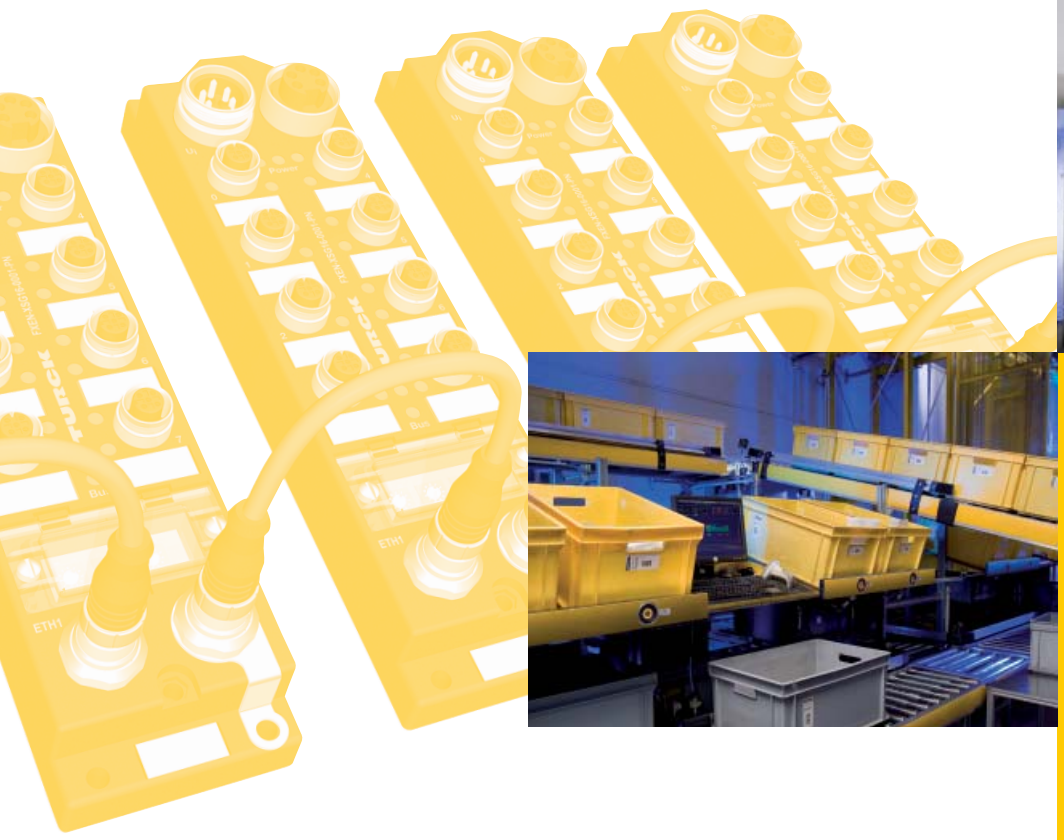
TURCK

Industrial
Automation

FXEN – ETHERNET/IP

USER MANUAL



EtherNet/IP™

Edition 08/2008

Warning!
Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighboring units that are live.
- Follow the engineering instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0 105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0 100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- All shrouds and doors must be kept closed during operation.

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Documentation Concept

This manual contains all information about the TURCK FXEN product series for EtherNet/IP in IP67.

The following chapters contain a short FXEN system description, a description of the fieldbus system EtherNet/IP, exact information about function and structure of the FXEN modules as well as all bus specific information concerning the connection to automation devices, diagnostics and data mapping.

Overview

Attention

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual includes all information necessary for the prescribed use of FXEN-modules for EtherNet/IP. It has been specially conceived for personnel with the necessary qualifications.

Prescribed Use

Warning

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

Notes Concerning Planning /Installation of this Product

Warning

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

Description of Symbols Used

Warning

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps.
These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

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System Description

Ethernet Industrial Protocol (EtherNet/IP) is a communication system for industrial applications.

It is used to exchange time-critical application information between industrial devices such as simple I/O devices (sensors/actuators) or even complex control devices (robots, programmable logic controllers, etc.).

EtherNet/IP is an open network because it uses:

- IEEE 802.3 Physical and Data Link standard
- Ethernet TCP/IP protocol suite (Transmission Control Protocol/Internet Protocol), the Ethernet industry standard.
- Common Industrial Protocol (CIP), the protocol that provides real-time I/O messaging and information/peer-to-peer messaging. ControlNet and DeviceNet networks also use CIP.

Note

For further infomation about CIP and EtherNet/IP, please contact also the user organization ODVA (www.odva.org).

IP (Internet Protocol)

The Internet Protocol is a connection-free transport protocol. Since the protocol does not use acknowledgement messages, telegrams can get lost. Therefore it is not suitable for safe data transfer. The main functions of the internet protocol are the addressing of hosts and the fragmentation of data packages.

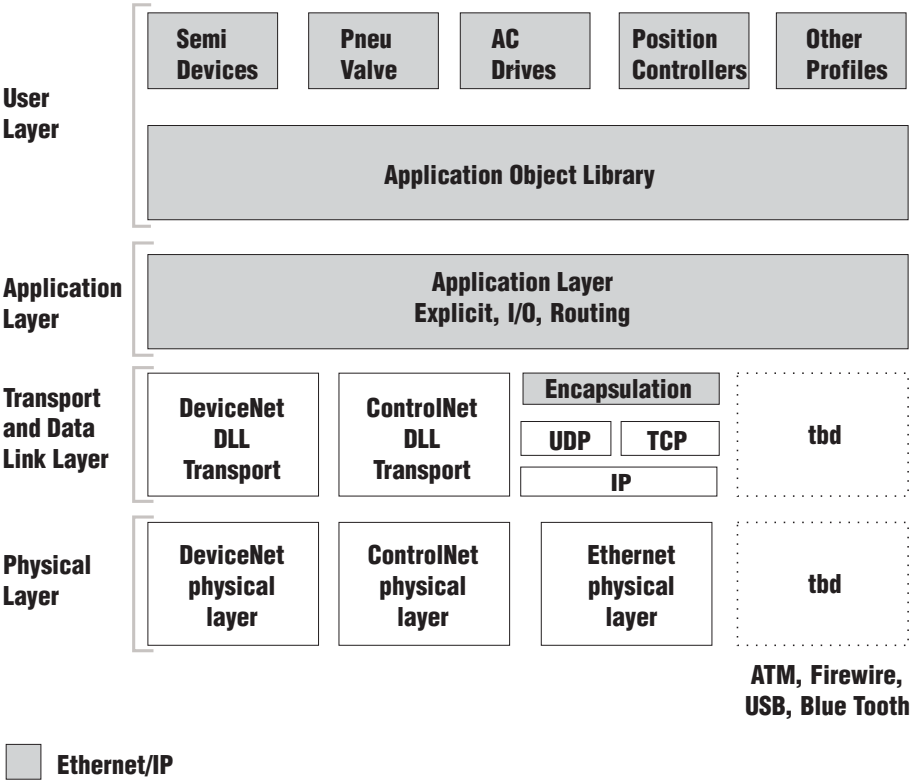
TCP (Transmission Control Protocol)

The Transmission Control Protocol (TCP) is a connection-oriented transport protocol and is based on the Internet Protocol. A safe and error-free data transport can be guaranteed by means of certain error diagnostic mechanisms. For example, the acknowledgement and time monitoring of telegrams.

UDP/IP (User Datagram Protocol)

UDP/IP provides the fast, efficient data transport necessary for real-time data exchange. To make EtherNet/IP successful, CIP has been added on top of TCP/UDP/IP to provide a common application layer.

Figure 1: EtherNet/IP in OSI 7 layer model



Network-Topology

EtherNet/IP network uses an active star topology in which groups of devices are connected point-to-point to a switch.

Products with both transmission speeds (10 and 100 Mbit/s) can be used in the same network and most Ethernet switches will negotiate the speed automatically.

Transmission Media

For communication via Ethernet, different transmission media can be used:

- coaxial cable (10Base5)
- optical fibre (10BaseF)
- twisted two-wire cable (10BaseT) with shielding (STP) or without shielding (UTP)

Addressing on EtherNet/IP

Ethernet MAC-ID

The Ethernet MAC-ID is a 6-byte-value which serves to identify an Ethernet device. The MAC-ID is determined for each device by the IEEE (Institute of Electrical and Electronics Engineers, New York).

The first 3 bytes of the MAC-ID contain a manufacturer identifier (TURCK: 00:07:46:xx:xx:xx). The last 3 bytes can be chosen freely by the manufacturer for each device and contain a serial number.

The MAC-ID can be read from the module using the software tool "I/O-ASSISTANT".

IP address

Each Ethernet-host receives its own IP address. In addition, the node knows its netmask and the IP address of the default gateway.

The IP address is a 4-byte-value which contains the address of the network to which the node is connected as well as the host address in the network.

The IP address of the FXEN-XSG16-0001-IP is predefined as follows:

IP address: 192.168.1.×××

netmask: 255.255.255.0

gateway: 192.168.1.001

The netmask shows which part of the IP address defines the network as well as the network class, and which part of the IP address defines the single node in the network.

In the example mentioned above, the first 3 bytes of the IP address define the network. They contain the subnet-ID 192.168.1.
The last byte of the IP address defines the node's address within the network.

Note

In order to build communication between a PC and an Ethernet-module, both have to be nodes on the same network.

If necessary, the nodes' network addresses have to be adapted one to another. Please read chapter 6, "Changing the IP address of a PC/network interface card"', page 6-4

Network Classes

The available networks are divided into the different network classes A, B, and C.

Figure 2: Network classes

Class	Network addresses	Bytes for net address	Bytes for host address	No. of possible networks/ hosts
A	1.xxx.xxx.xxx- 126.xxx.xxx.xxx	1	3	126/ 2^{24}
B	128.0.xxx.xxx - 191.255.xxx.xxx	2	2	2^{14}/ 2^{16}
C	192.0.0.xxx - 223.255.255.xxx	3	1	2^{21}/ 256

According to their predefined address 192.168.1.xxx FXEN-modules are nodes on a Class C network.

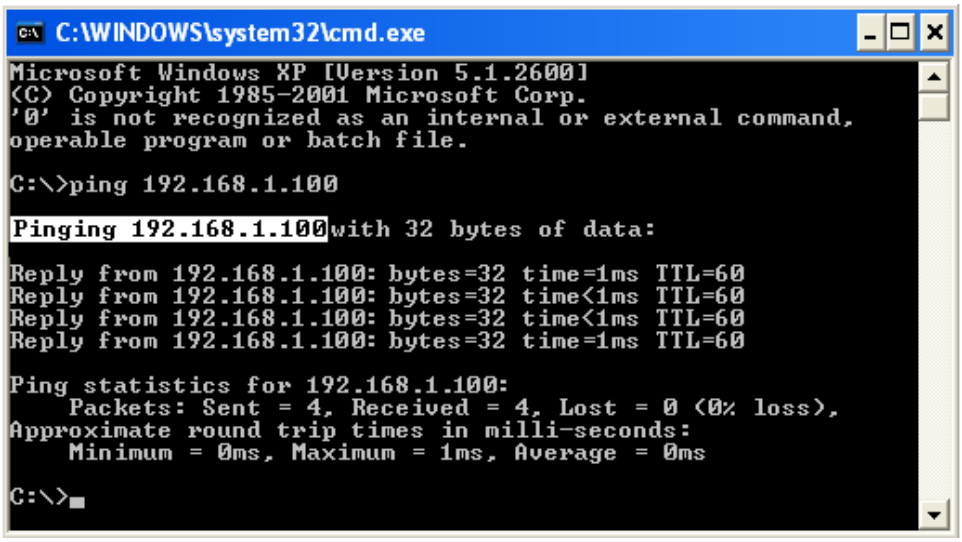
Checking the communication via "ping-signals"

You can check the communication between nodes in a network using ping-signals in the DOS-prompt of your PC.

For that purpose, enter the command "ping" and the IP address of the network node to be checked.

If the node answers the ping-signal, it is ready for communication and takes part in the data transfer.

Figure 3: ping-signal



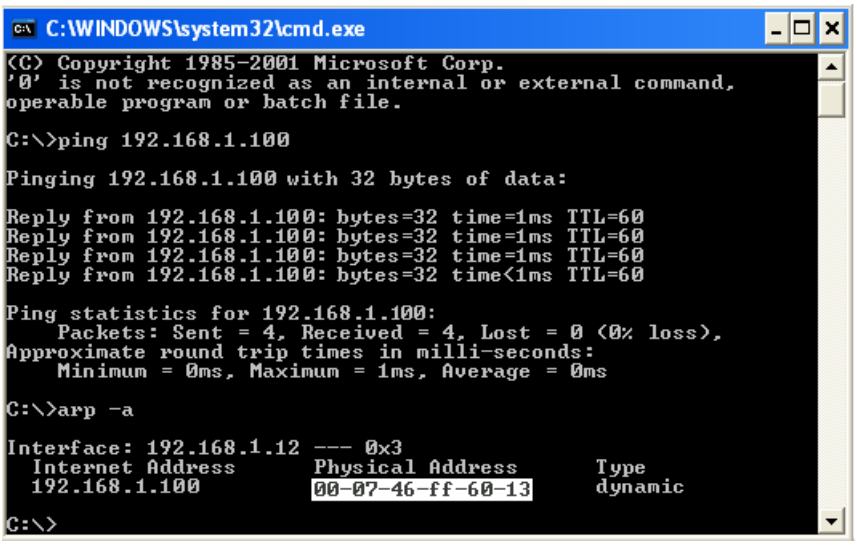
ARP (Address Resolution Protocol)

In each TCP/IP-capable computer, ARP serves to clearly assign the worldwide unique hardware addresses (MAC-IDs) to the single IP addresses of the network nodes via internal tables.

Using ARP in the DOS-prompt, every node in a network can be clearly identified via its MAC-ID.

- Write a ping command for the respective station/ IP address: (example: "x:\\ping 192.168.1.100").
- Via the command "x:\\arp -a", the MAC-ID (00-07-46-ff-60-13) for this IP address is determined. This MAC-ID clearly identifies the network node.

Figure 4: Determination of the MAC-ID of a FXEN module via ARP



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General Information

This chapter contains all information concerning the hardware of the FXEN modules, the general technical data as well as the connection possibilities, the addressing, the diagnostics and concerning the general EtherNet/IP parameters.

Note

All module-specific information can be found within the module descriptions in the respective module-chapters of this manual.

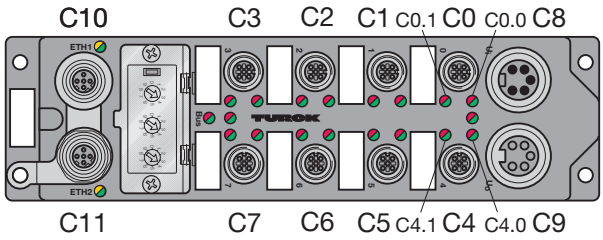
General Information on FXEN for EtherNet/IP

The FXEN-product family offers the following approved features:

- Suitable for EtherNet/IP applications
- Integrated auto-crossing Ethernet switch (line topology)
- Supported via FDT/DTM
- Power supply via 7/8''
- Fibre-glass reinforced PA6 housing
- Vibration and shock resistant
- Encapsulated module electronics
- Metal connector
- Degree of protection IP67

Figure 5: FXEN module

FXEN-module with 7/8'' power supply:



Address Setting for EtherNet/IP

Addressing the FXEN-modules for EtherNet/IP can be done via different modes:

- rotary mode (manual addressing via rotary coding-switches)
- PGM mode (manual addressing via software)
- BootP mode, DHCP mode (automatic addressing via BootP/DHCP-server at the module's boot-up).

