bus-Outputs: 64 Byte; Safety Outputs: 27 Byte
(2) Diagnostic Inputs: 128 Byte; SD-Bus-Inputs: 64 Byte; Safety Inputs: 27 Byte
(3) 12 Byte user data + 12 Byte CRC + 2 Byte Connection ID + 1 Byte Master Command

3.1.5 PROFIBUS

Reaction time	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16-32ms
Cyclic Output Data Size	80 Byte (1)
Cyclic Input Data Size	204 Byte (2)
Device Class	DP Slave
Safety I/O data (output)	12 Byte (Extended format) (3)
Safety I/O data (input)	12 Byte (Extended format) (3)
Supported State Machines	FSPMS, MSCY1S, DMPMS, MSAC1S, MSAC2S, MSRM2S
Data Transport Layer	PROFIBUS FDL
Freeze Mode	supported
Sync Mode	supported
Auto baud rate	supported

Table 6: Field bus specific data for PROFIBUS

(1) Outputs: 4 Byte; SD-Bus-Outputs: 64 Byte; Safety Outputs: 12 Byte
(2) Diagnostic Inputs: 128 Byte; SD-Bus-Inputs: 64 Byte; Safety Inputs: 12 Byte
(3) 12 Byte user data + 12 Byte CRC + 2 Byte Connection ID + 1 Byte Master Command

3.1.6 DeviceNet

Reaction time	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16-32ms
Protocol	DeviceNET / CAN
Connector	Sub-D
Type	12 – Communications Adapter
Output Data Size (Consumed)	4 Byte functional inputs (1) (Network to Slave)
Input Data Size (Produced)	128 Byte diagnostic data (2) (Slave to Network)
Baud Rate	Configurable via SafePLC² 125kBit/s, 250kBit/s, 500kBit/s
Baud Rate Auto-Detection	not supported
Address / MAC ID	Physical rotary switch
Remote Setting of MAC ID	supported; Set address switch to 63 (0x3F). Any value above 63 (64..255) is read as 63 and enables remote MAC ID assignment.
Connections	Poll Change-of-state Cyclic Bit-strobe
Explicit messaging	supported
Fragmentation	Explicit and I/O
Supported Standard Objects	Identity Object (0x01) Message Router Object (0x02) DeviceNet Object (0x03) Connection Object (0x05) Acknowledge Handler Object (0x2B)
Behaviour	Continue on Bus-Off Clear Data on Receive Idle Remote Setting of MAC ID

Table 7: Field bus specific data for DeviceNet

(1) Outputs: 4 Byte; SD-Bus-Outputs: 64 Byte; Safety Outputs: 12 Byte
(2) Diagnostic Inputs: 128 Byte; SD-Bus-Inputs: 64 Byte; Safety Inputs: 12 Byte

3.1.7 CANopen

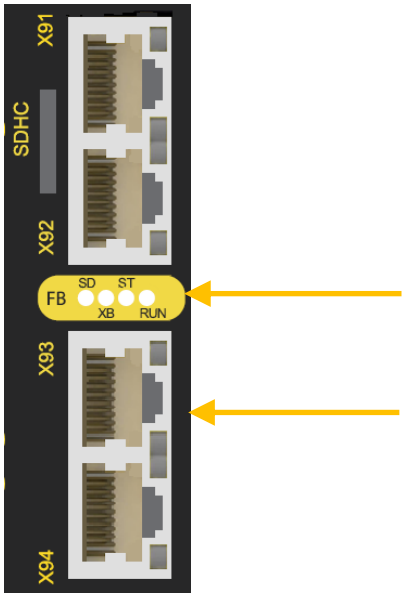
Reaction time	Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16-32ms
Device Type	NMT Slave
Protocol	CAN
Connector	Sub-D
Node ID	Physical rotary switch
Baud Rate	Manually configured: 125, 250, 500 kBaud With Auto detection: 10, 20, 50, 100, 125, 250, 500, 800, 1000 kBaud
Baud Rate Auto-Detection	supported
Number of PDOs	64 Rx PDO 64 Tx PDO
PDO mapping	supported
Cyclic Communication (PDO)	Synchronous, Event-driven, remotely requested
Acyclic communication (SDO)	SDO Up- and Download (Server only), Emergency message (producer), Timestamp (producer/consumer)
Heartbeat	supported 1 producer, max. 64 consumer
Node Guarding	supported
SYNC protocol	supported (consumer)

Table 8: fieldbus specific data for CANopen

4 Device equipment and settings

4.1 Ethernet-based device derivatives (/DNM)

The front panel of the Ethernet-based fieldbus derivatives shows the following features:



Diagnostics LEDs
(see chapter 0

Diagnostics LEDs)

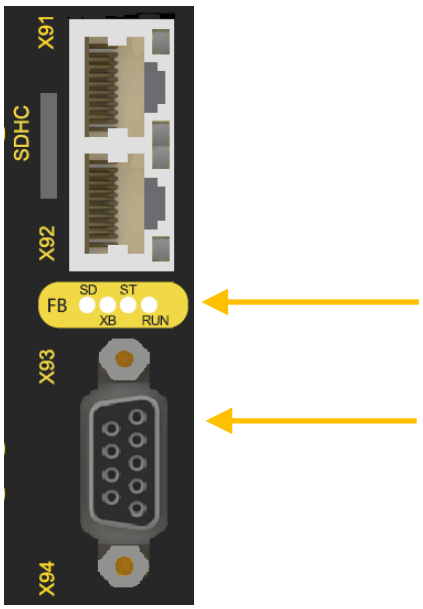
Ethernet female connector for
Ethernet based fieldbus
(see chapter 5.5.1 Female connector for the
fieldbus interface with /DNM, /xNM, and /NM

Figure 1: Front view device Variant (/DNM)

No adjustments on the equipment must be made.

4.2 CAN or RS485-based device derivatives (/DBM)

The front panel of the CAN or RS485-based fieldbus derivatives shows the following features:



Diagnostics LEDs
(see chapter 0

Diagnostics LEDs)

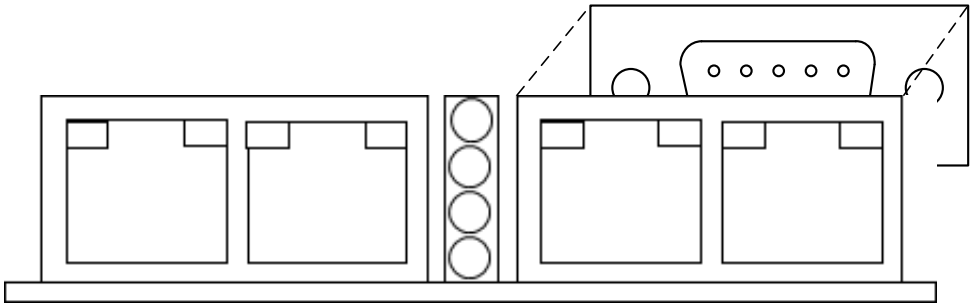
D-SUB 9P female connector for CAN or RS485-based fieldbus derivatives
(see Capture “5.5.2 Female connector for the

Figure 2: Front view device Variant (/DBM)

No adjustments on the equipment must be made.

4.3 Diagnostics LEDs

The universal communication interface has 4 bi-color LEDs, regardless of the device model.



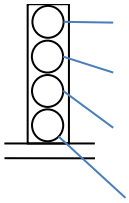
	No.	Name	function
	4	Run	SMX status SDDC/SMMC communication
	3	ST	Field bus feedback Ethernet/IP: Network Status
	2	XB	Cross Communication to F-CPU Ethernet/IP: Module Status
	1	SD	SD-Bus LED

Figure 3: Diagnostic LED's

The diagnosis LEDs are not reliable indicators and cannot be guaranteed to provide accurate information. They should only be used for general diagnostics during commissioning or troubleshooting. Do not attempt to use LEDs as operational indicators.

