Installation manual
for
SMX fieldbuses

Modbus TCP/IP
EtherNet/IP
PROFINET
EtherCAT
PROFIBUS
DeviceNet
CANopen

Installation manual for SMX fieldbuses: Modbus TCP/IP, EtherNet/IP, PROFINET, EtherCAT, PROFIBUS, DeviceNet and CANopen

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

Status: 05/2018

Subject to change without prior notification
The contents of this documentation have been collated with greatest care and corresponds with our present status of information.
However, we would like to point out, that this document cannot always be updated at the same time as the technical development of the products.
Information and specifications can be changed at any time. Please keep yourself informed about the current version under www.bbh-products.de.

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Table of contents

List of tables

List of figures

1 Important notes

Definition of individual target groups:

Project engineering for safe drive systems:
- Engineers and technicians

Assembly, electric 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.

COM is the abbreviation for the universal communication interface for the 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 modules.

1.2 Applicable documents

Description	***Reference***
General information concerning SMX modules and their use	Installation manual SMX, Installation manual SMX100, Programming manual SafePLC2

Table 1: Applicable documents

⚠ **Note:**

- Thoroughly read the manuals before you start the installation and the commissioning of the SMX module.
- 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
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 2: Abbreviations

2 Safety regulations

2.1 Intended use

The universal communication interface COM is an option for the modules SMX1x/2/xxx and SMX1xx/2/xxx and their variants for non-safe data transfer with Ethernet or CAN respectively RS485 based protocol.

The COM interface has the following additional options:

- Safe data transfer using safety fieldbus protocols
- **SDDC** ETH (decentral) "**S**afe **D**evice – **D**evice **C**ommunication" over Ethernet. Safety Remote communication
- **SMMC** "**S**afe **M**aster – **M**aster **C**ommunication" Safety Cross-communication
- SD-Bus communication

These options are described in separate manuals.

The option: Memory Card (SDHC) is described in the installation manuals SMX / SMX100.

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 "0. 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 must be strictly 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 de-energized 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 ear thing should by means of e.g. an ear thing 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 in chapter "7.

3 Description and function of device

The universal communication interface COM is permanently integrated into every SMX base module with the option /DNM or /DBM.
In this connection the COM interface is responsible for non-safe communication based on Ethernet or CAN respectively RS485 bus protocols.

Here, depending on the option /DNM (Modbus TCP/IP, EtherNet/IP, PROFINET, EtherCAT) or /DBM (PROFIBUS, DeviceNet), 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 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 (SMX1xx/2/x).

In addition, up to 32 non-safe functional inputs are available on the SMX, via which digital information can be received by the higher-level PLC.
In the “SafePLC2 functional scheme”, these inputs are AND-linked with a safe input and can then be used as desired.

The exact breakdown of the diagnostic data and the preselect able profiles can be found in the chapter *“9.Diagnostic 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	Cycle Time (Input Trigger) minimum 1ms, Reaction time base on host device SMX1x/2: 8ms SMX1xx/2: 16-32ms	
Protocol	TCP/IP	
Address Space (1)	132 Byte	
	Coils	0..31
	Discrete Inputs	-
	Input Register	0..63
	Holding Register	0..65
Max number of connections	1	
Supported Entities	Read Coils, Read Holding Register, Read Input Register, Write Single Coil, Write Single Register, Write Multiple Coils, Write Multiple Register,	
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 3: 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	0	-	0..7	r/w	Read Coils, Read Holding Register, Write Single Coil, Write Single Register, Write Multiple Coils, Write Multiple Register
1	Functional Inputs 8..15			8..15	r/w	
2	Functional Inputs 16..23	1	-	16..23	r/w	
3	Functional Inputs 24..31			24..31	r/w	
4	Device Diagnosis	2	0	-	r	Read Holding Register, Read Input Register (Starting with Address 0)
5	Device Diagnosis			-	r	
...	Device Diagnosis	3..65	1	-	r	
131	Device Diagnosis			-	r	

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
Output Data Size (O -> T)	68 Byte (1)
Input Data Size (T -> O)	192 Byte (2)
IO Connection Types	Exclusive Owner, Listen Only, Input Only
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) 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	supported
DLR V2 (ring topology)	supported
Quick Connect	supported
CIP sync	supported
Integrated switch	supported
Reset services	Identity Object Reset Service of Type 0 and 1
DHCP	supported
BOOTP	supported