Setting the address mode is done through the 3 rotary coding-switches on the module.

Attention

The cover of the decimal rotary coding-switches must be closed by tightening the screw after use.

The seal in the cover must not be damaged or slipped.

The protection class IP67 can only be guaranteed when the cover is closed correctly.

LED-behavior

During it's start-up, the module waits for the address setting via the BootP-server. This is indicated by the red flashing "MS" LED. The LED begins to flash green as soon as the address setting via the server is completed. The station is ready for communication.

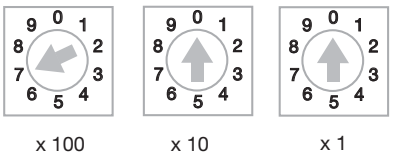
Default setting of the module

The modules default-settings are as follows:

IP address192.168.001.254
subnet mask 255.255.255.000
default gateway192.168.001.001

Note

The module can be reset by the user to these default settings at any time.
To reset the module, set the three coding-switches on the gateway to "000" followed by a power-on reset.



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

Figure 6: Decimal rotary coding-switches for the EtherNet/IP address setting

Attention

After every change of the address-mode, a voltage reset must be carried out.

Address setting via the rotary-mode

When using the rotary-mode, the last byte of the module's IP address can be set via the rotary coding-switches on the module.

Note

All other network settings are stored in the module's non-volatile EEPROM and can not be changed in the rotary-mode.

Addresses in the range from 1 to 254 can be allocated. Addresses 0 and 255 are reserved for broadcast messages in the subnet.

The following example shows the setting of address **173**.

Figure 7: Address setting

000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

Attention

The settings carried out in the rotary-mode are not stored in the module's EEPROM. Thus, they will get lost in case of a subsequent address-assignment via a BootP/ DHCP or PGM.

Attention

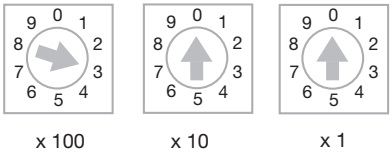
After changing the position of the rotary coding-switches, a voltage reset must be done to store the new address.

Address setting via BootP-mode

Address setting is carried out by a BootP-server in the network after the start-up of the module.

In order to activate the BootP-mode, the rotary coding-switches must be set to "300".

Figure 8: BootP-mode



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

Note

The IP address, as well as the default subnet mask assigned to the module by the BootP-server, are stored in the module's non-volatile memory.

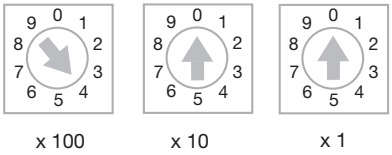
If the module is subsequently switched to rotary- or PGM-mode, the settings carried out via BootP (IP address, subnet mask, etc.) will be read from the module's EEPROM.

Address setting via DHCP-mode

Address setting is carried out by a DHCP-server in the network after the start-up of the module.

In order to activate the DHCP-mode, the rotary coding-switches must be set to "400".

Figure 9: DHCP-Modus



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

Note

The IP address, as well as the default subnet mask assigned to the module by the DHCP-server, are stored in the module's non-volatile memory.

If the module is subsequently switched to rotary- or PGM-mode, the settings carried out via DHCP (IP address, subnet mask, etc.) will read from the module's EEPROM.

DHCP supports three mechanisms for IP address allocation:

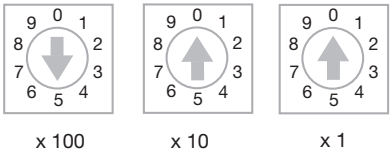
- In "automatic allocation", the DHCP-server assigns a permanent IP address to a client.
- In "dynamic allocation", DHCP assigns an IP address to a client for a limited period of time. After this time, or until the client explicitly relinquishes the address, the address can be re-assigned.
- In "manual allocation", a client's IP address is assigned by the network administrator, and DHCP is used simply to convey the assigned address to the client.

Address setting via PGM-mode

The PGM-mode enables access of the software I/O-ASSISTANT to the module's network settings.

In order to activate the PGM-mode, the rotary coding-switches must be set to "500".

Figure 10: PGM-mode



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

Note

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are read from the module's internal EEPROM.

Settings carried out in the rotary-mode are stored in the module's non-volatile EEPROM.

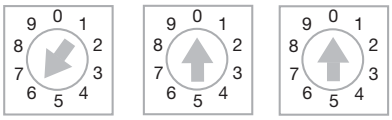
Address setting via PGM-DHCP

This mode operates exactly like the PGM-mode except that when the module is initially powered in this mode it will broadcast its MAC ID (similar to DHCP mode).

But, in contrast to the regular DHCP mode, the DHCP transmission on startup can be enabled/disabled via TCP Object attributes in EtherNet/IP.

In order to activate the PGM-DHCP-mode, the rotary coding-switches must be set to "600".

Figure 11: PGM-DHCP-mode



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
700: PROFINET

The I/O-ASSISTANT can also be used to set the IP Address in this mode.

This mode is the Out-of-the-Box mode for the module and provides powerful and convenient Start-up features.

1 DHCP start up –if network contains DHCP server and/or automated configuration setup

2 Easy Rockwell BOOTP/DHCP-Server manipulation allowing TCP object access.

Address setting via the software I/O-ASSISTANT

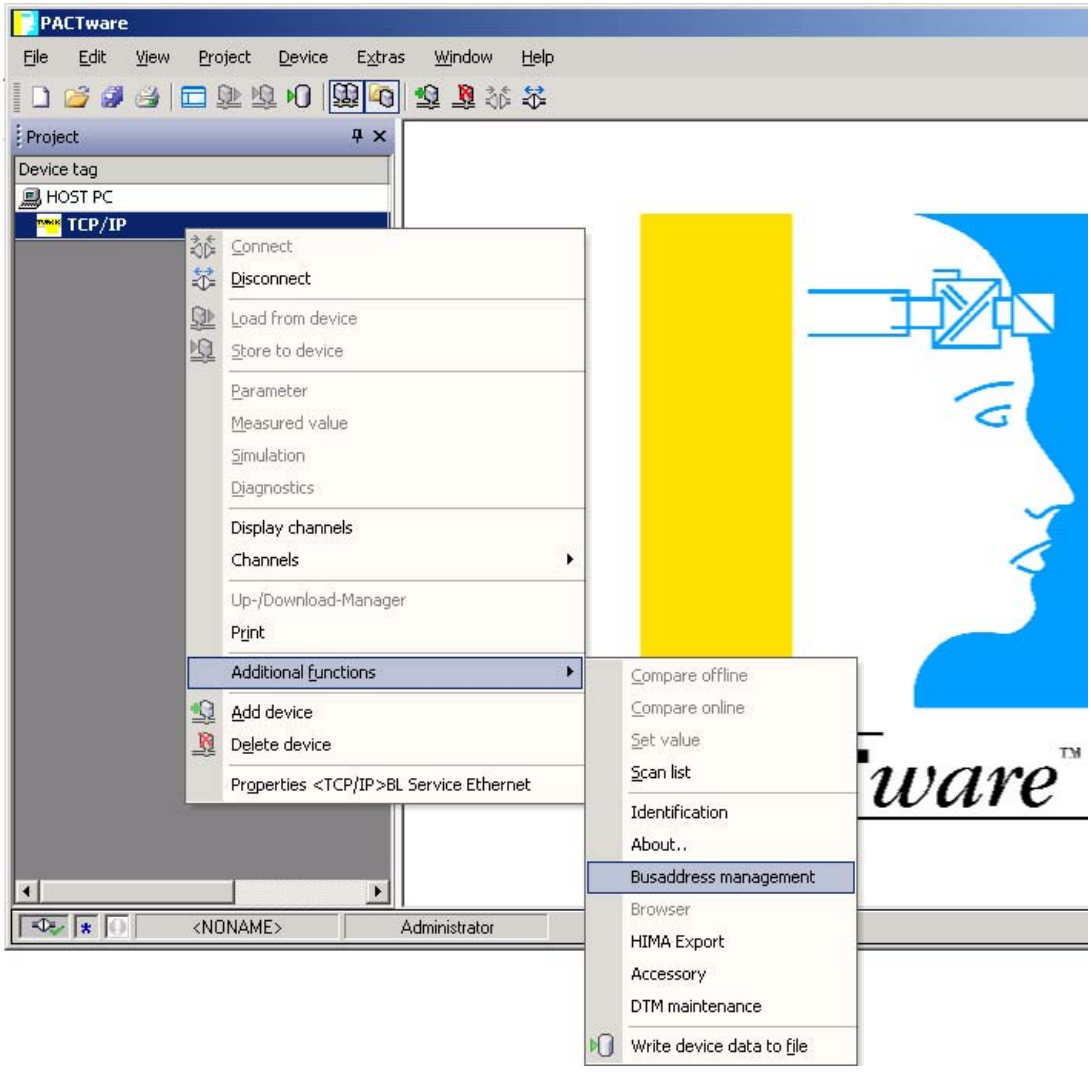
The software-tool I/O-ASSISTANT enables direct access to the Ethernet-network via the fieldbus cable.

Naturally, access to the single station via the service interface at the module is also possible.

The IP address, as well as the subnet mask of the TURCK Ethernet modules, can be changed according to the application by using the Busaddress Management function of the BL Service Ethernet interface in the I/O-ASSISTANT V3.

Changes in the network-configuration are only accepted in the PGM-mode and the PGM-DHCP mode (see page 2-9) of the module (see page 2-8).

Figure 12: Opening the Busaddress management



The network connected to the used network card can be scanned using the “Search“ function of the Busaddress management.

Figure 13: Search the network for nodes

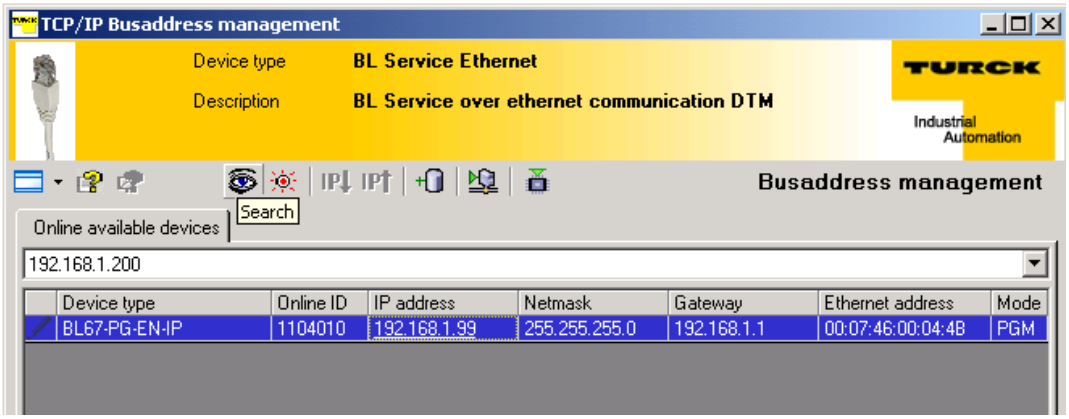
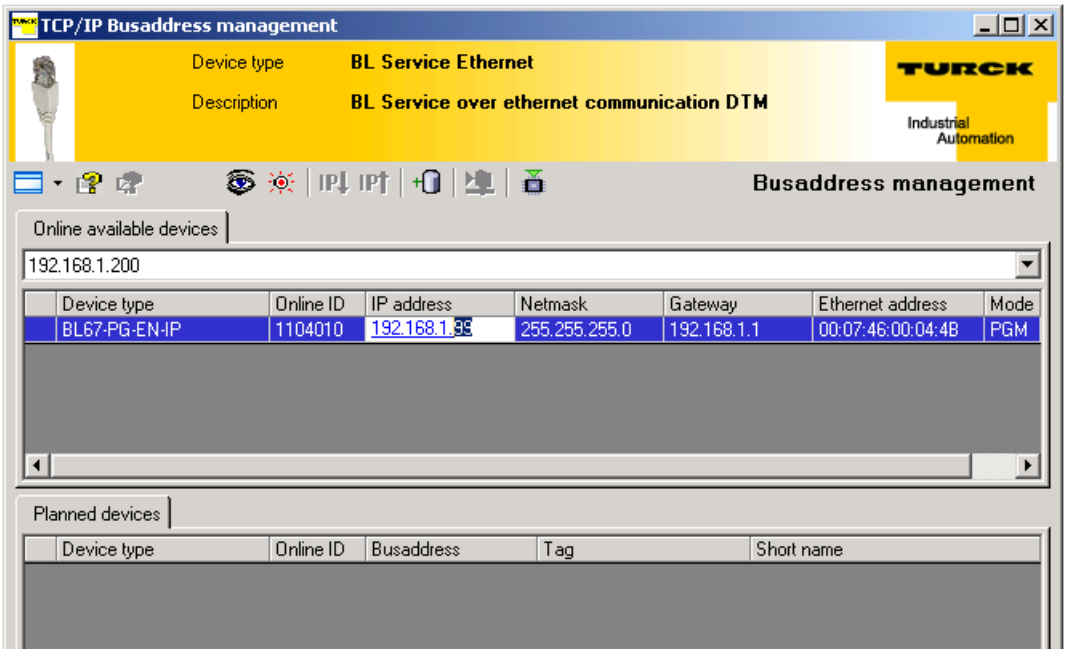


Figure 14: Change the IP address of a node



Attention

Please observe that, if the system integrated Windows-firewall is activated, difficulties may occur during the communication between the module and the Address-tool. The firewall may possibly inhibit the access of the tool on Ethernet.

Note

For further information about the Busaddress management in the software tool I/O-ASSISTANT, please read the online help delivered with the tool.

SET Button

The current configuration of the BL67 EtherNet/IP station is saved as the actual configuration when the SET button on the gateway is pressed for approximately 10 seconds; it is also saved to the both the Temp-Required Configuration Memory and the Required Configuration Memory. The LED "GW" flashes.

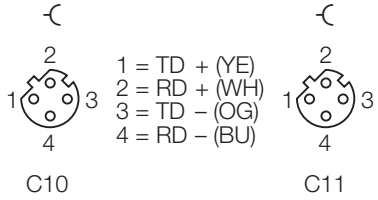
In addition to that, pressing the SET button reads a possible BL remote subnet connected to the gateway (see separate manual D301118).

EtherNet/IP

The connection to EtherNet/IP via the integrated auto-crossing switch is done using 2 M12 x 1-Ethernet-female connectors.

Figure 15: Pin assignment of the M12 x 1-female connectors

Female connector M12 x 1



Operation Voltage/ Load Voltage

The power supply is realized either via a 7/8" or via a M23x1 male connector on the module.