The following table shows the display functions:

Run	orange	flashing	Initialization; Waiting for connection and receiving the device and connection parameters
		permanent	Waiting for logical link to master COM
	green	flashing	Waiting for receiving the device and connection parameter after a time-out of master Run
		permanent	Active process data exchange
	red	permanent	No link at both ports; Connection timeout from state start-up or master restart
ST (Network Status)	green	permanent	EtherNet/IP: connected PROFINET: application relationship (AR) established; active EtherCAT: Status Operational PROFIBUS: Connection active DeviceNet: Bus On CANopen: Status Operational
		flashing	EtherNet/IP: IP address configured, no CIP connections established PROFINET IO: Bus Link, but no integration EtherCAT: Status Preoperational PROFIBUS: Bus Link, but no integration DeviceNet: - CANopen: Status Preoperational
		Short flash	EtherNet/IP: - PROFINET IO: Bus Link but no integration EtherCAT: Status Safe operational PROFIBUS: - Modbus TCP/IP: - DeviceNet: - CANopen: Node stopped
	Red	permanent	EtherNet/IP: Duplicate IP PROFINET IO: Bus error EtherCAT: Application Controller Failure PROFIBUS: Bus error Modbus TCP/IP: MBAP Header error (invalid frame) DeviceNet: Duplicate MAC ID CANopen: Bus error
		flashing	EtherNet/IP: Connection timeout PROFINET IO: Bus error EtherCAT: Error code according to ETG.1300 EtherCAT Indicator and labelling Specification PROFIBUS: Bus error Modbus TCP/IP: - DeviceNet: -
	Orange	flashing	EtherNet/IP: - PROFINET IO: - EtherCAT: - PROFIBUS: - Modbus TCP/IP: - DeviceNet: Send Last State CANopen: Baud Rate Auto detection in progress
		permanent	Modbus TCP/IP: No MAC address assigned DeviceNet: Send Zero
	Orange/green	flashing	Modbus TCP/IP: MBAP ok, PDU error
	Off	-	EtherNet/IP: Not powered; No IP address assigned PROFINET IO: inactive EtherCAT: inactive/status initialization PROFIBUS: inactive Modbus TCP/IP: inactive DeviceNet: Bus Off
	Green/red	flashing	EtherNet/IP: TUNID proposed, awaiting apply TUNID
XB (Module Status)	off	permanent	EtherNet/IP: No power Others: no SPI communication
	green	flashing	EtherNet/IP: Idle
		permanent	EtherNet/IP: Executing Others: SPI connection to F-CPU active and ok
	red	flashing	EtherNet/IP: Major Recoverable Fault (e.g. Duplicate IP) Others: -
		permanent	EtherNet/IP: Major Unrecoverable Fault Others: Error: Timeout for SPI connection to the F-CPU
	green/orange	flashing	Traffic Tooling connection

	Green/red	flashing	EtherNet/IP: Waiting for TUNID (Out-of-box) Others: -
SD	green	flashing	SD-Bus scan active
		permanent	Data Exchange active
	red/orange	flashing	Error SD-Bus Scan
	red	permanent	SD Bus error in cyclic operation
	off	-	No slave connected to SD-bus

Table 9: Display functions of diagnostic LEDs

5 Connection and installation

The COM interface requires no additional voltage supply for non-secure fieldbus communication. The interface is supplied directly from the basic module.

The installation of the bus systems must be carried out according to the respective installation regulations of the user organizations (ODVA, PNO, ETG, CiA).

The fieldbus connection must always be connected to the RJ45-female connectors labelled X93 / X94 (option /DNM, /xNM, /NM) or to the D-SUB female connector marked (option /DBM, xBM), as shown in the following figure.

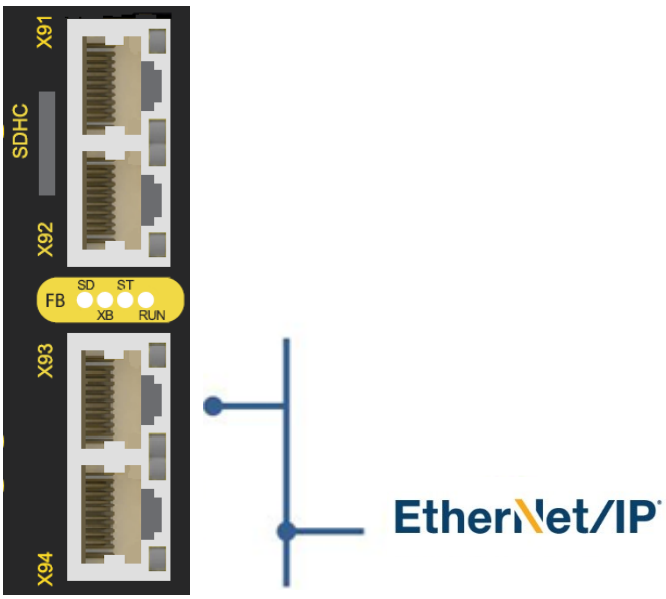


Figure 4: Example for fieldbus connection to female connector X93/X94 (EtherNet / IP)

A 2-port switch functionality is integrated for Modbus TCP/IP, EtherNet/IP or PROFINET.

5.1 General notes on installation

Strictly follow the safety regulations when installing!

Type of protection: IP20

In any case isolate 230 VAC voltages from low voltage lines, if these voltages are used in connection with the application.

Apply appropriate measures to exclude any faults caused by overvoltage. Appropriate measures include e.g. lightning protection for outdoor lines, overvoltage protection of the indoor system, protected routing of cables.

Measures concerning the electromagnetic compatibility (EMC):

The SCU/SMX modules are intended for use in the drive environment and meet the Standard EMC requirements.
It is also assumed that the electromagnetic compatibility of the overall system is ensured by application of appropriate measures.

Note

- Electric power supply lines of the SCU/SMX and "discontinuous-action lines" of the power converter must be isolated from each other.
- Signal lines and power lines of the power converter must be routed through separate cable ducts. The distance between the cable ducts should be minimum 10 mm.
- EMC-compliant installation of the power converter technology in the environment of the SCU/SMX module must be assured. Special attention must be paid to the routing of cables, the shielding of motor cables and the connection of the braking resistor. Strict compliance with the installation instructions of the power converter manufacturer is mandatory.
- All contactors in the environment of the power converter must be equipped with appropriate suppressor circuits.
- Suitable measures to protect against over voltages must be applied.

5.2 Installation of SCU / SMX modules

The module is solely to be installed in control cabinets, with a degree of protection of at least IP54.

The modules must be vertically fastened on a top hat rail.

The ventilation slots must be kept unobstructed, to ensure adequate air circulation inside the module.

For further information, refer to the " Installation Manual SMX Gen2", " Installation Manual SMX100 Gen2 and Installation manual SCU".

5.3 Assembly of modules and backplane bus

Figure 5: Assembly

The devices are inserted into the rail under an oblique angle and then snapped on downwards.

For further information, refer to the "Installation Manual SMX Gen2", " Installation Manual SMX100 Gen2 and Installation manual SCU".

5.4 Address Selector

For SMX modules with option /DBM, /xBM, 2 address selector switches are installed at the bottom of the COM interface.