Table 3: Field bus specific data for EtherNet/IP

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

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
Cyclic Output Data Size	80 Byte (1)
Cyclic Input Data Size	204 Byte (2)
Baud Rate	100 MBit/s
Supported Protocols	RTC – Real time cyclic protocol (Class 1, Class 2, Class 3) RTA – Real time acyclic protocol DCP – Discover and Configuration Protocol LLDP – Link Layer Discovery Protocol
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

3.1.4 EtherCAT

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	95 Byte (1)
Cyclic Input Data Size	219 Byte (2)
Baud Rate	100 MBit/s
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

3.1.5 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
Baud Rate	9,6 kBits/s up to 12 MBit/s
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

3.1.6 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
Typ	12 – Communications Adapter
Output Data Size (Consumed)	4 Byte functional inputs (Network to Slave)
Input Data Size (Produced)	128 Byte diagnostic data (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

Tabelle 8: Field bus specific data for DeviceNet

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)

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:

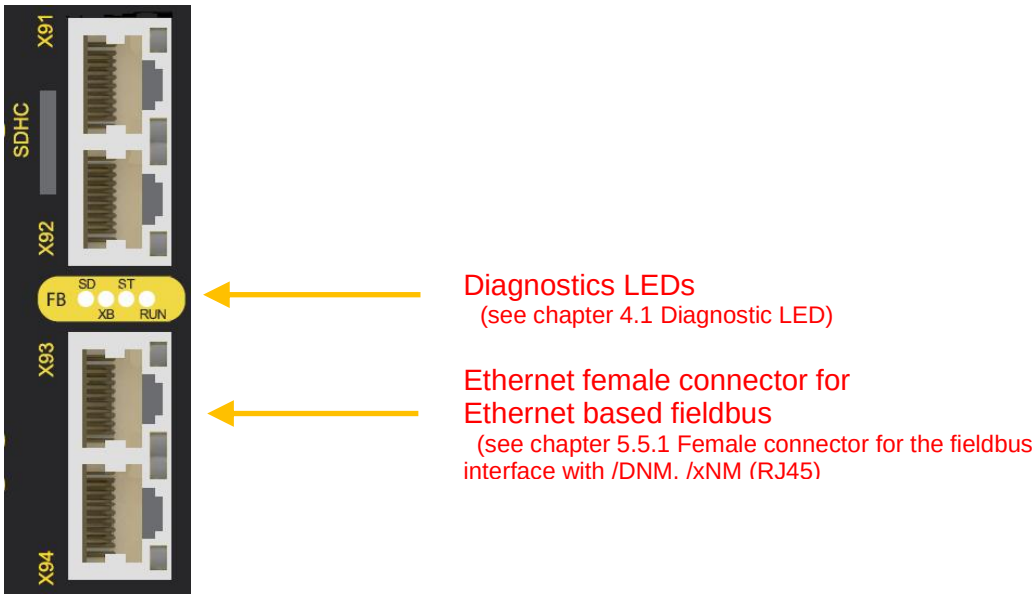
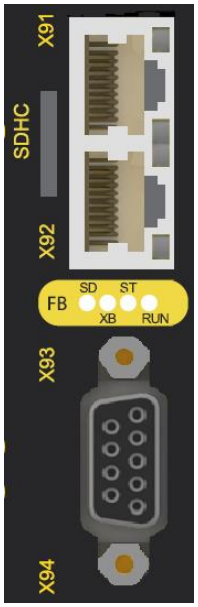


Figure 1: Front view device Variant (/DNM)

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 4.1 Diagnostic LED)