Note

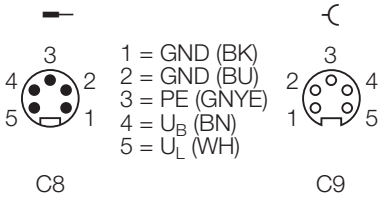
The operation voltage (U_B) and the load voltage (U_L) are fed and monitored seperately. If the voltage falls below the permissible voltage, the outputs are switched off.

U_L can be switched off. In this case, the module still communicated and the inputs are still read in.

In case of an undervoltage at U_L, the "POWER" LED changes from green to red. In case of an undervoltage at U_B, the "POWER" LED is turned off.

Power supply via 7/8'' (FXEN-XSG16-0001-IP)

Figure 16: 7/8''- male and female connector



In-/ and Outputs

The module is equipped throughout with 5-pole metal M12- connectors for connection of the sensor/actuator level.

Note

For the pin assignment of the M12-connectors, please refer to the wiring diagrams in the module specific chapters of this manual.

General Technical Data

Technical Data

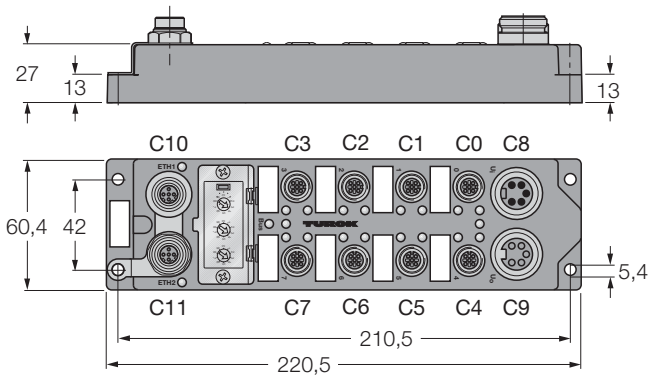
Table 1: Technical data of the FXEN-modules

Power supply	
Operational voltage U_B	18 to 30 V DC
Load voltage U_L	18 to 30 V DC
Internal current consumption (via U_B)	< 200 mA
Connections	nickel-plated brass connectors
PROFINET	2 x female M12 connector (OUT), 4-pole, d-coded
Power supply	7/8” connectors or M23 x 1 connectors
Inputs/outputs	female M12-connectors, 5-pole
Isolation voltages	
U_{BL} (U_B to U_L)	none
U_{ETH} (supply voltage to Ethernet)	500 V AC
U_{IO} (IOs to supply voltage)	none
U_{ETHETH} (ETH1 to ETH 2)	500 V AC
Housing	Fibre-glass reinforced PA6 (PA6-GF30)
Dimensions	60,4 x 220,5 x 27 mm (width x length x height)
Mounting	via 4 through-holes Ø 5.4 mm
Mounting distance module/module	min. ≥ 50 mm **A** Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting).
Degree of protection (IEC 60529/EN 60529)	IP67
Vibration resistance test	acc. to EN 60068-2-6, IEC 68-2-47
Shock resistance test	acc. to EN 60068-2-27
EMC	acc. to EN 61000-6-2, EN 61000-6-4
Temperature range	
– Operating temperature	0 °C to + 55 °C (+ 32 °F to + 131 °F)
– Storage and transport	- 25 °C to + 70 °C (- 13 °F to + 158 °F)

A *In case of low simultaneity factors and low ambient temperatures, mounting distances of < 50 mm may be possible.*

Dimension drawings

Figure 17: Dimensions for the FXEN-modules



LED-Displays

Table 2: LED-displays of the FXEN-modules

LED	Display	Meaning	Remedy
ETHx (blinking during data transfer)	green	Link, 100 Mbps	
	green, flashing	Ethernet Traffic 100 Mbps	
	yellow	Link, 10 Mbps	
	yellow, flashing	Ethernet Traffic 10 Mbps	
	off	No Ethernet link	– Check the Ethernet-connection
U	off	U_B < 18 VDC	– Check the operating voltage
	green	U_B and U_L, within the operating range	–
	red	U_L < 18 VDC	– Check the load voltage –
Cx.0	green	24 V at input/ output	
	red	Overcurrent at output or at sensor supply	
Cx.1	green	24 V at input/ output	
	red	Overcurrent at output or at sensor supply	
BUS	Green	Displays an active CIP Class 1 I/O connection	
	Green, flashing	Gateway is ready for operation	
	Red	Gateway indicates error	
	Red, flashing	DHCP/BootP search of settings	

Diagnostic Messages via the Process Data

Besides the evaluation of diagnostic data via Explicit Messages, FXEN for EtherNet/IP offers the possibility of mapping diagnostic data into the module's process data.

2 different forms of diagnostic data handling are provided:

- Summarized Diagnostics
- Scheduled Diagnostics

Summarized Diagnostics

The summarized diagnostic data mode will send back one bit summarizing any diagnostic message pending at one of the module channels. This bit is "0" if there are no diagnostic flags set on these channels. If there are any diagnostic events on the channels the bit will be set to "1".

Values:

0 = ok

1 = one channel sends diagnostics

The diagnostic bit is placed at the end of the input data. The diagnostic data start WORD aligned (see page 5-13).

Scheduled Diagnostics

The scheduled diagnostic data map is a time sliced data block, which holds diagnostic data of all modules with active diagnostics using a round robin mechanism.

This diagnostic "window" visualizes a specific module diagnostic data for approx. 125 ms and changes over to the next active diagnostics afterwards. This is done automatically by the module.

Word	Byte	Data
0	0	Slot number: Always “1“ if there is any diagnostic message from the I/O-channels of the module.
	1	State of the diagnostic message: bit 5 = 1: diagnostic active All other bits are reserved (acc. to VSC 100, Gateway Class, Attr. 116, page 5-23)
1		Module diagnostics from the module, see each module description.

The scheduled diagnostic data is placed at the end of the input data and after the summarized diagnostic data (see page 5-13).

3 Digital Input Module FXEN-IM16-0001-IP

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FXEN-IM16-0001-IP

The module offers 16 digital inputs for 3-wire-pnp sensors.

Technical Data

Table 3: Technical data FXEN-IM16-000x-IP

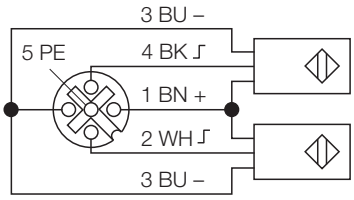
Designation	FXEN-IM16-000x-IP
Inputs (configurable)	(n) 3 wire pnp sensors (n = 0...16)
Supply (via U_B)	24 VDC (18... 30 VDC)
Supply current	< 120 mA per connector, short-circuit protected
Switching threshold OFF/ON	2 mA/4 mA
Switching current limitation	6 mA
Switch-on delay	2,5 ms
Switching frequency	< 250 Hz
Galvanic isolation	galvanic isolation to Ethernet

Note

The general technical data for the FXEN-products can be found in chapter 2.

Wiring Diagram

Figure 18: Wiring diagram



Process Data Mapping

Process input data

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	In7	In6	In5	In4	In3	In2	In1	In0
Byte 1	In15	In14	In13	In12	In11	In10	In 9	In 8

Parameterization

The parameters described in the following are only valid for the I/O-level of the module FXEN-IM16-0001-IP.

Table 4: Parameters

A *Default settings*

Parameter name	Value	Meaning
Module parameters for Slot 0		
The general parameters of the module's EtherNet/IP-level are described in the "Gateway Class (VSC 100)", page 5-23		
Channel parameters for Slot 1		
Digital input x	0 = normal **A**	
	1 = inverted	

Parameter Data Mapping

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
Byte 1	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
Byte 2	Invert7	Invert6	Invert5	Invert4	Invert3	Invert2	Invert1	Invert0
Byte 3	Invert15	Invert14	Invert13	Invert12	Invert11	Invert10	Invert9	Invert8

Diagnostics

Note

For the mapping of diagnostic data into the process data please refer to page 2-17.

Diagnostic Data Mapping

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	ErrSens7	ErrSens6	ErrSens5	ErrSens4	ErrSens3	ErrSens2	ErrSens1	ErrSens0

ErrSensX:

0 = normal operation

1 = Short circuit at sensor supply

4 Configurable I/O-Module FXEN-XSG16-000x-IP

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FXEN-XSG16-000x-IP

The in- and output station FXEN-XSG16-000x is a modular EtherNet/IP-slave in compact housing design.
The module is equipped with sixteen channels, which can be configured differently depending on the specific application requirements. Up to sixteen 2/3 wire pnp sensors or sixteen DC actuators with a maximum output current of 1.4 A per output can be connected.

Technical Data

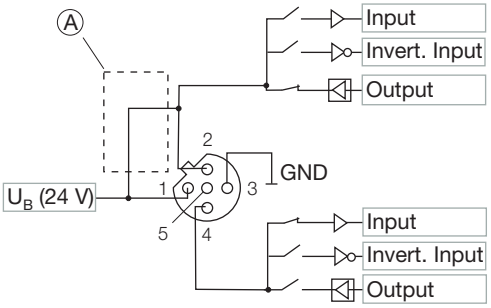
Table 5: Technical data of FXEN-XSG16-000x-IP

Designation	FXEN-XSG16-000x-IP
Inputs (configurable)	(n) 3 wire pnp sensors (n = 0...16)
Supply (via U_B)	24 VDC (18 ... 30 VDC)
Supply current	< 120 mA per connector, short-circuit protected
Switching threshold OFF/ON	2 mA/4 mA
Switching current limitation	6 mA
Switch-on delay	2,5 ms
Switching frequency	< 250 Hz
Galvanic isolation	galvanic isolation to Ethernet
Outputs (configurable)	(16-n) DC actuators (n = 0...16)
Load supply (via U_L)	24 VDC (18 ... 30 VDC)
Output current	1.4 A, short-circuit protected (ON period = 35 %)
Switching frequency	< 250 Hz
Galvanic isolation	galvanic isolation to Ethernet

Note
The general technical data for the FXEN-products can be found in chapter 2.

Block diagram

Figure 19: Block diagram FXEN-XSG16-000x-IP

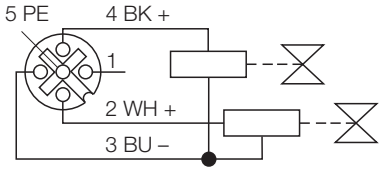


Pin 2 = channel 1, 3, 5 ... (all impair channel numbers)
Pin 4 = channel 0, 2, 4 ... (all pair channel numbers)

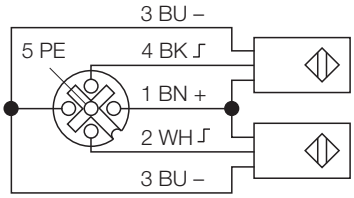
Wiring diagrams

Figure 20: Wiring diagrams

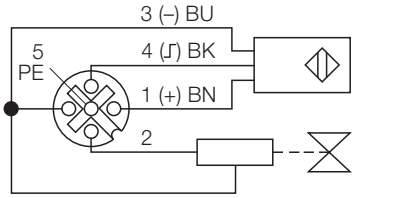
Connection of 2 actuators:

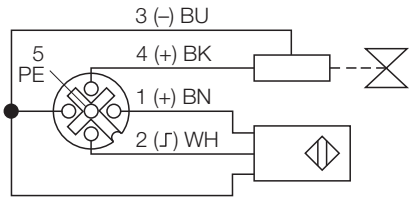


Connection of 2 sensors:



Combinations of sensor and actuator:





Process Data Mapping

Note

Besides the evaluation of diagnostic data via Explicit Messages, FXEN for EtherNet/IP offers the possibility of mapping diagnostic data into the module's process data (please read "Diagnostic Messages via the Process Data", page 2-17).

Process input data

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	In7	In6	In5	In4	In3	In2	In1	In0
Byte 1	In15	In14	In13	In12	In11	In10	In9	In8

Process output data

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Out7	Out6	Out5	Out4	Out3	Out2	Out1	Out0
Byte 1	Out15	Out14	Out13	Out12	Out11	Out10	Out9	Out8

Parameterization

The parameters described in the following are only valid for the I/O-level of the module FXEN-XSG16-000x-IP.

Table 6: Parameters

A *Default-settings*

Parameter name	Value	Meaning
Module parameters for Slot 0		
The general parameters of the module's EtherNet/IP-level are described in the "Gateway Class (VSC 100)", page 5-23		
Channel parameters for Slot 1		
Digital input x (Invertx)	0 = normal **A**	
	1 = inverted	
Output x (OvlModx)	0 = deactivated **A**	
	1 = activated	
Output on overcurrent x (OutEnx)	0 = automatic recovery **A**	
	1 = controlled recovery: The output is manually switched-off and on again.	

Parameter data mapping

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
Byte 1	reserved	reserved	reserved	reserved	reserved	reserved	reserved	reserved
Byte 2	Invert7	Invert6	Invert5	Invert4	Invert3	Invert2	Invert1	Invert0
Byte 3	Invert15	Invert14	Invert13	Invert12	Invert11	Invert10	Invert9	Invert8
Byte 4	OvlMod7	OvlMod6	OvlMod5	OvlMod4	OvlMod3	OvlMod2	OvlMod1	OvlMod0
Byte 5	OvlMod15	OvlMod14	OvlMod13	OvlMod12	OvlMod11	OvlMod10	OvlMod9	OvlMod8
Byte 6	OutEn7	OutEn6	OutEn5	OutEn4	OutEn3	OutEn2	OutEn1	OutEn1
Byte 7	OutEn15	OutEn14	OutEn13	OutEn12	OutEn11	OutEn10	OutEn9	OutEn8

Diagnostics

Note

For the mapping of diagnostic data into the process data please refer to page 2-17.

Diagnostic data mapping

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	ErrSens7	ErrSens6	ErrSens5	ErrSens4	ErrSens3	ErrSens2	ErrSens1	ErrSens0
Byte 1	ErrOut7	ErrOut6	ErrOut5	ErrOut4	ErrOut3	ErrOut2	ErrOut1	ErrOut0
Byte 3	ErrOut15	ErrOut14	ErrOut13	ErrOut12	ErrOut11	ErrOut10	ErrOut9	ErrOut8

ErrOut:

0 = normal operation

1 = Short circuit at output x

ErrSensX:

0 = normal operation

1 = Short circuit at sensor supply

Explicit Messaging via VSC

Note

Please refer to ”Digital Versatile Module Class (VSC117)” page 5-27 for the Vendor Specific Class of FXEN-XSG16-0001-IP.

5 Implementation of EtherNet/IP

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The EtherNet/IP Communications Profile

EtherNet/IP is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices.

Communication between the nodes in the EtherNet/IP network can be carried out either via I/O Messages or Explicit Messages.

I/O Messages

I/O Messages serve to exchange high priority process and application data over the network. Communication between the slaves in the EtherNet/IP network is carried out according to the Server/Client Model, which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit Messages

Explicit Messages are used to transmit low-priority configuration data, general management data or diagnostic data between two specific devices. This is a point-to-point connection in a Server/Client System that requires a request from a client always to be confirmed by a response from the server.