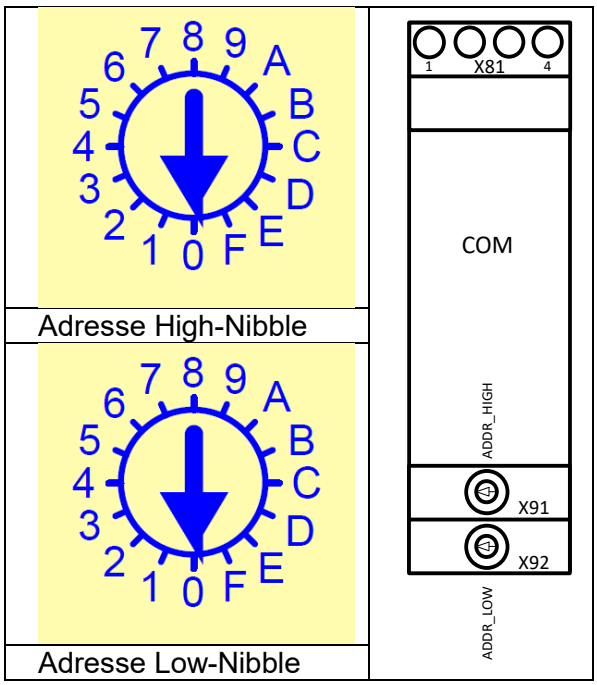
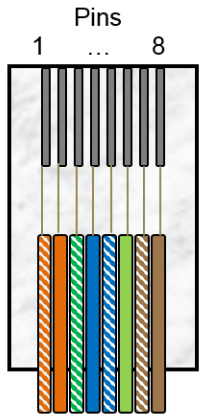


Figure 6: Address selector switch for SMX derivatives with option /DBM, /xBM

5.5 Pin assignment female connector

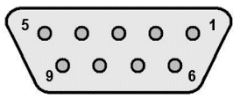
5.5.1 Female connector for the fieldbus interface with /DNM, /xNM and /NM (RJ45)



Pin	Name	Description	Colour
1	TX+	Transmit Data +	white-orange
2	TX-	Transmit Data -	orange
3	RX+	Receive Data +	white-green
4	nc	not used	Blue
5	nc	not used	white-blue
6	RX-	Receive Data -	green
7	nc	not used	white-brown
8	nc	not used	brown

Figure 7: Female connector field bus interface / option /DNM, /xNM, /NM (RJ45)

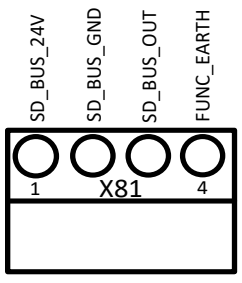
5.5.2 Female connector for the fieldbus interface with /DBM, /xBM (D-SUB)



Pin	Name	Description
1	NC	
2	CAN_N	CAN data line negative (in preparation)
3	PB_P / CCL_P	Data line plus (PROFIBUS: B)
4	PB-CNTR_P	Repeater direction control plus (**OPTIONAL**)
5	GND Bus	Data GND
6	+5V Bus	+5V Power supply for bus termination
7	CAN_P	CAN data line positive (in preparation)
8	PB_N / CCL_N	Data line minus (PROFIBUS: A)
9	PB-CNTR_N	Repeater direction control minus (**OPTIONAL**)

Figure 8: Female connector field bus interface / option /DBM, /xBM (D-SUB)

5.5.3 Female connector SD-BUS



Pin	Name	Description
1	SD_BUS_24V	Power supply SD-BUS +24 VDC
2	SD_BUS_GND	Power supply SD-BUS 0 VDC
3	SD_BUS_OUT	SD-BUS Output
4	FUNC_EARTH	Functional Earth

Figure 9: Female connector SD-Bus (Phoenix plug)

6 Modification / handling changes to the device

Repair
Repair work on the device can only be performed in the factory of
BBH Products GmbH.

Warranty
By opening or modifying the module, all warranty will become null and void.

7 Maintenance

7.1 Exchanging a module

The following sequence should be noted when exchanging a module:

- De-activate power supply
- Remove the connected Ethernet cable
- Take the module off the top hat rail and pack up EMC-compliant
- Mount a new module on the top hat rail
- Plug in the Ethernet cable
- Activate power supply

NOTICE:

Pluggable connections of the SMX/ SCU module must generally not be disconnected or connected in live condition.

8 Technical data

8.1 Environmental conditions

Class of protection	IP 20
Operating ambient temperature	0°C* ... 50°C
Storage temperature	-25°C … +70°C
Climatic category	3k3 acc. to DIN 60 721
Min-, Maximum relative humidity (no condensation)	5% - 85%
Overvoltage category	III
Degree of contamination	2
Operating materials	2000m
Lifetime	20 years in 50°C ambient

Table 10: Environmental Condition

9 Input/Output Data

The first 128 Bytes of the input assembly are used for Diagnostic data.

The following 64 Bytes are used for SD-Bus data which is described in chapter “10 SD-Bus data”.

128 bytes of diagnostic data are always sent, regardless of how much data the superordinate standard control system actually need. Bytes which are not used are written with 0.

Configuration of Diagnostic data is done in SafePLC².

Irrespective of the device and selected profile, 68 bytes of output data are available. The upper 64 bytes of this are used for the SD bus.

9.1 SMX1x/2/(DNM, xNM, DBM, xBM) and SDU-x/NM

9.1.1 Output data

Structure of the overall frame:

Size of diagnostic data: always 128 Byte, 16 Bytes can be used for diagnostics

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0...3	device mode 1, 2, 3, 4, 5, 6 = Fatal error, 7 = Alarm	
	4	0x1 (always 1)	
	5..7	Alive counter (3 Bit)	
Byte 1	0...7	Logic data (Bit ID: 49..56)	
Byte 2	0...7	Logic data (Bit ID: 41..48)	
Byte 3	0...7	Logic data (Bit ID: 33..40)	
Byte 4	0...7	Logic data (Bit ID: 9..16)	
Byte 5	0...7	Logic data (Bit ID: 1...8)	
Byte 6	0..6	Logic data (Bit ID: 25.. 31)	Error code high Byte
	7	„0“	„1“
Byte 7	0..7	Logic data (Bit ID: 17..24)	Error code low Byte

Table 11: Logic data of the SMX1x/2/(DNM, xNM, DBM, xNM) and SDU-x/NM

The bits of device mode show the status of the control. The states 1-5 are issued on the 7-segment display in parallel. Status 6 indicates an error, status 7 an alarm.

NOTICE:
The meaning of the error codes in decimal notation can be found in the TS-37350-130-xx-xxF EN Error list SMX or HB-37500-813-02-xxF Error list SCU-SDU modules.

Process data follow with a byte offset of 7; Byte 0 of process data is Byte 8 of the total frame/input assignment.

Byte	Assignment
Byte 0	Status
Byte 1	Logic data (Bit ID: 49..56)
Byte 2	Logic data (Bit ID: 41..48)
Byte 3	Logic data (Bit ID: 33..40)
Byte 4	Logic data (Bit ID: 9..16)
Byte 5	Logic data (Bit ID: 1..8)
Byte 6	Logic data (Bit ID: 25..31) / Error code
Byte 7	Logic data (Bit ID: 17..24) / Error code
Byte 8	Process data (Bit: 57..64)
Byte 9	Process data (Bit: 49..56)
Byte 10	Process data (Bit: 41..48)
Byte 11	Process data (Bit: 33..40)
Byte 12	Process data (Bit: 25..32)
Byte 13	Process data (Bit 17..24)
Byte 14	Process data (Bit: 9..16)
Byte 15	Process data (Bit: 1..8)
Byte 16	not used
…	…
Byte 127	not used
Byte 128	SD-Gateway - Diagnostic
Byte 129	SD-Gateway - Data
Byte 130	SD-Slave 1 - Data
Byte 131	SD-Slave 1 - Diagnostic
Byte 132	SD-Slave 2 - Data
Byte 133	SD-Slave 2 - Diagnostic
…	…
Byte 190	SD-Slave 31 - Data
Byte 191	SD-Slave 31 - Diagnostic

Table 12: logic and process data of the SMX1x/2/(DNM, xNM, DBM, xBM)

9.1.2 Input data

Structure of functional input data

Byte	Assignment
Byte 0	Logic data (Bit ID: 1..8)
Byte 1	Logic data (Bit ID: 9..16)
Byte 2	Logic data (Bit ID: 17..24)
Byte 3	Logic data (Bit ID: 25..32)
Byte 4	SD-Gateway - Instruction
Byte 5	SD-Gateway - Address
Byte 6	SD-Slave 1 - Request
Byte 7	SD-Slave 1 - Reserved
Byte 8	SD-Slave 2 - Request
Byte 9	SD-Slave 2 - Reserved
…	…
Byte 66	SD-Slave 31 - Request
Byte 67	SD-Slave 31 - Reserved

Table 13: SMX1x/2/(DNM, xNM, DBM, xBM) input data

9.2 SMX100-x/2/(DNM, xNM, DBM, xBM)

9.2.1 Output data

Three different profiles can be used; they are determined in SafePLC².