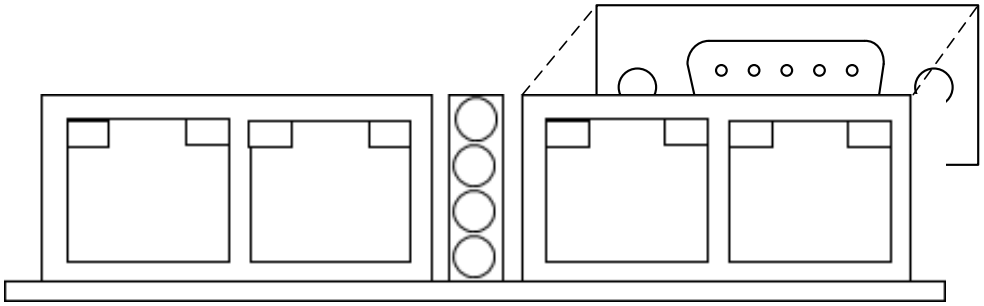
D-SUB 9P female connector Buchse for CAN or RS485-based fieldbus derivatives
(see Capture "5.5.2 Female connector for the fieldbus interface with /DBM, /xBM (D-SUB))

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-colour LEDs, regardless of the device model.



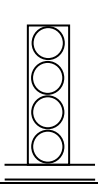
		Name	function
	4	Run	SMX status SDDC communication
	3	ST	Bus feedback
	2	XB	Communication to F-CPU
	1	SD	SD-Bus Led

Figure 3: Diagnostic LED's

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
Bus	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: - PROFINET IO: Bus Link, but no integration EtherCAT: Status Preoperational PROFIBUS: Bus Link, but no integration DeviceNet: - CANopen: Status Preoperational
		Short flash	EtherNet/IP: waiting for connection to scanner (bridge) PROFINET IO: Bus Link but no integration EtherCAT: Status Safe operational PROFIBUS: - Modbus TCP/IP: - DeviceNet: - CANopen: Node stopped
	Red	permanent	EtherNet/IP: Timeout 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: - 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: network-/link error; Same IP address 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 active; No MAC address; not initialized PROFINET IO: inactive EtherCAT: inactive/status initialization PROFIBUS: inactive Modbus TCP/IP: inactive DeviceNet: Bus Off
XB	green	permanent	SPI connection to F-CPU active and ok
	red	permanent	Error: Timeout for SPI connection to the F-CPU
	green/orange	flashing	Traffic Tooling connection
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 7: 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) or to the D-SUB female connector marked (option /DBM, xBM), as shown in the following figure.

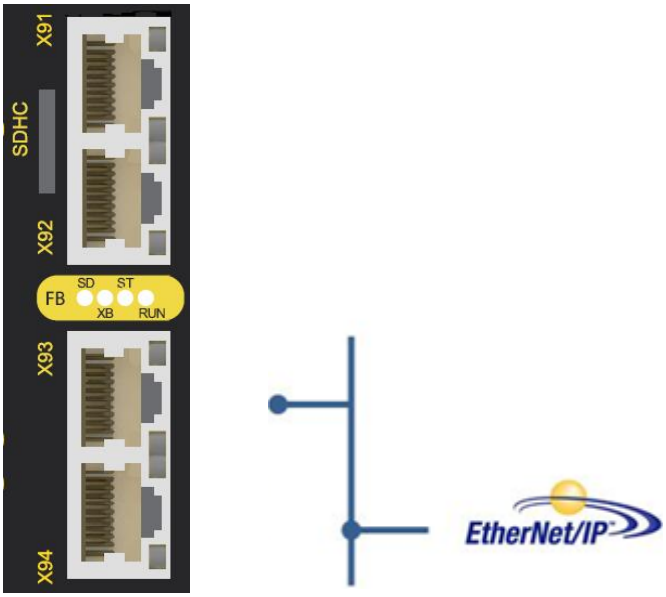


Figure 4: Example for fieldbus connection to female connector X93/X94 (EtherNet / IP)

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 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 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 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 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 "SMX1x/2/x Installation Manual" and "SMX100-x/2/x Installation Manual ".

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 "SMX1x/2/x Installation Manual" and "SMX100-x/2/x Installation Manual ".