Explicit messages, whether connected or unconnected, use the Message Router (for detailed information, read Abschnitt „Message Router Request/Response Formats“, page 5-8).

- Message Router Request
  Consists of a service code, path size value, a message router path and service data. An EPATH is used in the message router path to indicate the target object.
- Message Router Response
  Consists of a service field with the most significant bit set. This is an echo of the service code in the request message with the most significant bit set. A reserved byte follows the service code, which is followed by the General Status code.

Communications Profile of the FXEN Module

The EtherNet/IP module behaves as an EtherNet/IP Server in the network; the scanner of the higher-level controller operates as a EtherNet/IP Client.

The following EtherNet/IP communications types are supported:

- Point to Point or Multicast
- Cyclic Connection
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

Point to point

A connection that exists between two nodes only.

Multicast

A packet with a special destination address, which multiple nodes on the network may be willing to receive.

COS I/O Connection

COS (Change Of State) I/O Connections establish event-controlled connections. This means that the EtherNet/IP devices generate messages as soon as a change of status occurs.

Cyclic I/O Connection

Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

UCMM

The EtherNet/IP module offers the option of establishing explicit messaging via the UCMM port (Unconnected Message Manager Port).

UCMM-based explicit messaging is normally used for random, non-periodic requests. It is not recommended for frequent messaging because the UCMM input queue in a product is typically limited to just a few messages. Once this limit is reached, subsequent requests are ignored and must be retried.

Connected Explicit messaging

CIP is a connection-based system. For most communications between nodes, a connection is used.

A connection is a path or a virtual circuit between two or more end points in a system. The purpose is to transfer data in the most efficient manner possible.

The Connection ID is a number that is associated with a communication relationship. Receiving nodes decode this key to know whether they must accept the data or not.

Classes and Instances of the EtherNet/IP-module

EtherNet/IP Standard Classes

The FXEN module supports the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Table 7: EtherNet/IP Standard Classes

Class Code	Object-Name	Description
01 (0×01)	„Identity Object (0×01)“	The Identity Object is required on all devices and provides general information about the device. It enables clear and unambiguous identification of modules. Contains information such as manufacturer name, product type, ident number, revision number etc.
02 (0×02)	„Message Router Object (0×02)“	The Message Router Object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.
04 (0×04)	„Assembly Object (0×04)“	The Assembly Object binds attributes of multiple objects, which allows data to or from each object to be sent or received over a single connection. Assembly objects can be used to bind input data or output data. The terms "input" and "output" are defined from the network’s point of view. An input will produce data on the network and an output will consume data from the network.
06 (0×06)	„Connection Manager Object (0×06)“	The Connection Manager Class allocates and manages the internal resources associated with both I/O and Explicit Messaging Connections. The specific instance generated by the Connection Manager Class is referred to as a Connection Instance or a Connection Object.
15 (0×0F)	Parameter Object	currently not supported
244 (0×F4)	„Port Object (0×F4)“	Provides a standard way of describing a device’s ports.
245 (0×F5)	„TCP/IP Interface Object (0×F5)“	Contains the device TCP/IP-related configuration information.
246 (0×F6)	„Ethernet Link Object (0×F6)“	Contains link-specific counters and status information for an Ethernet 802.3 communications interface.

Identity Object (0×01)

The following description of the Identity Object is taken from the CIP specification, Vol. 1, Rev. 2.1, by ODVA & ControlNet International Ltd. and adapted to FXEN.

Class Attributes

Table 8: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
6 (0×06)	MAX CLASS ATTRIBUTE	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	7

Instance Attributes

Table 9: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	VENDOR	G	UINT	Contains the vendor ID, managed by the Open DeviceNet™ Vendor Association, Inc. (ODVA) and ControlNet International (CI): TURCK = 48
2 (0×02)	PRODUCT TYPE	G	UINT	Indicates the general type of product. Communications Adapter 12_{dez} = 0×0C
3 (0×03)	PRODUCT CODE	G	UINT	Identifies a particular product within a device type. Default: 27247
4 (0×04)	REVISION Major Minor	G	STRUCT OF: USINT USINT	Revision of the item the Identity Object is representing. 0x01 0x06
5 (0×05)	DEVICE STATUS	G	WORD	See Table 10: „Device Status”
6 (0×06)	SERIAL NUMBER	G	UDINT	Contains the ident-no. of the product (3 last bytes of the MAC-ID).
7 (0×07)	PRODUCT NAME LENGTH NAME	G	STRUCT OF: USINT STRING [13]	FXEN-XSG16-0001-IP

Device Status

Table 10: Device Status

Bit	Name	Definition
0 to 1	reserved	Default = 0
2	Configured	TRUE → The application of the device has been configured (≠ default-settings).
3	reserved	Default = 0
4 to 7	Extended Device Status	0011 = No I/O connections established 0110 = At least one I/O connection in run mode 0111 = At least one I/O connection established, all in idle mode All other settings = reserved
8 to 15	reserved	Default = 0

Common Services

Table 11: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined listing of this objects attributes.
05 (0x05)	no	yes	Reset Starts the Reset service for the device.
14 (0x0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.
16 (0x10)	no	no	Set_Attribute_Single Modifies a single attribute.

Message Router Object (0×02)

This object provides a messaging connection point through which a Client may address a service to any object class or instance residing in the physical device.

The following description of the Message Router Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FXEN.

Class Attributes

Table 12: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
4 (0×04)	OPTIONAL ATTRIBUTE NUMBER	G	UINT	0
5 (0×05)	OPTIONAL SERVICE NUMBER	G	UINT	0
6 (0×06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	2

Instance Attributes

Table 13: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	OBJECT LIST	G	STRUCT OF	Structure with an array of object class-codes supported by the device.
	NUMBER	G	UINT	Depending
	CLASSES	G	ARRAY of UINT	Number of the classes supported by the module.
2 (0×02)	MAX NUMBER OF CONNECTIONS	G	UINT	Count of the maximum number of connections supported.

Common Services

Table 14: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single

Message Router Request/Response Formats

- Message Router Request Format:

Table 15: Message Router Request

Parameter	Data Type	Description
Service	USINT	Service code of the request.
Request Path Size	USINT	Number of 16 bit words in the "Request Path".
Request Path	Padded EPATH	Array of bytes containing the information for the path of request (class ID, Instance ID, etc.) for this transaction.
Request Data	Array of octed	Additional service specific data to be delivered in the Explicit Messaging Request.

- Message Router Response Format:

Table 16: Message Router Request

Parameter	Data Type	Description
Reply Service	SINT	Reply service code.
General Status	USINT	General Status Code according to CIP specification. See Table 17: „General Status Codes according to CIP spec.”
Size of Additional Status	USINT	Number of 16 bit words in Additional status.
Additional Status	Array of USINT	Additional status.
Response Data	Array of octet	Response data from request or additional error data if an error was indicated in "General Status".

Table 17: General Status Codes according to CIP spec.

Status Code (hex)	Status Name	Description
00	Success	Service successfully performed by the object specified.
01	Connection failure	A connection related service failed along the connection path.
02	Resource unavail-able	Resources needed for the object to perform the requested service were unavailable.
03	Invalid parameter value	See Status Code 0x20, which is the preferred value to use for this condition.
04	Path segment error	The path segment identifier or the segment syntax was not understood by the processing node. Path processing shall stop when a path segment error is encountered.

Table 17: General Status Codes according to CIP spec.

Status Code (hex)	Status Name	Description
05	Path destination unknown	The path is referencing an object class, instance or structure element that is not known or is not contained in the processing node. Path processing shall stop when a path destination unknown error is encountered.
06	Partial transfer	Only part of the expected data was transferred.
07	Connection lost	The messaging connection was lost.
08	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
09	Invalid attribute value	Invalid attribute data detected.
0A	Attribute list error	An attribute in the Get_Attribute_List or Set_Attribute_List response has a non-zero status.
0B	Already in requested mode/state	The object is already in the mode/state being requested by the service.
0C	Object state conflict	The object cannot perform the requested service in its current mode/state.
0D	Object already exists	The requested instance of object to be created already exists.
0E	Attribute not settable	A request to modify a non-modifiable attribute was received.
0F	Privilege violation	A permission/privilege check failed.
10	Device state conflict	The device's current mode/state prohibits the execution of the requested service.
11	Reply data too large	The data to be transmitted in the response buffer is larger than the allocated response buffer.
12	Fragmentation of a primitive value	The service specified an operation that will fragment a primitive data value, i.e. half a REAL data type.
13	Not enough data	The service did not supply enough data to perform the specified operation.
14	Attribute not supported	The attribute specified in the request is not supported.
15	Too much data	The service supplied more data than expected.
16	Object does not exist	The object specified does not exist in the device.
17	Service fragmentation sequence not in progress	The fragmentation sequence for this service is not currently active for this data.

Table 17: General Status Codes according to CIP spec.

Status Code (hex)	Status Name	Description
18	No stored attribute data	The attribute data of this object was not saved prior to the requested service.
19	Store operation failure	The attribute data of this object was not saved due to a failure during the attempt.
1A	Routing failure, request packet too large	The service request packet was too large for transmission on a network in the path to the destination. The routing device was forced to abort the service.
1B	Routing failure, response packet too large	The service response packet was too large for transmission on a network in the path from the destination. The routing device was forced to abort the service.
1C	Missing attribute list entry data	The service did not supply an attribute in a list of attributes that was needed by the service to perform the requested behavior.
1D	Invalid attribute value list	The service is returning the list of attributes supplied with status information for those attributes that were invalid.
1E	Embedded service error	An embedded service resulted in an error.
1F	Vendor specific error	A vendor specific error has been encountered. The Additional Code Field of the Error Response defines the particular error encountered. Use of this General Error Code should only be performed when none of the Error Codes presented in this table or within an Object Class definition accurately reflect the error.
20	Invalid parameter	A parameter associated with the request was invalid. This code is used when a parameter does not meet the requirements of this specification and/or the requirements defined in an Application Object Specification.
21	Write-once value or medium already written	An attempt was made to write to a write-once medium (e.g. WORM drive, PROM) that, has already been written, or to modify a value that cannot be changed once established.
22	Invalid Reply Received	An invalid reply is received (e.g. reply service code does not match the request service code, or reply message is shorter than the minimum expected reply size). This status code can serve for other causes of invalid replies.
23 to 24	Reserved by CIP for future extensions	
25	Key Failure in path	The Key Segment that was included as the first segment in the path does not match the destination module. The object specific status shall indicate which part of the key check failed.

Table 17: General Status Codes according to CIP spec.

Status Code (hex)	Status Name	Description
26	Path Size Invalid	The size of the path which was sent with the Service Request is either not large enough to allow the Request to be routed to an object or too much routing data was included.
27	Unexpected attribute in list	An attempt was made to set an attribute that is not able to be set at this time.
28	Invalid Member ID	The Member ID specified in the request does not exist in the specified Class/Instance/Attribute
29	Member not settable	A request to modify a non-modifiable member was received
2A	Group 2 only server general failure	This error code may only be reported by Group 2 Only servers with 4K or less code space and only in place of Service not supported, Attribute not supported and Attribute not settable.
2B to CF	Reserved by CIP for future extensions	
D0 to FF	Reserved for Object Class and service errors	This range of error codes is to be used to indicate Object Class specific errors. Use of this range should only be performed when none of the Error Codes presented in this table accurately reflect the error that was encountered.

Assembly Object (0×04)

Assembly Objects bind attributes of multiple objects to allow data to or from each object to be sent or received over a single connection.

The following description of the Assembly Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FXEN.

Class Attributes

Table 18: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	2
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	104

Instance Attributes

Table 19: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	NUMBER OF MEMBERS IN LIST	G	UINT	0 (no dynamic)
2 (0×02)	MEMBER LIST	G	ARRAY of STRUCT UINT Packed EPATH	Depends on Instance.
3 (0×03)	DATA	S	ARRAY OF BYTE	
4 (0×04)	SIZE	G	UINT Number of bytes in Attr. 3	256 or variable

Instance 101

Contains the station's input data (static length 256 bytes).

2 Bytes Status information + process data

Instance 102

Contains the station's output data (static length 256 bytes).

2 Bytes Control data + process data

Instance 103 + Instance 104

In- and output assembly instances with variable assembly sizes. The assembly size is precalculated to support the stations I/O-configuration, RFID Command interface configuration, enabled diagnostics, etc.

- input assembly instance: 103
- output assembly instance: 104

The size of each assembly instance can be retrieved through the assembly object, instance 0x67, attribute: 0x04 and can vary between 2 and 496 bytes.

Example:

Table 20: Example

Module	Data width		Ass. Inst. 103	Ass. Inst. 104
	Process input	**Process output**		
FXEN-XSG16-000x-IP (EtherNet/IP-communication)	1 status word	1 control word	**2**	**2**
– I/O-channels (16 in-/ outputs)	1 word	1 word		
FXEN-IM16-000x-IP (EtherNet/IP-communication)	1 status word	1 control word	**2**	**1**
– I/O-channels (16 inputs)	1 word	-		

Common Services

Table 21: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	no	yes	Get_Attribute_Single

Mapping of Process Data

- Mapping with summarized and scheduled diagnotics

Table 22: Mapping of Process Data with summarized and scheduled diagnotics

Produced Data (Word No.)	Input Data
0	Status Word of the module → VSC 100 (64h), Object instance 2, Attr. 109 (6Dh)
1	Input data of module
2	1 bit of summarized diagnostic data (page 2-17) monitoring a diagnosis pending at at least one of the module channels. Can be **enabled**/**disabled** using VSC102, Object Instance 3, attr. 104, page 5-26 ff.
3 to n	Scheduled diagnostic data (page 2-17). Can be **enabled**/ **disabled** using VSC102, Object Instance 3, attr. 105, page 5-26 ff. n = data length for the scheduled diagnostics set according to the properties of the module which is used.
Consumed Data (Word No.)	**Output Data**
0	Control Word of the module
1	Output data of the module

Connection Manager Object (0×06)

This object is used for connection and connectionless communications, including establishing connections across multiple subnets.

The following description of the Connection Manager Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FXEN.

Common Services

Table 23: Common services

Service Code	Class	Instance	Service Name
84 (0x54)	no	yes	FWD_OPEN_CMD (Opens a connection)
78 (0x4E)	no	yes	FWD_CLOSE_CMD (Closes a connection)
82 (0x52)	no	yes	UNCONNECTED_SEND_CMD (Unconnected Send Service. Only originating devices and devices that route between links need to implement).

Port Object (0×F4)

The following description of the Port Object is taken from the CIP specification, Vol. 1, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FXEN.

Class Attributes

Table 24: Class attributes

Attr. No.	Attribute Name	**G**et/ **S**et	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
8 (0×08)	ENTRY PORT	G	UINT	1
9 (0×09)	ALL PORTS	G	ARRAY of STRUCT UINT UINT	0,0 for class 4,2 for TCP_IP_PORT

Instance Attributes

Table 25: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	ATTRIBUTE PORT TYPE	G	UINT	4 for TCP_IP_PORT
2 (0×02)	ATTRIBUTE PORT NUMBER	G	UINT	2
3 (0×03)	ATTRIBUTE PORT OBJECT	G	UINT EPATH Logical path	2 0x12, 0x02 0x00, 0x00

Common Services

Table 26: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single

TCP/IP Interface Object (0×F5)

The following description of the TCP/IP Interface Object is taken from the CIP specification, Vol. 2, Rev. 1.1 and adapted to FXEN.