9.2.1.1 Structure Device Profile 0 (=legacy profile)

9.2.1.1.1 Configuration with axis extension modules (slave devices)

Structure of the overall frame:

Size of diagnostic data: 128 Byte

Byte Offset	Description	Data Size
0	Bit data type „1“ (Logic data Bit ID1 bis Bit ID56)	8 Byte
8	Process data slave device addr. 1	12 Byte
20	Bit data type „1“ (Logic data Bit ID57 bis Bit ID112)	8 Byte
28	Process data slave device addr. 2	12 Byte
40	Bit data type „1“ (Logic data Bit ID113 to Bit ID168)	8 Byte
48	Process data slave device addr. 3	12 Byte
60	Bit data type „1“ (Logic data Bit ID169 to Bit ID224)	8 Byte
68	Process data slave device addr. 4	12 Byte
80	Bit data type „1“ (Logic data Bit ID225 to Bit ID280)	8 Byte
88	Process data slave device addr. 5	12 Byte
100	Bit data type „1“ (Logic data Bit ID281 to Bit ID336)	8 Byte
108	Process data slave device addr. 6	12 Byte
120	Bit data type „1“ (Logic data Bit ID337 to Bit ID392)	8 Byte

Table 14: Structure for Device Profile 0 (= free assignment) with extension modules

Offset error code of slave device: offset bit data + 6

9.2.1.1.2 Configuration without axis extension modules (slave device)

Organization of the frame
Total size of diagnostic data: 128 Bytes

Byte Offset	Description	Data Size
0	Bit data type „1“ (Logic data Bit ID1 to Bit ID56)	8 Byte
8	Bit data type „2“ (Logic data Bit ID57 to Bit ID112)	7 Byte
15	Bit data type „2“ (Logic data Bit ID113 to Bit ID168)	7 Byte
22	Bit data type „2“ (Logic data Bit ID169 to Bit ID224)	7 Byte
29	Bit data type „2“ (Logic data Bit ID225 to Bit ID280)	7 Byte
36	Bit data type „2“ (Logic data Bit ID281 to Bit ID336)	7 Byte
43 …127	Not used	

Table 15: Structure for Device Profile 0 without expansion modules

Offset error code of master device: offset bit data + 6 (only for Bit data type “1”)

9.2.1.2 Data Types

9.2.1.2.1 Bit data type “1”

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0...3	device mode 1, 2, 3, 4, 5, 6 = Fatal error, 7 = Alarm	
	4	0x1 (always 1)	
	5..7	Alive counter (3 Bit)	
Byte 1	0...7	Logic data (Bit ID: 49..56)	
Byte 2	0...7	Logic data (Bit ID: 41..48)	
Byte 3	0...7	Logic data (Bit ID: 33..40)	
Byte 4	0...7	Logic data (Bit ID: 9..16)	
Byte 5	0...7	Logic data (Bit ID: 1...8)	
Byte 6	0..6	Logic data (Bit ID: 25.. 31)	Error code high Byte
	7	„0“	„1“
Byte 7	0..7	Logic data (Bit ID: 17..24)	Error code low Byte

Table 16: Bit data type "1"

The bits of device mode show the status of the control. The states 1-5 are issued on the 7-segment display in parallel. Status 6 indicates an error, status 7 an alarm.

NOTICE:
The meaning of the error codes in decimal notation can be found in the TS-37420-130-xx-xxF EN Error list SMX100.

9.2.1.2.2 Bit data type “2”

Byte	Bit	Data
Byte 0	0...7	Logic data (Bit: 49..56)
Byte 1	0...7	Logic data (Bit: 41..48)
Byte 2	0...7	Logic data (Bit: 33..40)
Byte 3	0...7	Logic data (Bit: 9..16)
Byte 4	0...7	Logic data (Bit: 1...8)
Byte 5	0..6	Logic data (Bit: 25.. 31)
	7	„0“
Byte 6	0..7	Logic data (Bit: 17..24)

Table 17: Bit data type "2"

9.2.1.2.3 Process data slave devices

Byte	Data
BYTE 0	Process data Bit 1..8
BYTE 1	Process data Bit 9..16
BYTE 2	Process data Bit 17..24
BYTE 3	Process data Bit 25..32
BYTE 4	Process data Bit 33..40
BYTE 5	Process data Bit 41..48
BYTE 6	Process data Bit 49..56
BYTE 7	Process data Bit 57..64
BYTE 8	Process data Bit 65..72
BYTE 9	Process data Bit 73..80
BYTE 10	Process data Bit 81..88
BYTE 11	Process data Bit 89..96

Table 18: Process data

9.2.1.3 Structure Device Profile 1 (=only logic data)

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0..3	device mode 1, 2, 3, 4, 5, 6 = Fatal error, 7 = Alarm	
	4	0x1 (always 1)	
	5..7	Alive counter (3 Bit)	
Byte 1	0..7	0	Device address where the error is occupied
Byte 2	0..7	reserved	
Byte 3	0..7	0	Error code low Byte
Byte 4	0..7	0	Error code high Byte
Byte 5	0..7	Logic data (Bit ID: 1..8)	
Byte 6	0..7	Logic data (Bit ID: 9..16)	
Byte 7	0..7	Logic data (Bit ID: 17..24)	
Byte 8	0..7	Logic data (Bit ID: 25..32)	
Byte 9	0..7	Logic data (Bit ID: 33...40)	
Byte 10	0..7	Logic data (Bit ID: 41..48)	
...	...	....	
Byte 55	0..7	Logic data (Bit ID: 401..408)	

Table 19: Structure for Device Profile 1 (=only logic data)

The bits of device mode show the status of the control. The states 1-5 are issued on the 7-segment display in parallel. Status 6 indicates an error, status 7 an alarm.

NOTICE:
The meaning of the error codes in decimal notation can be found in the TS-37420-130-xx-xxF EN Error list SMX100.