5.4 Address Selector

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

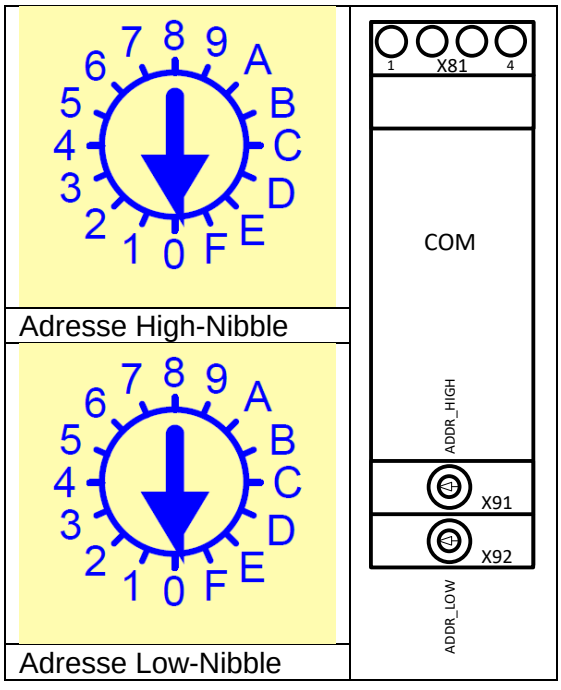
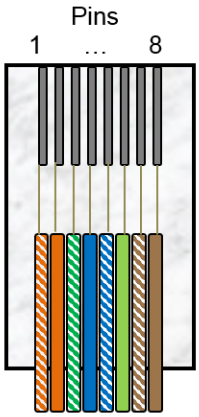


Figure 6: Address selector switch for SMX derivatives with option /DBM, /xBM

5.5 Pin assignment female connector

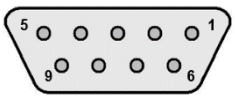
5.5.1 Female connector for the fieldbus interface with /DNM, /xNM (RJ45)



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 /DBM, /xBM (RJ45)

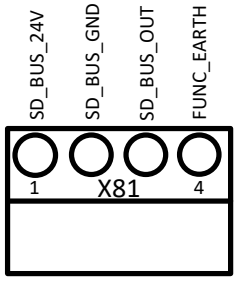
5.5.2 Female connector for the fieldbus interface with /DBM, /xBM (D-SUB)



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	Beschreibung
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

Note:

Pluggable connections of the SMX 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
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	90000h at 50°C ambient

Table 8: Environmental conditions

9 Diagnostic 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 separate manual.

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.

9.1 Diagnostic Data of SMX1x/2/(DNM, xNM, DBM, xBM)

Organization of the frame:

Size of diagnostic data: always 128 Byte

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0...3	SMX 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 9: Logic data of the SMX1x/2/(DNM, xNM, DBM, xNM)

Process data follow with a byte offset of 7; Byte 0 of process data is Byte 8 in the assembly.

Byte	Data
BYTE 0	Process data Bit 56..63
BYTE 1	Process data Bit 48..55
BYTE 2	Process data Bit 40..47
BYTE 3	Process data Bit 32..39
BYTE 4	Process data Bit 24..31
BYTE 5	Process data Bit 16..23
BYTE 6	Process data Bit 8..15
BYTE 7	Process data Bit 0..7

Table 10: Process data of the SMX1x/2/(DNM, xNM, DBM, xNM)

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

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

9.2.1 Structure Device Profile 0 (=legacy profile)

9.2.1.1 Configuration with slave devices

Organization of the frame

Size of diagnostic data: 128 Byte

Byte Offset	Description	Data Size
0	Bit data type „1“ (Logic data Bit ID0 to Bit ID55)	8 Byte
8	Process data slave device addr. 1	12 Byte
20	Bit data type „1“ (Logic data Bit ID56 to Bit ID111)	8 Byte
28	Process data slave device addr. 2	12 Byte
40	Bit data type „1“ (Logic data Bit ID112 to Bit ID167)	8 Byte
48	Process data slave device addr. 3	12 Byte
60	Bit data type „1“ (Logic data Bit ID168 to Bit ID223)	8 Byte
68	Process data slave device addr. 4	12 Byte
80	Bit data type „1“ (Logic data Bit ID224 to Bit ID279)	8 Byte
88	Process data slave device addr. 5	12 Byte
100	Bit data type „1“ (Logic data Bit ID280 to Bit ID335)	8 Byte
108	Process data slave device addr. 6	12 Byte
120	Bit data type „1“ (Logic data Bit ID336 to Bit ID391)	8 Byte