Class Attributes

Table 27: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
6 (0×06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance Attributes

Table 28: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	STATUS	G	DWORD	Interface status (see page 5-17)
2 (0×02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag (see page 5-17)
3 (0×03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag (see page 5-17)
4 (0×04)	PHYSICAL LINK OBJECT	G	STRUCT	
	Path size		UINT	Number of 16bit words: 0×02
	Path		Padded EPATH	0×20, 0×F6, 0×24, 0×01
5 (0×05)	INTERFACE CONFIGURATION	G	Structure of:	TCP/IP Network Interface Configuration (see page 5-17)
	IP ADDRESS	G	UDINT	Current IP address
	NETWORK MASK	G	UDINT	Current network mask
	GATEWAY ADDRESS	G	UDINT	Current default gateway
	NAME SERVER	G	UDINT	0 = no name server address configured
	NAME SERVER 2		UDINT	0 = no secondary name server address configured
5 (0×05)	DOMAIN NAME	G	UDINT	0 = no Domain Name configured
6 (0×06)	HOST NAME	G	STRING	0 = no Host Name configured (see page 5-18)

Common Services

Table 29: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
02 (0x02)	no	no	Set_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
16 (0×10)	no	yes	Set_Attribute_Single

Interface Status

The Status attribute indicates the status of the TCP/IP network interface.
Refer to the state diagram, Figure 21: „TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)" for a description of object states as they relate to the Status attribute.

Table 30: Interface Status

Bit(s)	Name	Definition
0-3	Interface Configuration Status	Indicates the status of the Interface Configuration attribute: 0 = The Interface Configuration attribute has not been configured 1 = The Interface Configuration attribute contains valid configuration. 2 to 15 = Reserved
4 to 31	reserved	

Configuration Capability

The Configuration Capability indicates the device's support for optional network configuration capability.

Table 31: Configuration Capability

Bit(s)	Name	Definition	Value
0	BOOTP Client	The device is capable of obtaining its network configuration via BOOTP.	1
1	DNS Client	The device is capable of resolving host names by querying a DNS server.	0
2	DHCP Client	The device is capable of obtaining its network configuration via DHCP.	1

Configuration Control

The Configuration Control attribute is used to control network configuration options.

Table 32: Configuration Control

Bit(s)	Name	Definition
0-3	Startup Configuration	Determines how the device shall obtain its initial configuration at start-up. 0 = The device shall use the interface configuration values previously stored (for example, in non-volatile memory or via hardware switches, etc). 1 to 3 = reserved
4	DNS Enable	Always 0.
5-31	Reserved	Set to 0.

Interface Configuration

This attribute contains the configuration parameters required to operate as a TCP/IP node.

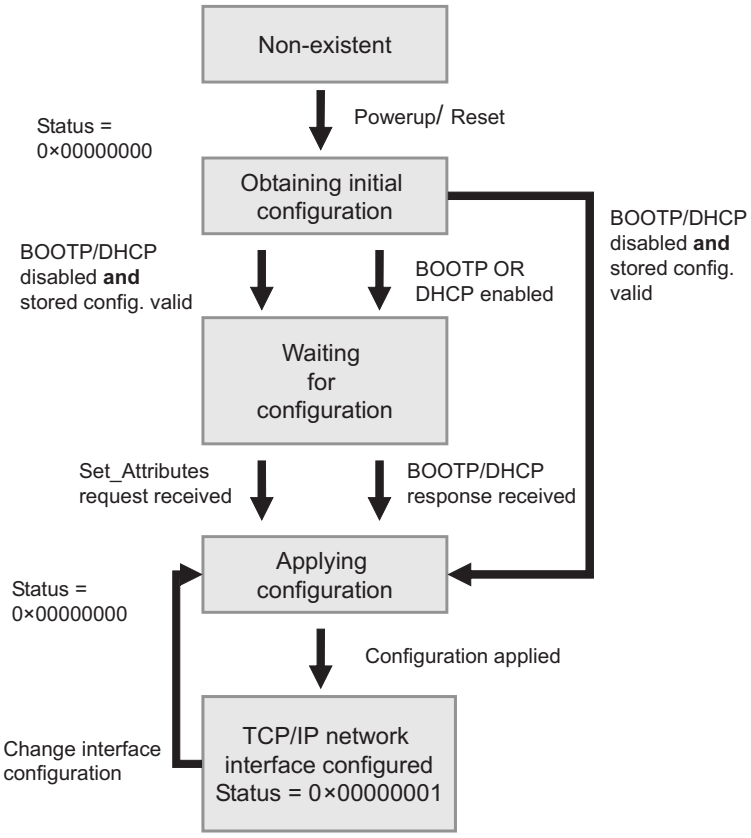
To modify the Interface Configuration attribute, get the Interface Configuration attribute first, change the desired parameters, then set the attribute.
The TCP/IP Interface Object applies the new configuration upon completion of the Set service. If the value of the Startup Configuration bits (Configuration Control attribute) is 0, the new configuration is stored in non-volatile memory.
The device does not reply to the set service until the values are safely stored to non-volatile memory.
An attempt to set any of the components of the Interface Configuration attribute to invalid values results in an error (status code 0x09) returned from the Set service.
If initial configuration is obtained via BOOTP or DHCP, the Interface Configuration attribute components are all zeros until the BOOTP or DHCP reply is received.
Upon receipt of the BOOTP or DHCP reply, the Interface Configuration attribute shows the configuration obtained via BOOTP/DHCP.

Host Name

The Host Name attribute contains the device's host name.

The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up.
The mechanism allows the DHCP client to transmit its host name to the DHCP server. The DHCP server then updates the DNS records on behalf of the client. The host name attribute does not need to be set for the device to operate normally. The value of the Host Name attribute, if it is configured, is used for the value of the FQDN option in the DHCP request. If the Host Name attribute has not been configured, then the device shall not include the FQDN option in the DHCP request.

Figure 21: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)



Ethernet Link Object (0×F6)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 1.1 by ODVA & ControlNet International Ltd. and adapted to FXEN.

Class Attributes

Table 33: Class attributes

Attr. No.	Attribute Name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1
2 (0×02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0×03)	NUMBER OF INSTANCES	G	UINT	1
6 (0×06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0×07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance Attributes

Table 34: Instance attributes

Attr. No.	Attribute Name	Get/ Set	Type	Description
1 (0×01)	INTERFACE SPEED	G	UDINT	Speed in megabits per second (e.g., 10, 100, 1000, etc.)
2 (0×02)	INTERFACE FLAGS	G	DWORD	see Table 35: „Interface flags”
3 (0×03)	PHYSICAL ADDRESS	G	ARRAY OF USINT	Contains the interface’s MAC address (TURCK: 00:07:46:××:××:××)

Table 35: Interface flags

Bits	Name	Definition	Default-Value
0	Link Status	Indicates whether or not the Ethernet 802.3 communications interface is connected to an active network. 0 = inactive link 1 = active link.	Depends on application
1	Half / Full Duplex	0 = half duplex; 1 = full duplex If the Link Status flag is 0, the value of the Half/Full Duplex flag is indeterminate.	Depends on application

Table 35: Interface flags

Bits	Name	Definition	Default-Value
2 to 4	Negotiation Status	Indicates the status of link auto-negotiations. 0 = Auto-negotiation in progress 1 = Auto-negotiation and speed detection failed. Using default values for speed and duplex (10Mbps/half duplex). 2 = Auto negotiation failed but detected speed (default: half duplex). 3 = Successfully negotiated speed and duplex. 4 = Auto-negotiation not attempted. Forced speed and duplex.	Depends on application
5	Manual Setting Requires Reset	0 = interface can activate changes to link parameters (auto-negotiate, duplex mode, interface speed) automatically 1 = device requires a Reset service to be issued to its Identity Object in order to adapt the changes	0
6	Local Hardware Fault	0 = interface detects no local hardware fault 1 = a local hardware fault is detected	0

Common Services

Table 36: Common services

Service Code	Class	Instance	Service Name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
76 (0×4C)	no	yes	Enetlink_Get_and_Clear

VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the FXEN gateway for EtherNet/IP supports the below vendor specific classes.

The VSC describing the possible DeviceNet™-master function (VSC 122 and VSC 123) of an EtherNet/IP gateway can be found in a separate manual (D301118).

It is possible to gain read (**G**= Get) and/or write (**S**= Set) access to the attributes of classes described in the following VSC-Vendor Specific Classes

Table 37: VSC-Vendor Specific Classes

Class Code dec. (hex.)	**Name**	**Description**
100 (64h)	Gateway Class	Contains data and settings concerning the gateway and the BL20 system as a whole.
102 (66h)	Process Data Class	Contains process data
117	Digital Versatile Module Class	Describes for example modules of the type BL20-4DI-NAMUR

Class Instance of the VSC

Note

The Class Instance attributes are the same for each Vendor Specific Class.

The class-specific Object Instances and the corresponding attributes are explained in the paragraphs for the different VSC.

The general VSC - Class Instance attributes are defined as follows:.

Table 38: Class instance

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	Class revision	G	UINT	States the revision number of the class (Maj. Rel. *1000 + Min. Rel.).
101 (65h)	Max. instance	G	USINT	Contains the number of the highest instance of an object created on this level in the class hierarchy.
102 (66h)	# of instances	G	USINT	Contains the number of Object Instances created in this class.
103 (67h)	Max. class attribute	G	USINT	Contains the number of the last Class Attribute to be implemented.

Gateway Class (VSC 100)

This class contains all information which refers to the whole module not to the different I/O channels.

Class Instance

Note

Please refer to paragraph "Class Instance of the VSC", page 9-6, for the description of the class instance for the VSC.

Object Instance 1

Table 39: Object instance 1, Boot instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented
101 (65h)	Hardware revision	G	STRUCT	Contains the hardware revision number of the gateway (USINT Maj./USINT Min.)
102 (66h)	Firmware revision	G	STRUCT	Contains the revision number of the Boot Firmware for DeviceNet™ (Maj./Min.).
103 (67h)	Service tool ident number	G	UDINT	Contains the BOOT ID number that serves as an identification number for the software I/O-ASSISTANT
104 (68h)	Hardware info	G	STRUCT	Contains gateway hardware information (UINT): – count (number of the following entries) – CLOCK FREQUENCY (kHz) – MAIN FLASH (in kB) – MAIN FLASH SPEED (ns) – SECOND FLASH (kB) – RAM (kB), – RAM SPEED (ns), – RAM data WIDTH (bit), – SERIAL EEPRPOM (kbit) – RTC SUPPORT (in #) – AUTO SERVICE BSL SUPPORT (BOOL) – HDW SYSTEM

Object Instance 2

Table 40: Object Instance 2, Gateway Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (6Dh)	Status register 2	G	STRUCT	The Status Word contains general module status information: **Gateway** – Bit 15: "I/O Controller Error" The communication controller for the I/O-system is faulty. – Bit 14: "Force Mode Active Error" The Force Mode is activated. – Bit 13: reserved – Bit 12: reserved **Module bus** – Bit 11: "I/O Cfg Modified Error" The I/O-configuration has been changed and is now incompatible. – Bit 10: "I/O Communication Lost Error" No communication on the I/O module bus. **Voltage errors** – Bit 09: "U_{sys} too low" System supply voltage too low (< 18 VDC). – Bit 08: "U_{sys} too high" System supply voltage too high (> 30 VDC). – Bit 07: "U_L too low" Load voltage too low (< 18 VDC). – Bit 06: "U_L too high" Load voltage too high (> 30 VDC) – Bit 05: "I_{sys} too high" Overload of the system voltage supply. – Bit 04: reserved **Warnings** – Bit 03: "I/O Cfg Modified Warning" – Bit 02: reserved – Bit 01: reserved – Bit 00: "I/O Diags Active Warning" At least one I/O-module sends active diagnostics.
116 (74h)	Module diag summary	G	ARRAY OF STRUCT	Contains the diagnostic information of all modules ARRAY OF STRUCT: USINT SLOT #: Indicates the slot number (module position) with diagnostic messages. BYTE SLOT FLAGS: Offers slot-related information. Bit 7 = 1 module missing Bit 6 = 1 wrong module plugged DWORD Diag: Contains the module diagnostic information. Module diagnostic bits that are not used are indicated by a "0".

Process Data Class (VSC102)

This class contains the process-relevant information.

Class Instance

Note

Please refer to paragraph "Class Instance of the VSC", page 5-22, for the description of the class instances for VSC.

Object Instance 1, standard input process data (compressed)

Tabelle 41: Object instance 1, standard input process data (compressed)

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	Attribute list	G	ARRAY OF USINT	List of all attributes that are supported by this Instance.
102 (66h)	Standard packed process input data	G	ARRAY OF WORD	Input process data, 16-bit aligned, compressed.
103 (67h)	Process data byte count	G	USINT	The number of bytes that are exchanged with this Instance.

Object Instance 2, standard output process data (compressed)

Tabelle 42: Object instance 2, standard output process data (compressed)

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	Attribute list	G	ARRAY OF USINT	List of all attributes that are supported by this Instance.
102 (66h)	Standard packed process output data	G/S	ARRAY OF WORD	Output process data, 16-bit aligned, compressed.
103 (67h)	Process data byte count	G	USINT	The number of bytes that are exchanged with this Instance.

Object Instance 3, diagnostic instance

Tabelle 43: Object Instance 3, diagnostic instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
104 (68h)	GW summarized diagnostics	G/S	BOOL	0 = disabled 1 = enabled: 1 bit of diagnosis mapped at the end of the input data image (page 2-17). Changes become valid after a start-up!
105 (69h)	GW scheduled diagnostics	G/S	BOOL	0 = disabled 1 = enabled: time sliced data block using a round robin mechanism (page 2-17). Changes become valid after a start-up!
106 (6Ah)	reserved			
107 (6Bh)	I-MAP summarized diags	G	USINT	Contains the number of summarized diagnostic bytes. Changes become valid after a start-up!
108 (6Ch)	I-MAP scheduled diags	G	USINT	Contains the number of scheduled diagnostics bytes. Changes become valid after a start-up!

Object Instance 4, COS/CYCLIC instance

Tabelle 44: Object Instance 4, COS/CYCLIC instance

Attr. No. dec. (hex.)	Attribute name	**G**et/ **S**et	Type	Description
104 (68h)	COS data mapping	G/S	ENUM USINT	The actual data are loaded to the non-volatile memory of the module. Changes become valid after a start-up! 0 = standard: Data of COS message → Data of polled produced message (input data). 1 = process input data (only the process data input image is transferred to scanner) 2 to 7: reserved

Digital Versatile Module Class (VSC117)

This class contains all information and parameters for the module's digital I/O channels.

Attention

In this class, chosen parameter options can only be deactivated by activating another option of this parameter.