Following logic data Bit IDs are reserved for compatibility reasons and cannot be used (value is 0):

- Bit ID 32
- Bit ID 88
- Bit ID 144
- Bit ID 200
- Bit ID 256
- Bit ID 312
- Bit ID 368

9.2.1.4 Structure Device Profile 2 (=logic data and process data for every slave device)

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0..3	Device mode 1, 2, 3, 4, 5, 6 = Fatal error, 7 = Alarm	
	4	0x1 (always 1)	
	5..7	Alive counter (3 Bit)	
Byte 1	0..7	0	Device address where the error is occupied
Byte 2	0..7	reserved	
Byte 3	0..7	0	Error code low Byte
Byte 4	0..7	0	Error code high Byte
Byte 5	0..7	Logic data (Bit ID: 1..8)	
Byte 6	0..7	Logic data (Bit ID: 9..16)	
Byte 7	0..7	Logic data (Bit ID: 17..24)	
Byte 8	0..6	Logic data (Bit ID: 25..31)	
	7	„0“	
Byte 9	0..7	Logic data (Bit ID: 33...40)	
Byte 10	0..7	Logic data (Bit ID: 41..48)	
...	...	....	
Byte 55	0..7	Logic data (Bit ID: 401..408)	
Byte 56	0..7	Process data axis slave device 1 Bit 1..8	
Byte 57	0..7	Process data axis slave device 1 Bit 9..16	
Byte 58	0..7	Process data axis slave device 1 Bit 17..24	
Byte 59	0..7	Process data axis slave device 1 Bit 25..32	
Byte 60	0..7	Process data axis slave device 1 Bit 33..40	
Byte 61	0..7	Process data axis slave device 1 Bit 41..48	
Byte 62	0..7	Process data axis slave device 1 Bit 49..56	
Byte 63	0..7	Process data axis slave device 1 Bit 57..64	
Byte 64	0..7	Process data axis slave device 1 Bit 65..72	
Byte 65	0..7	Process data axis slave device 1 Bit 73..80	
Byte 66	0..7	Process data axis slave device 1 Bit 81..88	
Byte 67	0..7	Process data axis slave device 1 Bit 89..96	
Byte 68	0..7	Process data axis slave device 2 Bit 1..8	
Byte 69	0..7	Process data axis slave device 2 Bit 9..16	
Byte 70	0..7	Process data axis slave device 2 Bit 17..24	
Byte 71	0..7	Process data axis slave device 2 Bit 25..32	
Byte 72	0..7	Process data axis slave device 2 Bit 33..40	
Byte 73	0..7	Process data axis slave device 2 Bit 41..48	
Byte 74	0..7	Process data axis slave device 2 Bit 49..56	
Byte 75	0..7	Process data axis slave device 2 Bit 57..64	
Byte 76	0..7	Process data axis slave device 2 Bit 65..72	
Byte 77	0..7	Process data axis slave device 2 Bit 73..80	

Byte 78	0..7	Process data axis slave device 2 Bit 81..88
Byte 79	0..7	Process data axis slave device 2 Bit 89..96
Byte 80	0..7	Process data axis slave device 3 Bit 1..8
Byte 81	0..7	Process data axis slave device 3 Bit 9..16
Byte 82	0..7	Process data axis slave device 3 Bit 17..24
Byte 83	0..7	Process data axis slave device 3 Bit 25..32
Byte 84	0..7	Process data axis slave device 3 Bit 33..40
Byte 85	0..7	Process data axis slave device 3 Bit 41..48
Byte 86	0..7	Process data axis slave device 3 Bit 449..56
Byte 87	0..7	Process data axis slave device 3 Bit 57..64
Byte 88	0..7	Process data axis slave device 3 Bit 65..72
Byte 89	0..7	Process data axis slave device 3 Bit 73..80
Byte 90	0..7	Process data axis slave device 3 Bit 81..88
Byte 91	0..7	Process data axis slave device 3 Bit 89..96
Byte 92	0..7	Process data axis slave device 4 Bit 1..8
Byte 93	0..7	Process data axis slave device 4 Bit 9..16
Byte 94	0..7	Process data axis slave device 4 Bit 17..24
Byte 95	0..7	Process data axis slave device 4 Bit 25..32
Byte 96	0..7	Process data axis slave device 4 Bit 33..40
Byte 97	0..7	Process data axis slave device 4 Bit 41..48
Byte 98	0..7	Process data axis slave device 4 Bit 49..56
Byte 99	0..7	Process data axis slave device 4 Bit 57..64
Byte 100	0..7	Process data axis slave device 4 Bit 65..72
Byte 101	0..7	Process data axis slave device 4 Bit 73..80
Byte 102	0..7	Process data axis slave device 4 Bit 81..88
Byte 103	0..7	Process data axis slave device 4 Bit 89..96
Byte 104	0..7	Process data axis slave device 5 Bit 1..8
Byte 105	0..7	Process data axis slave device 5 Bit 9..16
Byte 106	0..7	Process data axis slave device 5 Bit 17..24
Byte 107	0..7	Process data axis slave device 5 Bit 25..32
Byte 108	0..7	Process data axis slave device 5 Bit 33..40
Byte 109	0..7	Process data axis slave device 5 Bit 41..48
Byte 110	0..7	Process data axis slave device 5 Bit 49..56
Byte 111	0..7	Process data axis slave device 5 Bit 57..64
Byte 112	0..7	Process data axis slave device 5 Bit 65..72
Byte 113	0..7	Process data axis slave device 5 Bit 73..80
Byte 114	0..7	Process data axis slave device 5 Bit 81..88
Byte 115	0..7	Process data axis slave device 5 Bit 89..96
Byte 116	0..7	Process data axis slave device 6 Bit 1..8
Byte 117	0..7	Process data axis slave device 6 Bit 9..16
Byte 118	0..7	Process data axis slave device 6 Bit 17..24
Byte 119	0..7	Process data axis slave device 6 Bit 25..32

Byte 120	0..7	Process data axis slave device 6 Bit 33..40
Byte 121	0..7	Process data axis slave device 6 Bit 41..48
Byte 122	0..7	Process data axis slave device 6 Bit 49..56
Byte 123	0..7	Process data axis slave device 6 Bit 57..64
Byte 124	0..7	Process data axis slave device 6 Bit 65..72
Byte 125	0..7	Process data axis slave device 6 Bit 73..80
Byte 126	0..7	Process data axis slave device 6 Bit 81..88
Byte 127	0..7	Process data axis slave device 6 Bit 89..96

Table 20: Structure for Device Profile 2 (=logic and process data for every slave device)

The bits of device mode show the status of the control. The states 1-5 are issued on the 7-segment display in parallel. Status 6 indicates an error, status 7 an alarm.

Note:
The meaning of the error codes in decimal notation can be found in the TS-37420-130-xx-xxF EN Error list SMX100.

Following logic data Bit IDs are reserved for compatibility reasons and cannot be used (value is 0):

- Bit ID 32
- Bit ID 88
- Bit ID 144
- Bit ID 200
- Bit ID 256
- Bit ID 312
- Bit ID 368

NOTICE:
The listed bit IDs here refer to the SafePLC configuration.

9.2.2 Input data

Structure of input data

Byte	Assignment
Byte 0	Logic data (Bit ID: 1..8)
Byte 1	Logic data (Bit ID: 9..16)
Byte 2	Logic data (Bit ID: 17..24)
Byte 3	Logic data (Bit ID: 25..32)
Byte 4	SD-Gateway - Instruction
Byte 5	SD-Gateway - Address
Byte 6	SD-Slave 1 - Request
Byte 7	SD-Slave 1 - Reserved
Byte 8	SD-Slave 2 - Request
Byte 9	SD-Slave 2 - Reserved
…	…
Byte 66	SD-Slave 31 - Request
Byte 67	SD-Slave 31 - Reserved

Table 21: SMX100-x/2/(DNM, xNM, DBM, xNM) input data

9.3 SCU-x-EC/NM

9.3.1 Output data

Structure of the functional outputs

Byte	Bit	„Run“ mode (2, 3, 4, 8)	Error case (A, F)
DEBUG 0	0..3	device mode 1, 2, 3, 4, 5, 6 = FatalError, 7 = Alarm, 8	
	4	0x1 (define)	
	5..7	Alive counter (3 Bit)	
DEBUG 1	0..7	0	
DEBUG 2	0..7	0	
DEBUG 3	0..7	0 = no error error code low Byte	
DEBUG 4	0..7	0 = no error error code high Byte	
ByteOut 0	0..7	Functional Output (0..7)	
ByteOut 1	0..7	Functional Output (8..15)	
ByteOut 2	0..7	Functional Output (16..23)	
ByteOut 3	0..7	Functional Output (24..31)	
ByteOut 4	0..7	Functional Output (32...39)	
ByteOut 5	0..7	Functional Output (40...47)	
ByteOut 6	0..7	Functional Output (48...55)	
ByteOut 7	0..7	Functional Output (56...63)	
ByteOut 8	0..7	Functional Output (64...71)	
ByteOut 9	0..7	Functional Output (72...79)	
ByteOut 10	0..7	Functional Output (80...87)	
ByteOut 11	0..7	Functional Output (88...95)	
ByteOut 12	0..7	Functional Output (96...103)	
ByteOut 13	0..7	Functional Output (104...111)	
ByteOut 14	0..7	Functional Output (112...119)	
ByteOut 15	0..7	Functional Output (120...127)	
ByteOut 16	0..7	Functional Output (128...135)	

The bits of device mode show the status of the control. The states 1-5 are issued on the 7-segment display in parallel. Status 6 indicates an error, status 7 an alarm.