Table 11: Structure for Device Profile 0 with expansion modules

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

9.2.1.2 Configuration without slave devices

Organization of the frame

Size of diagnostic data: 128 Byte

Byte Offset	Description	Data Size
0	Bit data type „1“ (Logic data Bit ID0 to Bit ID55)	8 Byte
8	Bit data type „2“ (Logic data Bit ID56 to Bit ID111)	7 Byte
15	Bit data type „2“ (Logic data Bit ID112 to Bit ID167)	7 Byte
22	Bit data type „2“ (Logic data Bit ID168 to Bit ID223)	7 Byte
29	Bit data type „2“ (Logic data Bit ID224 to Bit ID279)	7 Byte
36	Bit data type „2“ (Logic data Bit ID280 to Bit ID335)	7 Byte
43 …127	Not used	

Table 12: Structure for Device Profile 0 without expansion modules

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

9.2.1.3 Data Types

9.2.1.3.1 Bit data type “1”

Byte	Bit	„Run“ mode (2, 3, 4)	Error case (A, F)
Byte 0	0...3	SMX 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 13: Bit data type "1"

9.2.1.3.2 Bit data type “2”

Byte	Bit	Data
Byte 0	0...7	Logic data (Bit: 48..55)
Byte 1	0...7	Logic data (Bit: 40..47)
Byte 2	0...7	Logic data (Bit: 32..39)
Byte 3	0...7	Logic data (Bit: 9..15)
Byte 4	0...7	Logic data (Bit: 0...8)
Byte 5	0..6	Logic data (Bit: 24.. 30)
	7	„0“
Byte 6	0..7	Logic data (Bit: 16..23)

Table 14: Bit data type "2"

9.2.1.3.3 Process data slave devices

Byte	Data
BYTE 0	Process data Bit 0..7
BYTE 1	Process data Bit 8..15
BYTE 2	Process data Bit 16..23
BYTE 3	Process data Bit 24..31
BYTE 4	Process data Bit 32..39
BYTE 5	Process data Bit 40..47
BYTE 6	Process data Bit 48..55
BYTE 7	Process data Bit 56..63
BYTE 8	Process data Bit 64..71
BYTE 9	Process data Bit 72..79
BYTE 10	Process data Bit 80..87
BYTE 11	Process data Bit 88..95

Table 15: Process data

9.2.2 Structure Device Profile 1 (=only logic data)

Byte	Bit	„Run“ mode (2, 3, 4)	
Byte 0	0..3	SMX 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..31)	
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 16: Structure for Device Profile 1 (=only logic data)

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

9.2.3 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	SMX 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: 0..7)	
Byte 6	0..7	Logic data (Bit ID: 8..15)	
Byte 7	0..7	Logic data (Bit ID: 16..23)	
Byte 8	0..6	Logic data (Bit ID: 24..30)	
	7	„0“	
Byte 9	0..7	Logic data (Bit ID: 32...39)	
Byte 10	0..7	Logic data (Bit ID: 40..47)	
...	...	....	
Byte 55	0..7	Logic data (Bit ID: 400..407)	
Byte 56	0..7	Process data axis slave device 1 Bit 0..7	
Byte 57	0..7	Process data axis slave device 1 Bit 8..15	
Byte 58	0..7	Process data axis slave device 1 Bit 16..23	
Byte 59	0..7	Process data axis slave device 1 Bit 24..31	
Byte 60	0..7	Process data axis slave device 1 Bit 32..39	
Byte 61	0..7	Process data axis slave device 1 Bit 40..47	
Byte 62	0..7	Process data axis slave device 1 Bit 48..55	
Byte 63	0..7	Process data axis slave device 1 Bit 56..63	
Byte 64	0..7	Process data axis slave device 1 Bit 64..71	
Byte 65	0..7	Process data axis slave device 1 Bit 72..79	
Byte 66	0..7	Process data axis slave device 1 Bit 80..87	
Byte 67	0..7	Process data axis slave device 1 Bit 88..95	
Byte 68	0..7	Process data axis slave device 2 Bit 0..7	
Byte 69	0..7	Process data axis slave device 2 Bit 8..15	
Byte 70	0..7	Process data axis slave device 2 Bit 16..23	
Byte 71	0..7	Process data axis slave device 2 Bit 24..31	
Byte 72	0..7	Process data axis slave device 2 Bit 32..39	
Byte 73	0..7	Process data axis slave device 2 Bit 40..47	
Byte 74	0..7	Process data axis slave device 2 Bit 48..55	
Byte 75	0..7	Process data axis slave device 2 Bit 56..63	
Byte 76	0..7	Process data axis slave device 2 Bit 64..71	
Byte 77	0..7	Process data axis slave device 2 Bit 72..79	