Oject Instance

Table 45: Object instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	reserved			
102 (66h)	reserved			
103 (67h)	Module ID	G	DWORD	Contains the module ID.
104 (68h)	Module order number	G	UDINT	Contains the ident number of the module.
105 (69h)	Module order name	G	SHORT STRING	Contains the name of the module.
106 (6Ah)	Module revision	G	USINT	Contains the revision number of the module firmware.
107 (6Bh)	Module type ID	G	ENUM USINT	Describes the module type: 0×01: digital module
108 (6Ch)	Module command interface	G/S	ARRAY	The control interface of the module. ARRAY OF: BYTE: Control byte sequence
109 (6Dh)	Module response interface	G	ARRAY	Response interface of the module. ARRAY OF: BYTE: Response byte sequence
110 (6Eh)	Module registered Index	G	ENUM USINT	Contains the index numbers specified in all the module lists.
111 (6Fh)	Module input channel count	G	USINT	Contains the number of input channels supported by the module.
112 (70h)	Module output Channel count	G	USINT	Contains the number of output channels supported by the module.
Input data				
113 (71h)	Module input_1	G	DWORD	Input data of the module (according to channels).

Table 45: Object instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
Output data				
115 (73h)	Module output_1	G	DWORD	Output data of the module (according to channels).
Diagnosis data				
119 (77h)	Short circuit output error_1	G	DWORD	This attribute contains diagnosis information about output short-circuits (according to channels).
121 (79h)	Short circuit sensor error_1	G	DWORD	This attribute contains diagnosis information about sensor short-circuits (according to channels).
Parameter data				
127 (7Fh)	Invert input data_1	G/S	DWORD	The input signal is inverted (channel 1 to 16).
129 (81h)	Invert output data_1	G/S	DWORD	The output signal is inverted (channel 1 to 16).
133 (84h)	Auto recovery output_1	G/S	DWORD	The outputs switch on automatically after an overload.
137 (88h)	Retriggered recovery output_1	G/S	DWORD	The outputs (channel 1 to 16) have to be retriggered in case of an overload.
139 (8Ah)	Enable high side output driver_1	G/S	DWORD	Enables the high side output driver of channels (channel 1 to 16).

6 Application Example: FXEN at an Allen Bradley PLC

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General

The following example shows detailed information about the connection of a FXEN station for EtherNet/IP to an Allen Bradley PLC.

Prerequisites for this example

In order to configure BL20 devices and to build up communications with the Allen Bradley ControlLogix PLC over EtherNet/IP, the following software tools and hardware devices are necessary.

Software:

- RSLinX - used to establish communication over EtherNet/IP
- RSLogix 5000 - used to configure the controller and the other network hosts

Hardware used in this example:

- Allen Bradley PLC 1756-L55/ A 1756-M12/A LOGIX5555
- Ethernet Bridge 1756-ENBT/A
- FXEN-XSG16-000x-IP with EtherNet/IP protocol

Network configuration

The FXEN-modules are delivered with the IP address **192.168.1.1**.

Note

In order to build up the communication between the FXEN and a PLC/ PC or a network interface card, both devices have to be hosts in the same network.

To achieve this, you have whether

- to adjust the gateway's IP address via BootP, DHCP etc. for integrating it into your own network (for detailed information about the different possibilities for address setting, please read, chapter 2, "Address Setting for EtherNet/IP", page 2-4.

  or

- to change the IP address of the used PC or network interface card (for detailed information, please read the following section "Changing the IP address of a PC/network interface card", page 6-4).

Changing the IP address of a PC/network interface card

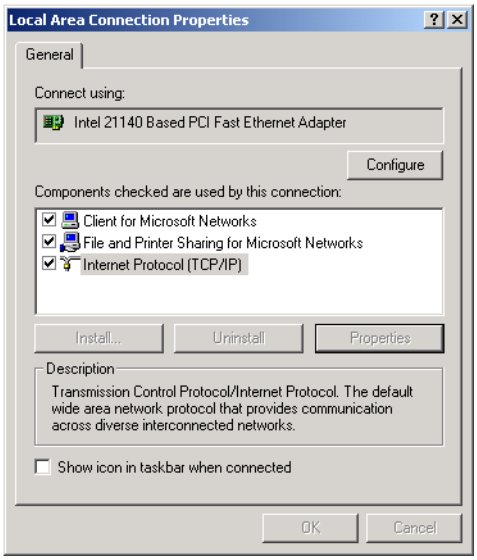
Changing the IP address in Windows 2000/ Windows XP

The IP address is changed in the "Control Panel" in "Network and Dial-up Connections":

1 Open the folder "Local Area Connection" and open the dialog "Local Area Connection Properties" via the button "Properties" in the dialog "Local Area Connection Status".

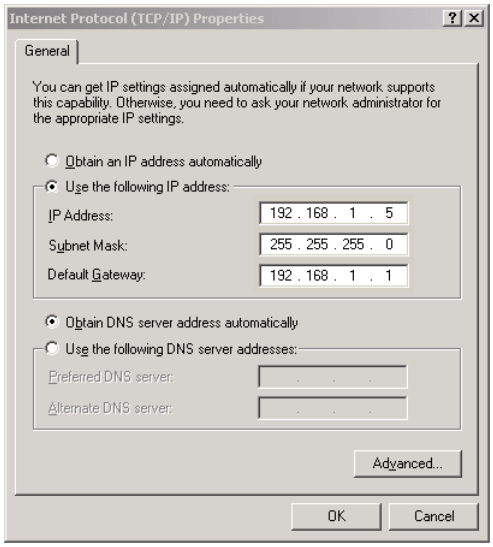
2 Mark "Internet Protocol (TCP/IP)" and press the "Properties"-button to open the dialog "Internet Protocol (TCP/IP) Properties".

Figure 22: Local Area Connection Properties



3 Activate "Use the following IP address" and assign an IP address of the network mentioned above to the PC/ Network interface card (see the following figure).

Figure 23: Changing the PC's IP address

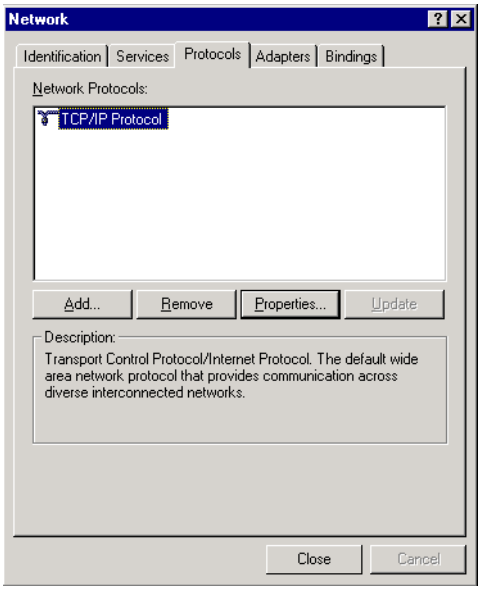


Changing the IP address in Windows NT

1 Open the folder "Network" in the Control Panel.

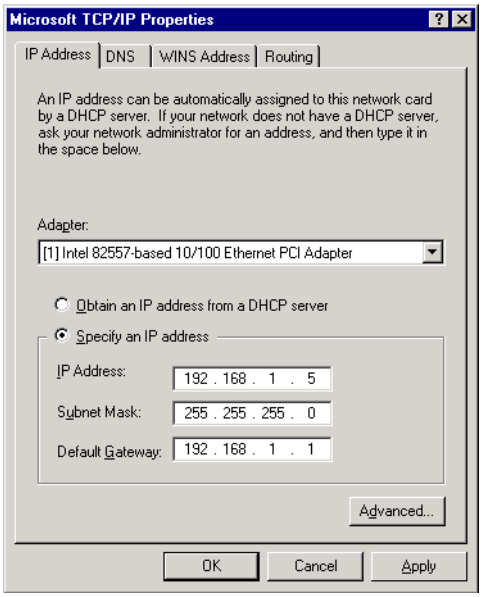
2 Activate TCP/IP connection in the tab "Protocols" and click the "Properties" button.

Figure 24: Network configuration WIN NT



3 Activate "Specify IP address " and set the address as follows.

Figure 25: Specify IP address

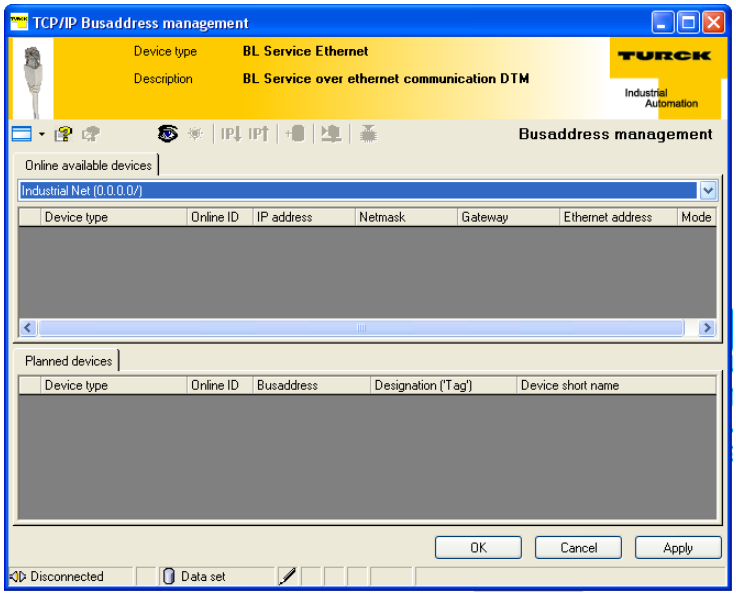


Changing the IP address via I/O-ASSISTANT V3

The Busaddress Management DTM in the software I/O-ASSISTANT offers the possibility to browse the whole Ethernet network for connected nodes and to change their IP address as well as the subnet mask according to the application.

Select the used network card under "Online available devices" and browse the connected network by pressing the search button.

Figure 26: Busaddress Management in the I/O-ASSISTANT



Attention

If Windows XP is used as operating system, problems with the system internal firewall may occur.

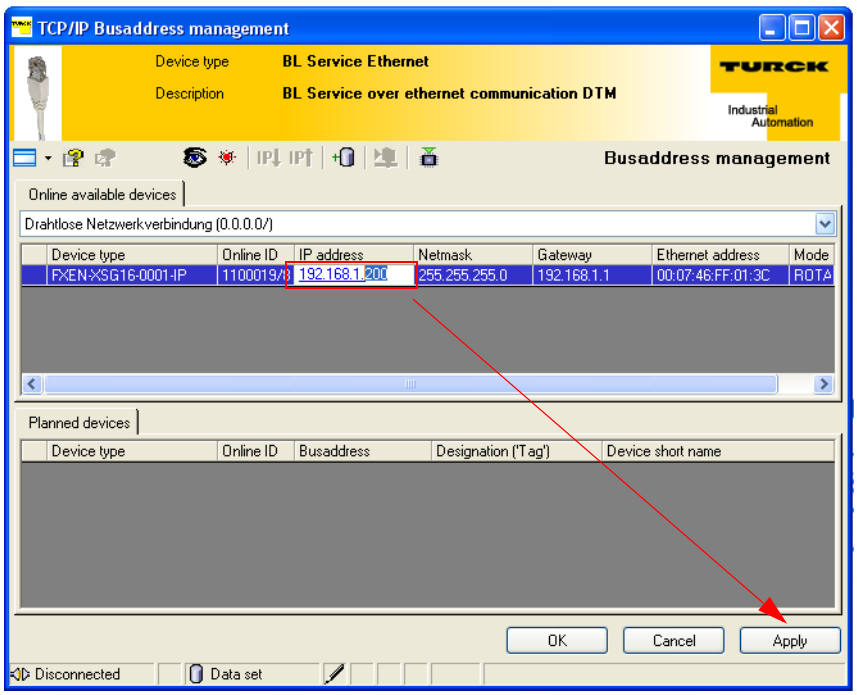
It may eventually inhibit the access of the I/O-ASSISTANT to the Ethernet. Please adapt your firewall settings accordingly or deactivate it completely (see also ”Deactivating/adapting the firewall in Windows XP”, page 6-8).

The network is browsed for connected nodes which are then listed in the Busaddress Management.

It is now possible to change the address settings for all nodes in the list or only for the selected one.

Mark the selected node, enter a new IP address and apply this address by confirming the changes using the "Apply" button.

Figure 27: Address changing for selected nodes



Note

For further information about the I/O-ASSISTANT, it's functions and it's handling, please read the online help of the software.

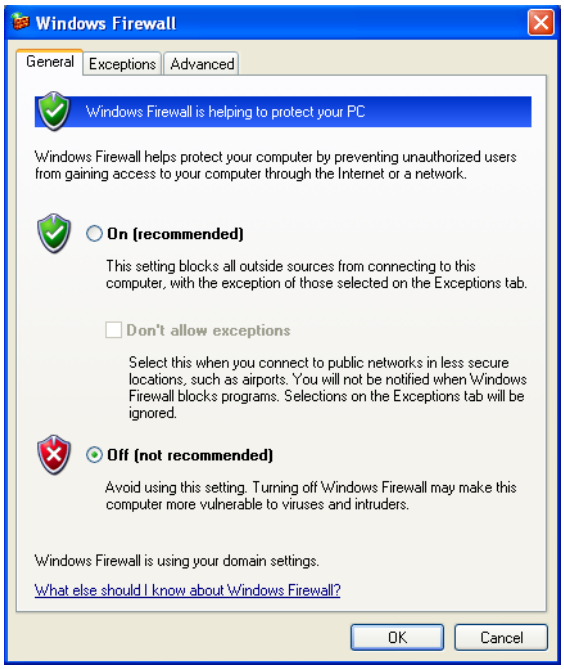
Deactivating/adapting the firewall in Windows XP

If you use Windows XP as operating system, problems may occur when changing the IP addresses via the I/O-ASSISTANT.

In this case, you can deactivate the system integrated Windows XP firewall completely or adapt it to your application.