NOTICE:
The meaning of the error codes in decimal notation can be found in the HB-37500-813-02-xxF EN Error list SCU.

9.3.2 Input data

Structure of functional input data

Byte	Bit	Assignment
Byte 0	0..7	Functional Input (0..7)
Byte 1	0..7	Functional Input (8..15)
Byte 2	0..7	Functional Input (16..23)
Byte 3	0..7	Functional Input (24..31)
Byte 4	0..7	Functional Input (32..39)
Byte 5	0..7	Functional Input (40..47)
Byte 6	0..7	Functional Input (48..55)
Byte 7	0..7	Functional Input (56..63)
Byte 8	0..7	Functional Input (64..71)
Byte 9	0..7	Functional Input (72..79)
Byte 10	0..7	Functional Input (80..87)
Byte 11	0..7	Functional Input (88..95)
Byte 12	0..7	Functional Input (96..103)
Byte 13	0..7	Functional Input (104..111)
Byte 14	0..7	Functional Input (112..119)
Byte 15	0..7	Functional Input (120..127)
Byte 16	0..7	Functional Input (128..135)
Byte 17	0..7	Functional Input (136..143)

10 SD-Bus data

The universal communication interface (/DNM, /xNM, /DBM, /xBM) behaves like a gateway with regard to the SD bus data; communication from the SD bus to the fieldbus in both directions.

10.1 Fieldbus data SD-Bus Gateway

For the Gateway diagnostics and for the acyclic data request of the SD slaves, 2 bytes are reserved in the request and the response of the fieldbus protocol.

Request:	Byte 00	instruction byte, acyclic data request
	Byte 01	SD slave address for the acyclic data request
Response:	Byte 00	diagnostic byte Gateway (refer to Table 23 and Table 22)
	Byte 01	data byte, acyclic data request

The detailed description of the acyclic data request of SD slaves can be found in chapter 10.4.

10.2 Fieldbus data SD slave

For each SD slave, 2 bytes are reserved in the request and the response of the fieldbus protocol.

- SD slave 01 uses byte 02 and 03 of the fieldbus
- SD slave 02 uses byte 04 and byte 05 of the fieldbus
… etc.
- SD slave 31 uses byte 62 and byte 63 of the fieldbus

In the **request**, only the first byte is needed in the fieldbus as request byte for an SD slave. The second byte is not used.

In the **response**, first the response byte and subsequently the diagnostic byte of each SD slave is transmitted to the fieldbus.

10.3 Structure of the SD bytes in the fieldbus protocol

Request for all fieldbus systems (OUTPUT byte control, transmission of the request data to the SD slave)

Byte no.	Byte 00	Byte 01	Byte 02	Byte 03	...	Byte 62	Byte 63
SD device	Gateway	Gateway	Slave 01	Slave 01	...	Slave 31	Slave 31
Content	Instruction byte	SD-Addr. (0, 1-31)	Request byte	---		Request byte	---

Response for all fieldbus systems (INPUT byte control, reception of the response data of the SD slave)

Byte no.	Byte 00	Byte 01	Byte 02	Byte 03	...	Byte 62	Byte 63
SD device	Gateway	Gateway	Slave 01	Slave 01	...	Slave 31	Slave 31
Content	Diagnostic byte	Date byte	Response byte	Diagnostic byte		Response byte	Diagnostic byte

The content of the diagnostic byte of an SD slave depends on the status of the warning and the error bits in the corresponding response byte (Bit 6 = error warning and Bit 7 = error).
The meaning of the individual bits of the SD bytes is explained in the mounting instructions of the SD devices
.

10.4 Reading acyclic data from the SD slave

In a permanently defined cycle, acyclic data of the individual SD slave can be requested through the 2 request bytes (fieldbus request byte 00 and byte 01) and the data byte (fieldbus response byte 01).

The instruction byte defines; which data will be requested from a slave. The SD device, from which the data are requested, is defined in the SD interface by means of the SD address byte. The response data of the SD slaves are saved in the fieldbus response byte 01.

The data request cycle is defined as follows:

1. The control deletes the data byte before or after each command. A feedback signal is generated through the response byte, indicating whether the data have been deleted or not.
   Hex FF: Data deleted, acyclic data service ready

2. The control first writes the SD address into the fieldbus request byte 01.
   Then, the control writes the instruction byte into the fieldbus request byte 00

3. The response data are made available in the fieldbus response byte 01 of the control. The data byte can also include an error message as response:
   Hex FE: Instruction error, undefined instruction requested
   Hex FD: Address error, invalid slave address for the selected instruction or slave address of a unavailable SD slave selected

Instructions, acyclic data request	Instruction byte fieldbus byte 00 (request)	SD address fieldbus byte 01 (request)	Data byte fieldbus byte 01 (response)	Data description
Delete data byte	Hex: 00	Hex: xx	Hex: FF	Data deleted, ready for new instruction
Read number of projected SD slaves	Hex: 01	Hex: 00	Hex: 01 to Hex: 1F	Number of projected SD slaves 1 – 31
Read device category of the SD slave	Hex: 02	Hex: 01 to Hex: 1F	Hex: 30 to Hex: F8	SD slave device category (see below)
Read hardware revision of the SD slave	Hex: 03	Hex: 01 to Hex: 1F	Hex: 41 to Hex: 5A	Hardware revision A –Z as ASCII characters
Read software version of the SD slave (high byte)	Hex: 04	Hex: 01 to Hex: 1F	Hex: 00 to Hex: 63	Software version, high byte: 0-99
Read software version of the SD slave (low byte)	Hex: 05	Hex: 01 to Hex: 1F	Hex: 00 to Hex: 63	Software-Version, Low-Byte: 0 - 99

Table 22: Overview of the instructions and response data

The device category of a SD slave can be found in the mounting instructions of the device concerned.

The following device categories are defined:

Hex: 30 CSS 34, Safety sensor
Hex: 31 AZM 200, Solenoid interlock „Z“-variant
Hex: 32 MZM 100, Solenoid interlock „Z“-variant
Hex: 33 AZ 200, Safety sensor
Hex: 34 CSS 30S, Safety sensor
Hex: 35 MZM 100 B, Solenoid interlock „B“-variant
Hex: 36 AZM 300B, Solenoid interlock „B“-variant
Hex: 37 RSS 36, Safety sensor
Hex: 38 AZM 300Z, Solenoid interlock „Z“-variant
Hex: 39 RSS 16, Safety sensor
Hex: 3A RSS 260, Safety sensor
Hex: 3D MZM 120 B, Solenoid interlock „B“-variant
Hex: 3E MZM 120 BM, Solenoid interlock „B“-variant
Hex: 3F AZM 201Z, Solenoid interlock „Z“-variant
Hex: 40 AZM 201B, Solenoid interlock „B“-variant
Hex: 41 Operator panel BDF200-SD
Hex: 43 AZ 201, Safety sensor

The individual bits in the diagnostic byte for the SD-Gateway have the following meaning:

BIT	Error	Description
Bit 0	Failure SD-Interface	SD Interface centralized alarm, message 1 sec. delayed, invalid SD data.
Bit 1	–	
Bit 2	–	
Bit 3	–	
Bit 4	SD initialization error	Reinitialization of the SD chain required! Shut down operating voltage of the gateway and SD Slaves. Possibly no SD slave connected!
Bit 5	SD Teach error	SD chain structure has changed after Power On! If OK, operate TEACH.
Bit 6	SD short circuit	Bit 6 SD short circuit Short-circuit in the SD interface wires. Switch off and eliminate error.
Bit 7	SD communication error	One or more SD slaves unavailable. Invalid data from the SD slaves. If necessary, check SD installation.