Byte 78	0..7	Process data axis slave device 2 Bit 80..87
Byte 79	0..7	Process data axis slave device 2 Bit 88..95
Byte 80	0..7	Process data axis slave device 3 Bit 0..7
Byte 81	0..7	Process data axis slave device 3 Bit 8..15
Byte 82	0..7	Process data axis slave device 3 Bit 16..23
Byte 83	0..7	Process data axis slave device 3 Bit 24..31
Byte 84	0..7	Process data axis slave device 3 Bit 32..39
Byte 85	0..7	Process data axis slave device 3 Bit 40..47
Byte 86	0..7	Process data axis slave device 3 Bit 48..55
Byte 87	0..7	Process data axis slave device 3 Bit 56..63
Byte 88	0..7	Process data axis slave device 3 Bit 64..71
Byte 89	0..7	Process data axis slave device 3 Bit 72..79
Byte 90	0..7	Process data axis slave device 3 Bit 80..87
Byte 91	0..7	Process data axis slave device 3 Bit 88..95
Byte 92	0..7	Process data axis slave device 4 Bit 0..7
Byte 93	0..7	Process data axis slave device 4 Bit 8..15
Byte 94	0..7	Process data axis slave device 4 Bit 16..23
Byte 95	0..7	Process data axis slave device 4 Bit 24..31
Byte 96	0..7	Process data axis slave device 4 Bit 32..39
Byte 97	0..7	Process data axis slave device 4 Bit 40..47
Byte 98	0..7	Process data axis slave device 4 Bit 48..55
Byte 99	0..7	Process data axis slave device 4 Bit 56..63
Byte 100	0..7	Process data axis slave device 4 Bit 64..71
Byte 101	0..7	Process data axis slave device 4 Bit 72..79
Byte 102	0..7	Process data axis slave device 4 Bit 80..87
Byte 103	0..7	Process data axis slave device 4 Bit 88..95
Byte 104	0..7	Process data axis slave device 5 Bit 0..7
Byte 105	0..7	Process data axis slave device 5 Bit 8..15
Byte 106	0..7	Process data axis slave device 5 Bit 16..23
Byte 107	0..7	Process data axis slave device 5 Bit 24..31
Byte 108	0..7	Process data axis slave device 5 Bit 32..39
Byte 109	0..7	Process data axis slave device 5 Bit 40..47
Byte 110	0..7	Process data axis slave device 5 Bit 48..55
Byte 111	0..7	Process data axis slave device 5 Bit 56..63
Byte 112	0..7	Process data axis slave device 5 Bit 64..71
Byte 113	0..7	Process data axis slave device 5 Bit 72..79
Byte 114	0..7	Process data axis slave device 5 Bit 80..87
Byte 115	0..7	Process data axis slave device 5 Bit 88..95
Byte 116	0..7	Process data axis slave device 6 Bit 0..7
Byte 117	0..7	Process data axis slave device 6 Bit 8..15
Byte 118	0..7	Process data axis slave device 6 Bit 16..23
Byte 119	0..7	Process data axis slave device 6 Bit 24..31

Byte 120	0..7	Process data axis slave device 6 Bit 32..39
Byte 121	0..7	Process data axis slave device 6 Bit 40..47
Byte 122	0..7	Process data axis slave device 6 Bit 48..55
Byte 123	0..7	Process data axis slave device 6 Bit 56..63
Byte 124	0..7	Process data axis slave device 6 Bit 64..71
Byte 125	0..7	Process data axis slave device 6 Bit 72..79
Byte 126	0..7	Process data axis slave device 6 Bit 80..87
Byte 127	0..7	Process data axis slave device 6 Bit 88..95

Table 17: Structure for Device Profile 2 (=logic and process data for every slave device)

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