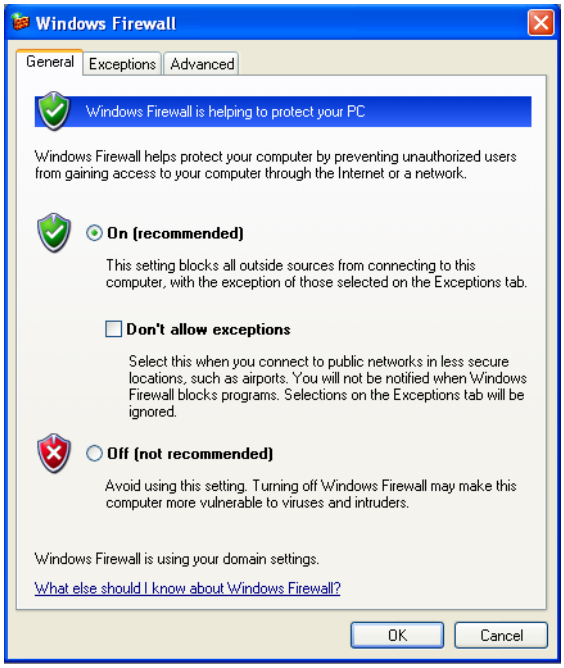
- **Deactivating the firewall**
  Open the "Windows Firewall" dialog in the control panel of your PC and deactivate it as follows:

Figure 28: Deactivating the Windows firewall



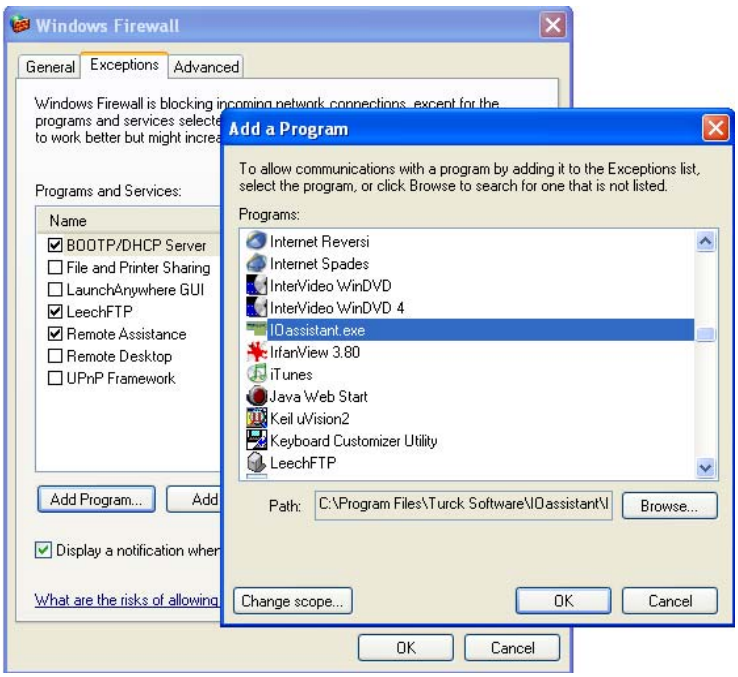
- **Adapting the firewall**
  The firewall remains active, the option "Don't allow exceptions" it deactivated:

Figure 29: Activating the Windows firewall



- In the "Exceptions"-tab, add the I/O-ASSISTANT to "Programs and Services".
- Pressing the button "Add Program..." opens the dialog "Add a Program". Select the I/O-ASSISTANT from the list of installed programs.
- If necessary, use the button "Browse..." to choose the file "IOassistant.exe" from the installation directory of the software.

Figure 30: "Exceptions"-tab



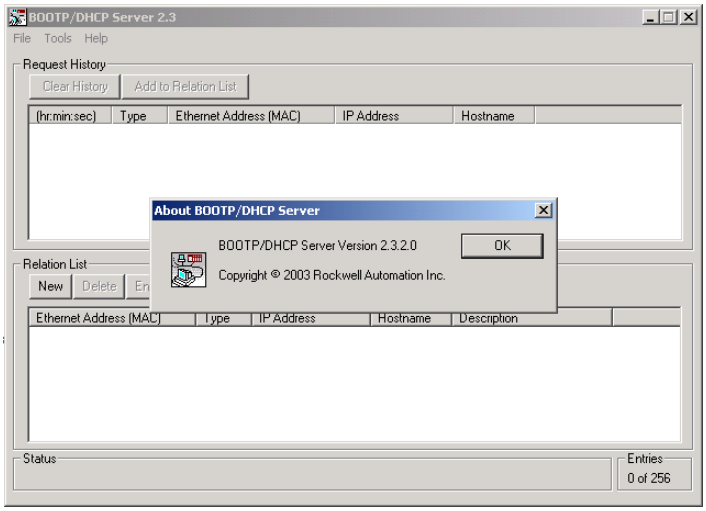
- Despite an active firewall, the I/O-ASSISTANT is now able to browse the network for hosts and the address changing via the software is possible for the connected nodes.

Address setting at the gateway

Address setting via DHCP-mode

In this application example, the IP address is set via DHCP using the software tool "BootP/DHCP-Server" version 2.3.2.0 from Rockwell Automation.

Figure 31: BootP-Server from Rockwell Automation



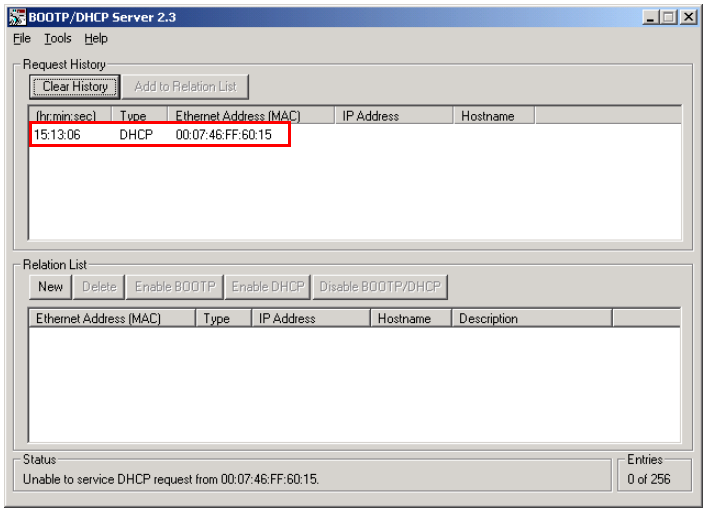
Addresses in the range from 1 to 254 can be allocated. The addresses 0 and 255 are reserved for broadcast messages in the subnet.

Note

The rotary coding switches on the gateway must be set to "400" in order to enable the DHCP-Mode.

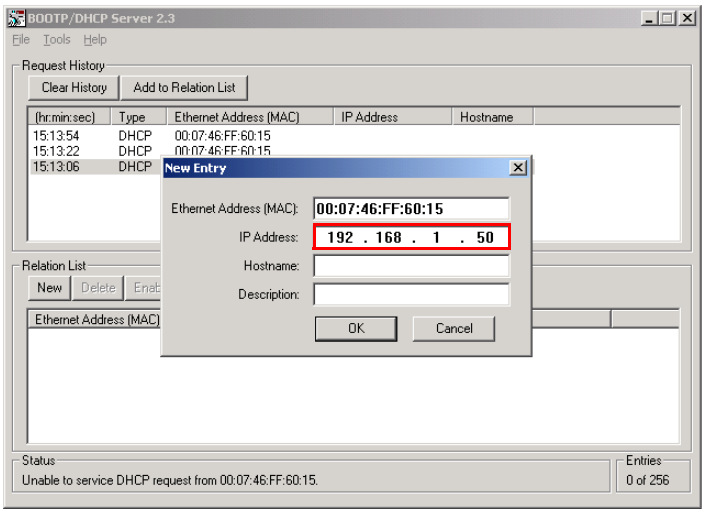
After having been connected to the network, the BL20 sends DHCP requests to the server using its MAC-ID.

Figure 32: DHCP-request of BL20 gateway



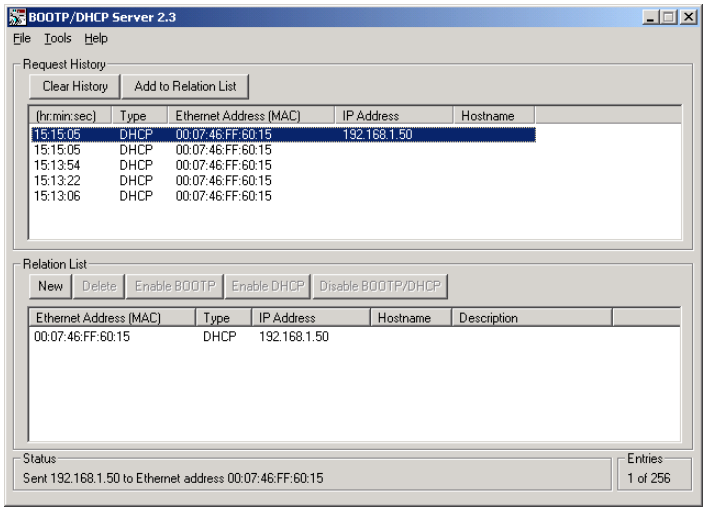
A double click on the request-entry opens the "New Entry" dialog box in which an IP address can be assigned to the module's MAC-ID.

Figure 33: Setting the IP address via DHCP



The BootP/DHCP-Server sends the IP Address via BootP/DHCP to the module and, after a few seconds, the module answers with its new IP address when having stored it.

Figure 34: Setting the IP address via DHCP



The "Relation list" can be stored for further applications. It can serve for permanent assignment of defined IP addresses to MAC-IDs/ modules.

Attention

If the BootP/DHCP-server is shut down, the FXEN modulen loses the IP address after a power reset!

Setting-up communications with the software tool "RSLinx"

Before the EtherNet/IP network can be configured, access to EtherNet/IP must be established using the software "RSLinx" (version 2.43.01) from Rockwell Automation.

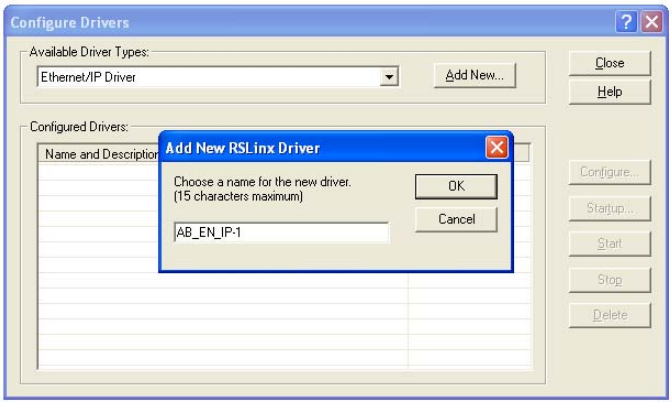
The following example explains the creation of a connection via the Allen Bradley EtherNet/IP interface.

The selection of the EtherNet/IP Driver module is done using the "Communications → Configure Drivers" command.

Select the driver type category "EtherNet/IP Driver".

Once the driver type has been selected, click the "Add new" button and choose a name for the new EtherNet/IP Driver.

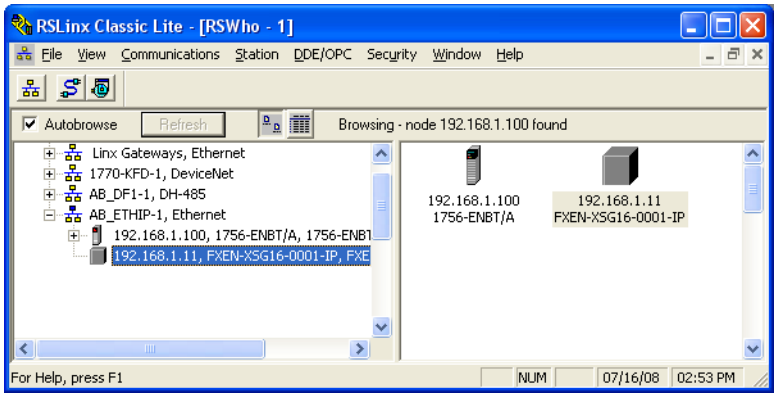
Figure 35: Selecting the EtherNet/IP Driver module



The connection to EtherNet/IP is established following successful configuration driver.

In RSLinx, the "Autobrowse" function can be used to scan the network. All hosts in the network, which is defined by the settings of your network card, will be found.

Figure 36: Scanning the EtherNet/IP network via RSWho



Configuration of the network in "RSLogiX 5000"

The EtherNet/IP hosts (PLC, EtherNet/IP interface, I/O modules) have to be configured using the software "RSLogix 5000" (in this example version 15) from Rockwell Automation.

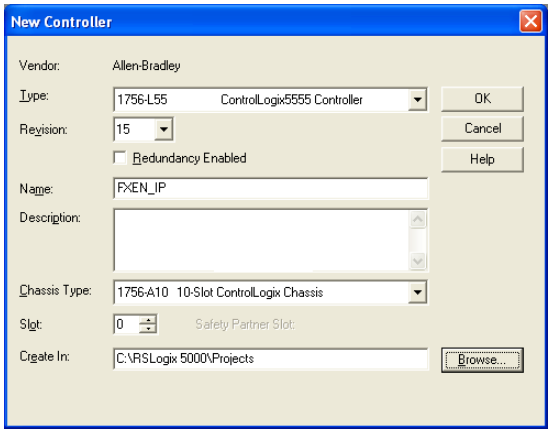
Start RSLogix and open a new project using the "File" menu.

Figure 37: Creating a new project in RSLogix

Configuration of the controller

Enter the information related to the controller depending on your configuration, as well as a name for the project.

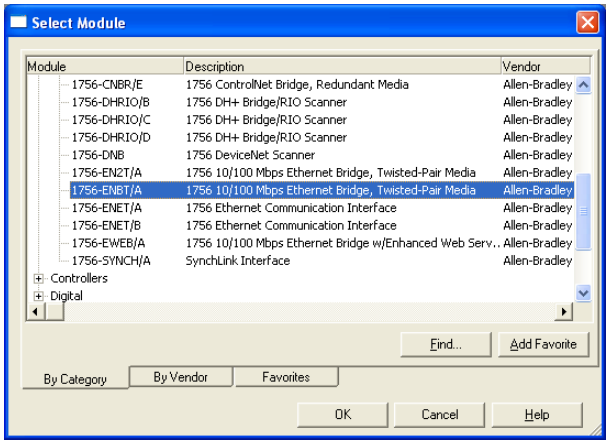
Figure 38: Configuration of the controller



Your project will be opened offline. In order to configure the network, please right-click "I/O Configuration" and select "new Module" to add the first host, the EtherNet/IP bridge, to the network.

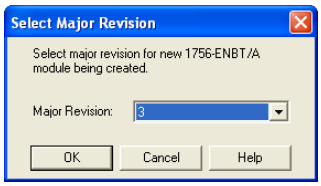
Open "Communications" and select the bridge. In this example this would be 1756-ENBT/A.

Figure 39: Selection of the EtherNet/IP bridge



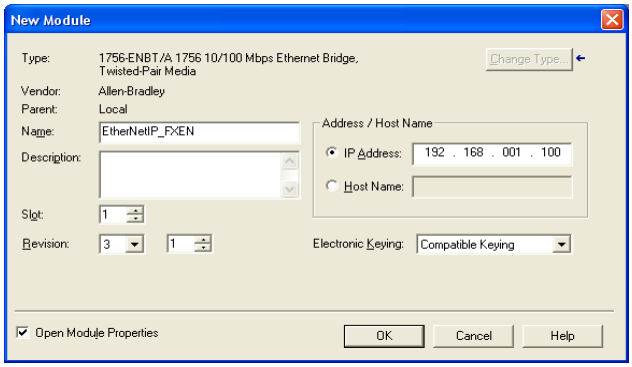
Enter the "Major Revision" of your EtherNet/IP bridge and click "OK".

Figure 40: Major Revision of the EtherNet/IP Bridge



In the following dialog box "New Module" enter a name for the bridge and define its IP Address (in this example 192.168.1.100).