Table 23: SD Master Diagnose, SD System error / Content Response byte 00, Diagnostic byte Gateway

11 Safety Data

There are 12 bytes of secure data in each direction. These depend on the device description file, e.g.: ESI, EDS ... already predefined.
Configuration of Diagnostic data is done in SafePLC².

11.1 Fieldbus Specific Safety Instructions

Depending on the used fieldbus and the underlying safety protocol, additional instructions must be followed.
These specific instructions are listed in the following topics.

11.1.1 CIP Safety (EtherNet/IP)

The following requirements must be met in order to operate a device with a CIP Safety Consumer or Provider connection:

	The replacement of safety devices requires that the replacement device be configured properly and operation of the replacement device shall be user verified.
	The SCID entered on the workstation and the SCID of the device shall be compared and must match. An exception to this is a validation run of the device, in which the SCID has to be set to 0 on the workstation.
	If you choose to configure safety connections with an SCID=0, you are responsible for ensuring that originators and targets have the correct configurations
	Any safety configuration must be manually validated by user testing.
	Only after a successful test and validation, the device shall be considered „verified“ and the configuration locked.
	A SNN should be assigned for each safety network or safety sub-net that are unqiue system-wide.
	Before installing a device into a safety network, any pre-existing safety configuration must be cleared locally from this device.
	Any SNN and UNID assignments (TUNID) on a safety device must be done prior to installing it into a safety network.
	Implications of integrating safety devices with different SIL levels must be carefully considered before installing them into a safety network.
	Safety connection configurations must be tested to verify, that they are working as intended.
	LEDs are NOT reliable indicators and cannot be guaranteed to provide accurate information. They should ONLY be used for general diagnostics during commissioning or troubleshooting. Do not attempt to use LEDs as operational indicators
	If the device is intended to be used with an originator with an automatic SNN assignment feature, it shall only be used if the safety system is not relying on it.
	After a configuration download the user shall visually verify, that all configuration data has been sent correctly.

11.2 SMX1x/2/, SMX1xx/2(DNM, xNM, DBM, xBM) or SDU-x/NM

Organization of the frame:

Size of safety data: always 12 Byte

F-Bus Input or Output:

Byte	Data
BYTE 0	Safe data Bit 1..8
BYTE 1	Safe data Bit 8..16
BYTE 2	Safe data Bit 17..24
BYTE 3	Safe data Bit 25..32
BYTE 4	Safe data Bit 33..40
BYTE 5	Safe data Bit 41..48
BYTE 6	Safe data Bit 49..56
BYTE 7	Safe data Bit 57..67
BYTE 8	Safe data Bit 65..72
BYTE 9	Safe data Bit 73..80
BYTE 10	Safe data Bit 81..88
BYTE 11	Safe data Bit 89..96

Table 24: safety data SMX1x/2/, SMX1xx/2(DNM, xNM, DBM, xBM) or SDU-x/NM

NOTICE: Bit designations are mapped in SafePLC² for SMX and SDU devices starting at bit 1. For SCU and SIO devices starting at bit 0.

Example:
F-bus input
Byte 0: Bit 0 is mapped to Bit 1 (E-Stop EXT) in the SafePLC² in the F-Bus module.

Output
F-Bus output: Bit 1 (Safety OK) is mapped to byte 0 bit 0 by the SafePLC².

12 Commissioning and Troubleshooting

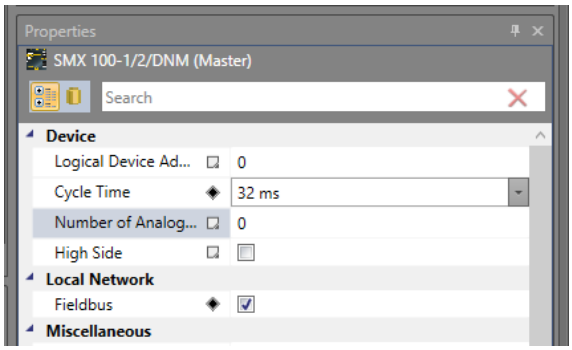
12.1 EtherNet/IP

EtherNet/IP is available for all Ethernet based field bus devices.

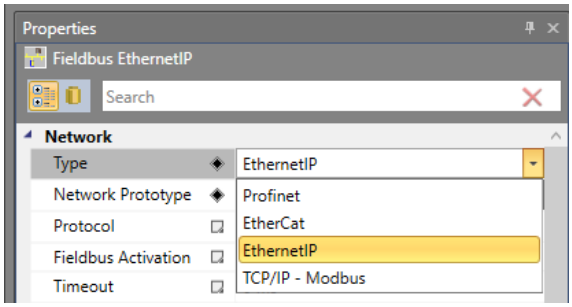
12.1.1 Enabling Ethernet/IP fieldbus

To activate the EtherNet/IP communication, the following steps should be followed:

- Make sure, a project with a compatible device is created and opened in SafePLC2
- Enable the property „Fieldbus" inside the properties of your base device



- Select the Network Type „EtherNet/IP" in the drop-down list inside the properties of the Fieldbus



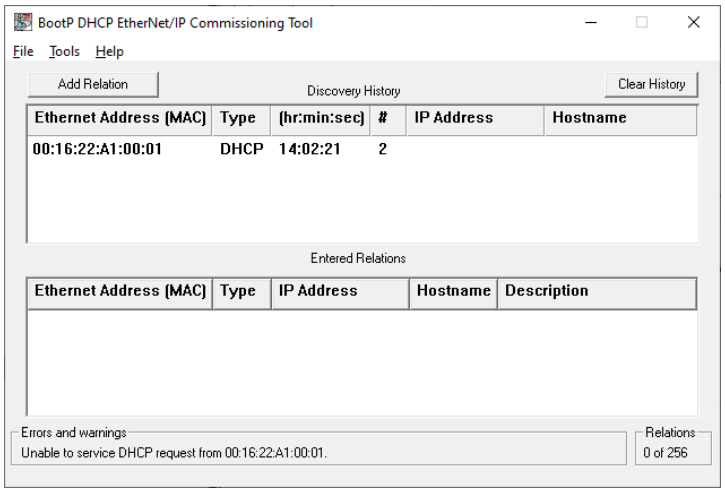
- Compile the project and send the configuration to the device.
- Start the device (Go To Run)

12.1.2 Setting TCP/IP Parameters

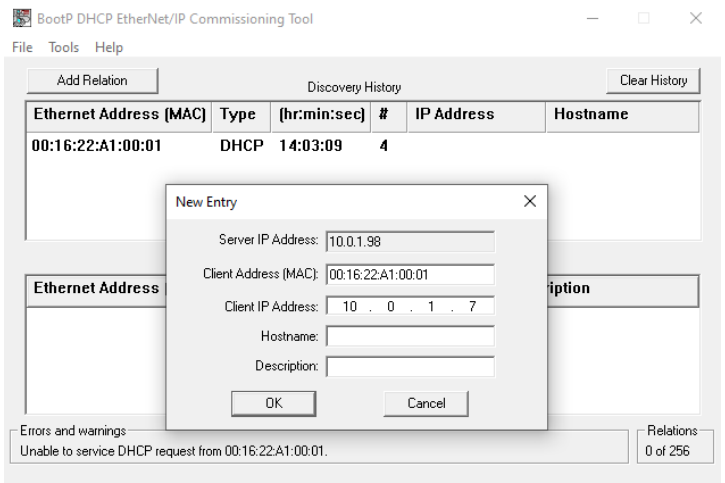
An out-of-box EtherNet/IP device does not have an IP address set and is waiting on an assignment through DHCP/BOOTP.

The commissioning of a safety device with IP Address and TUNID settings should be done prior to installing it onto a safe network.

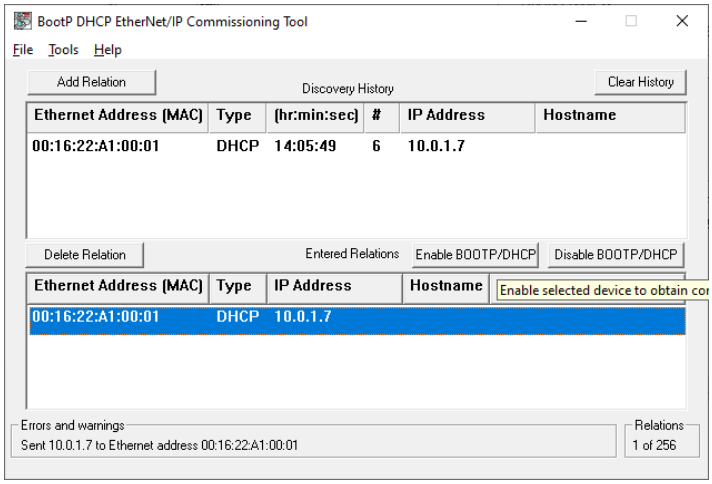
- Connect the device to your EtherNet/IP network (X93, X94)
- Start your BootP or DHCP Server
- The device will periodically poll for DHCP and a new device should be shown.



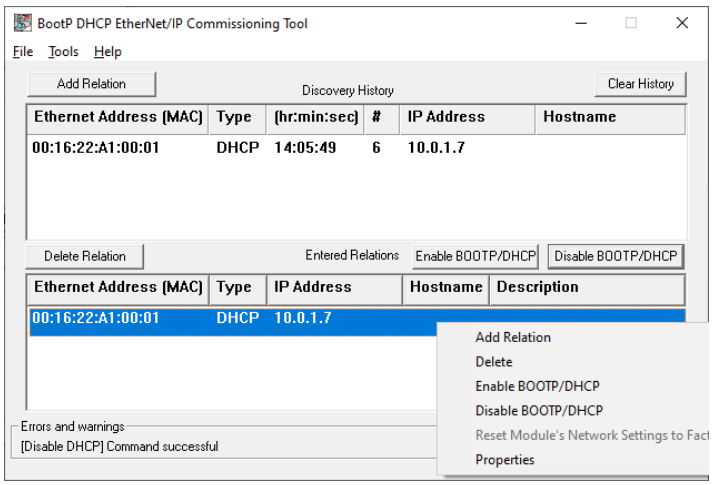
- Assign a new IP address to the device



Once applied, the device responds on your newly set IP address. This IP address is volatile and does not persist through power-off



To permanently store the IP address in the device press “Disable BOOTP/DHCP” while the assigned device is selected. Alternatively right click the device and choose the corresponding option from the context menu.



A device with an assigned TUNID (SNN) will reject any changes to the TCP/IP configuration.
To apply changes the device has to be brought back to the out-of-box state by using the Safety Reset first.

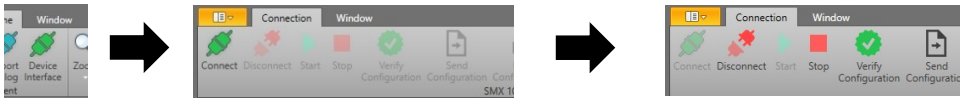
12.1.3 Propose and Apply TUNID (SNN)

Every CIP Safety device needs a unique device identifier (TUNID, Target Unique Node ID). It has to be unique within the reachable network.
The TUNID contains the SNN (safety network number) which also has to be unique.

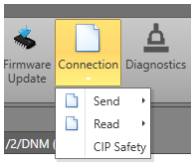
A SNN should be assigned for each safety network or safety sub-net that are unique system-wide.
Each safety device should be assigned a TUNID, reflecting the parent SNN and its NodeID (IP Address), creating a system-wide unique node identification.

To assign a TUNID to a device the following steps have to be completed:

Connect to the device with SafePLC2 device interface.



Select the dialog “CIP Safety” from the menu icon “Connection”

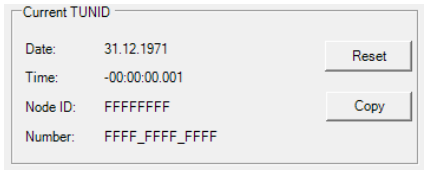


Press “Refresh” to read the current settings of the device.

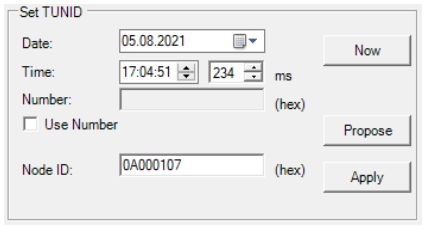
If the safety device has been used before and a TUNID is already present, a new TUNID can only be assigned after it has been reset and brought back to its out-of-box condition.

12.1.3.1 Propose/Apply

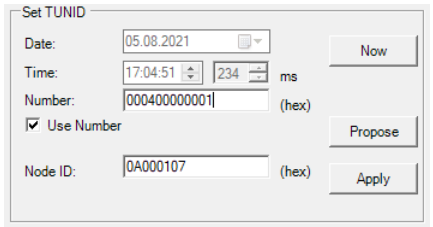
- Stop the device by pressing the "Stop" button on the menu
- Make sure no TUNID is applied to the device. There are several ways to identify this state:
- An unset TUNID can be identified with an all FF entry and the specific date 31.12.1971 in the "Current TUNID" section
- The Device Status label shows "Wait For TUNID"
- The Module LED flashes red/green



- Enter Date and Time of the desired SNN or press "Now" to create a new one
- Enter the Node ID of the device
- For EtherNet/IP the NodeID reflects the IP Address of the device. It has to be entered as a hexadecimal value (10.0.1.7 = 0A000107, 192.168.10.45 = C0A80A2D)



- Some SNN require a numerical setting or are not based on the IEC 1131-3 date format. You can enable the checkbox "Use Number" and enter a used defined number for the SNN (in hexadecimal) in the field "Number".



- Press "Propose"
- Verify the correct target device is about to be assigned
- Make sure the response reads "Command successful"
- The Device Status label changes to "Wait for Apply TUNID"
- Visually inspect the target device, both Module and Network LEDs must be flashing red/green
- When the correct target device has been addressed, press "Apply"
- The Device Status label changes to "Idle"
- The Current TUNID now shows the previously applied TUNID

- The response label reads “Command successful”
- The Module LED is now flashing green (Idle)
- The Network LED is not flashing red/green anymore and reflecting the current network status

- Restart the device by pressing the button “Run” on the menu
- The device is now configured and ready for a CIP Safety connection.

HINT The TUNID is stored permanently and persists through power-cycles

HINT A proposed TUNID is volatile and lost on power-cycle.

Applying a TUNID requires the Node ID (IP address) of the device and locks the TCP/IP settings!
Make sure the TCP/IP configuration has been finalized before applying a TUNID.

It is possible to dynamically assign an IP address by a DHCP server each time after power-on. However the device must be set to the identical IP address every time which was applied as the TUNID NodeID.

12.1.3.2 Reset to Out-Of-Box

- Stop the device by pressing the "Stop" button on the menu
- Press the button "Reset" in the "Current TUNID" group box
- The response label reads "Command successful"
- The Module LED is now flashing green/red
- The Device Status Label shows "Wait for TUNID"