Figure 41: Configuring the EtherNet/IP Bridge

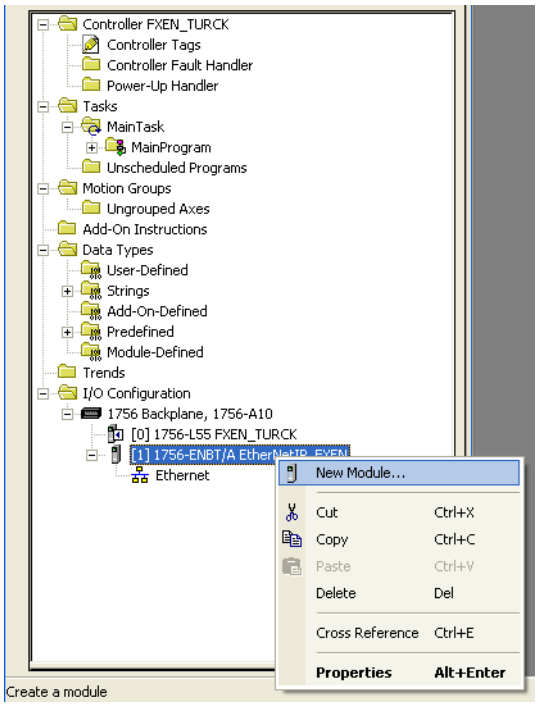


In the following dialog box "Module Properties: Local..." press "OK". You may also browse offline through the module properties when you click "Next". At this point there is no need for further entry action. If "Next" is selected, the "Module Properties" window displays information that will be available when the module is online. The configuration of the interface is completed. Press "Finish" to close the dialog box.

Configuration of a FXEN station

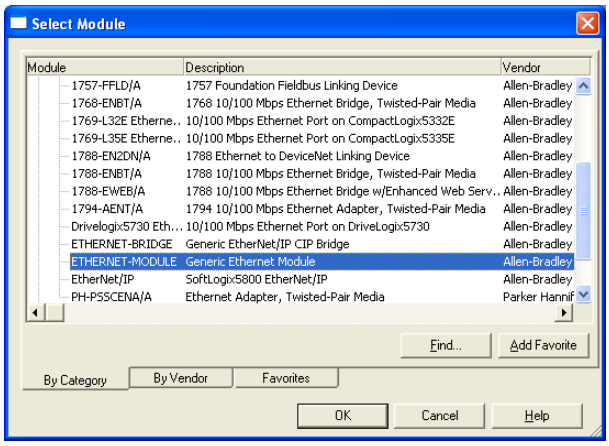
Add the FXEN to the I/O configuration by using a right-click on the EtherNet/IP bridge module 1756-ENBT/A and select "New Module".

Figure 42: Adding the FXEN station to the I/O configuration



Open "Communications" and select the entry "Generic Ethernet Module" to configure a FXEN module.

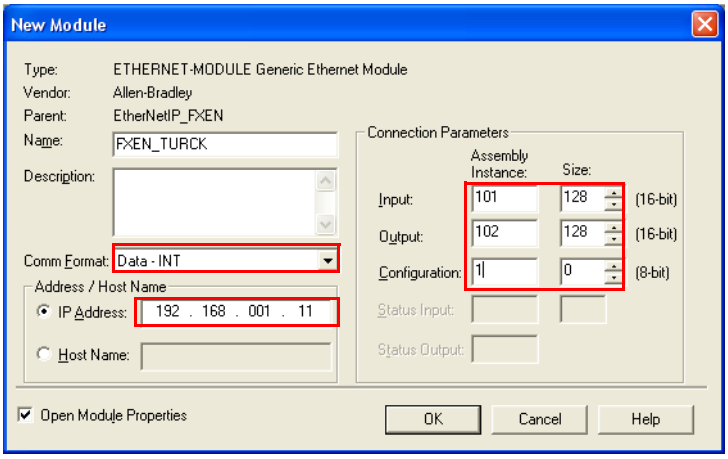
Figure 43: Add generic Ethernet module



Enter the necessary device information, like "Module name" and "Communication format" and define the module's IP Address and the connection parameters.

For the Assembly Instances 101 and 102, the Connection Parameters (input and output size = 256 Byte each) are static and have to be set as follows:

Figure 44: Configuration of BL20 gateway



Note

If the variable Assembly Instances 103 and 104 (see page 5-12) are used, the Connection Parameters have to be set according to the actual station configuration (see Table 46:) which means, the in- and output sizes have to match the sizes definitely required by the station. This required in- and output size (2 to max. 496 Byte) can be read out using Assembly Class (0×04), Instance 0×67, Attr. 0×04 and Assembly Class (0×04), Instance 0×68, Attr. 0×04 or by using the EhterNet/IP report function in the software I/O-ASSISTANT (see section “I/O data mapping“, page 6-20.

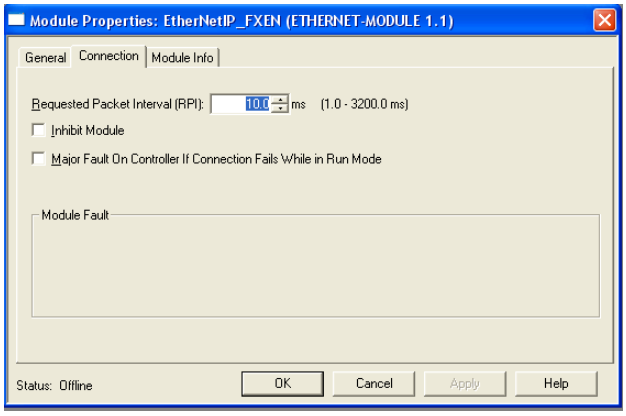
Example:

Table 46: Example

Module	**Data width**		**Ass. Inst. 103**	**Ass. Inst. 104**
	Process input	**Process output**		
FXEN-XSG16-000x-IP (EtherNet/IP-communication)	1 status word	1 control word	**2**	**2**
– I/O-channels (16 in-/ outputs)	1 word	1 word		
FXEN-IM16-000x-IP (EtherNet/IP-communication)	1 status word	1 control word	**2**	**1**
– I/O-channels (16 inputs)	1 word	-		

In the "Connection" tab set the "Requested Packet Interval" (RPI) to 10 ms, which normally should be the default setting. For FXEN, the successfully tested RPI range is 5 and higher.

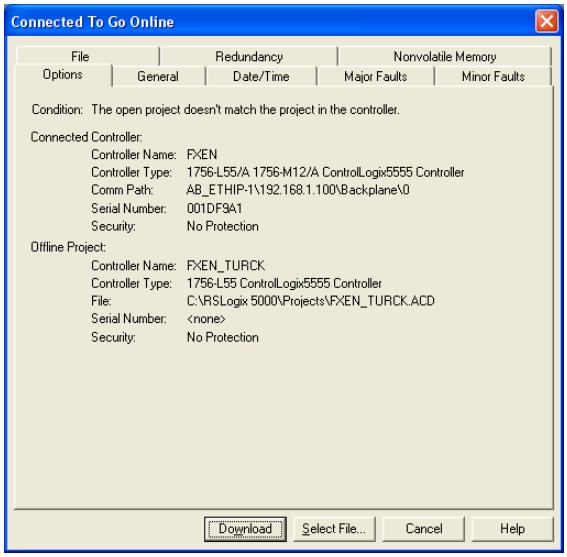
Figure 45: Set connection options for FXEN



Downloading the I/O configuration

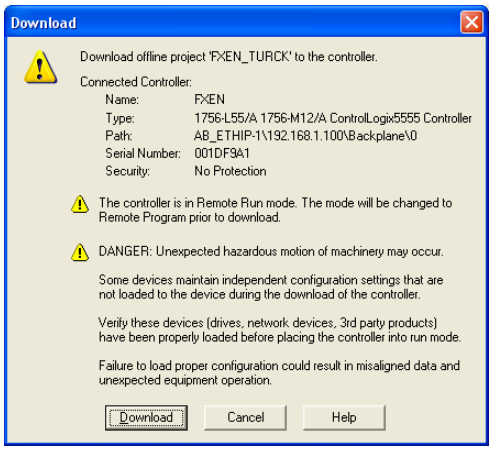
If the configuration of the network is completed, it can be downloaded to the controller by using for example the "Communication → Download" command.

Figure 46: Downloading the configuration



In the "Download" dialog box, start the download by pressing the "Download" button.

Figure 47: Downloading the configuration



If an error message is generated, warning, that the communication path can not be found, please open the "Path" menu (see Figure 49:), select your controller and press "Set Project Path" (see Figure 50:).

Figure 48: Error message

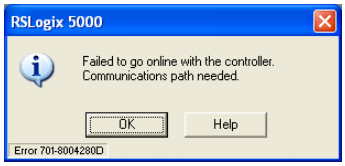


Figure 49: Communication Path

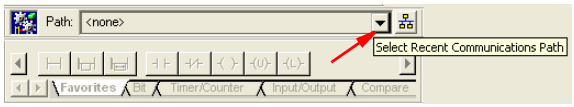
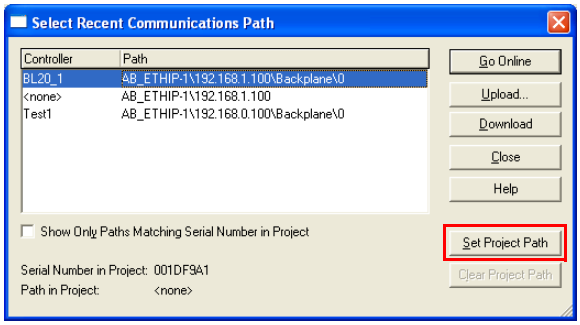


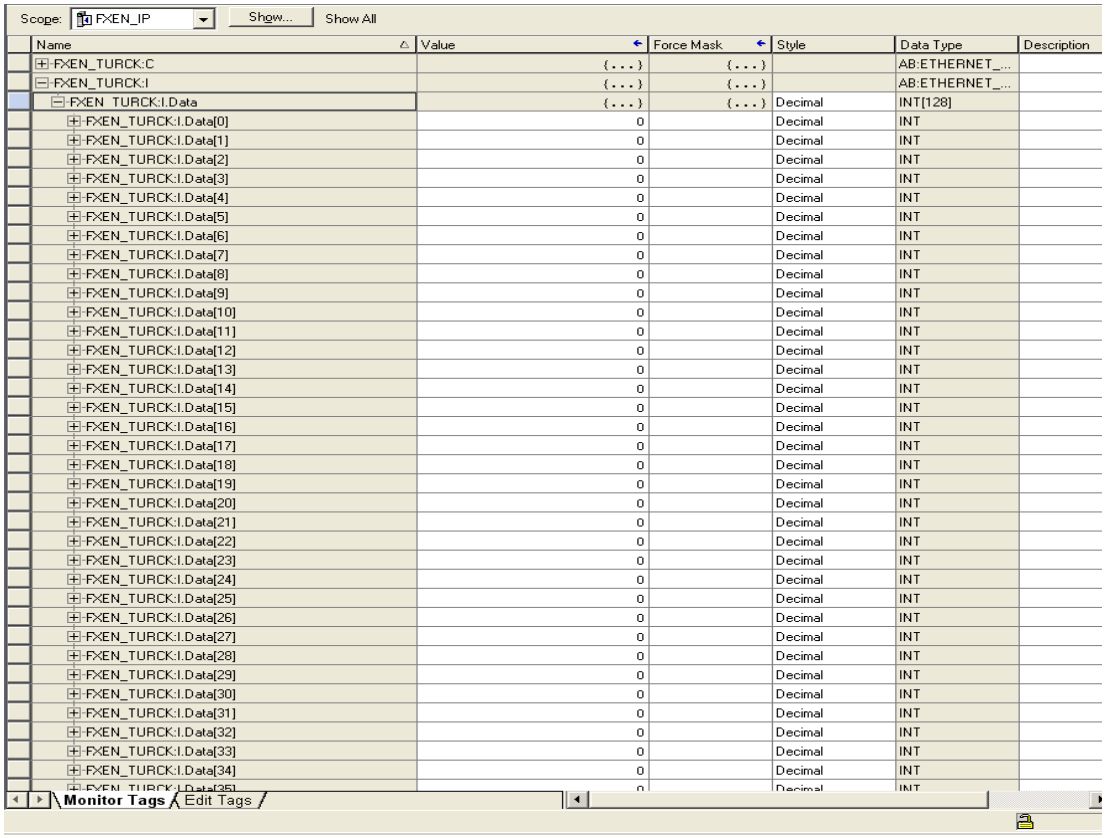
Figure 50: Communication Path



If the correct communication path is set, it is possible to download the configuration.

Once the I/O configuration is downloaded and the controller is in "Run" or "Remote Run" mode, the I/O-data mapping of the FXEN station is shown in the "Controller Tags":

Figure 51: Controller Tags



The controller tags for FXEN are divided into:

- FXEN_TURCK: C - the station's mapped configuration data
- FXEN_TURCK: I - the station's mapped input data
- FXEN_TURCK: O - the station's mapped output data

I/O data mapping

Each module is now accessible via the controller tags for viewing input data and/or forcing outputs.

The data mapping depends on the data width of each module connected to the gateway.

Table 47: Example station

Module	Data width	
	Process input	**Process output**
FXEN-XSG16-000x-IP (EtherNet/IP-communication)	1 status word	1 control word
– I/O-channels	1 word	1 word

Mapping report via I/O-ASSISTANT

An EtherNet/IP I/O mapping report can be generated for each station by means of the software tool I/O-ASSISTANT.

Figure 52: I/O mapping report in software tool I/O-ASSISTANT

6. EtherNet/IP report

6.1. Station description

Station address: 192.168.1.11

Adr./Slot	Name	TAG	Descr.	Data Size In	Data Size Out
Slot 0*	FXEN-XSG16-0001-IP	192.168.1.11/FXEN-XSG16-0001-IP	Term0A	16 bit	16 bit
Slot 1	Intern-XSG16	01/Intern-XSG16	Term0B	16 bit	16 bit
Total size for in/out data in bytes (rounded on full words)				**4**	**4**

*For detailed information about status/control word see online help

6.2. I/O map for input data

	Byte n+1								Byte n							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word0*	0A.15	0A.14	0A.13	0A.12	0A.11	0A.10	0A.9	0A.8	0A.7	0A.6	0A.5	0A.4	0A.3	0A.2	0A.1	0A.0
Word1	0B.15	0B.14	0B.13	0B.12	0B.11	0B.10	0B.9	0B.8	0B.7	0B.6	0B.5	0B.4	0B.3	0B.2	0B.1	0B.0

*For detailed information about status/control word see online help

Process input data: 4 Byte

6.3. I/O map for output data

	Byte n+1								Byte n							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word0*	0A.15	0A.14	0A.13	0A.12	0A.11	0A.10	0A.9	0A.8	0A.7	0A.6	0A.5	0A.4	0A.3	0A.2	0A.1	0A.0
Word1	0B.15	0B.14	0B.13	0B.12	0B.11	0B.10	0B.9	0B.8	0B.7	0B.6	0B.5	0B.4	0B.3	0B.2	0B.1	0B.0

*For detailed information about status/control word see online help

Process output data: 4 Byte

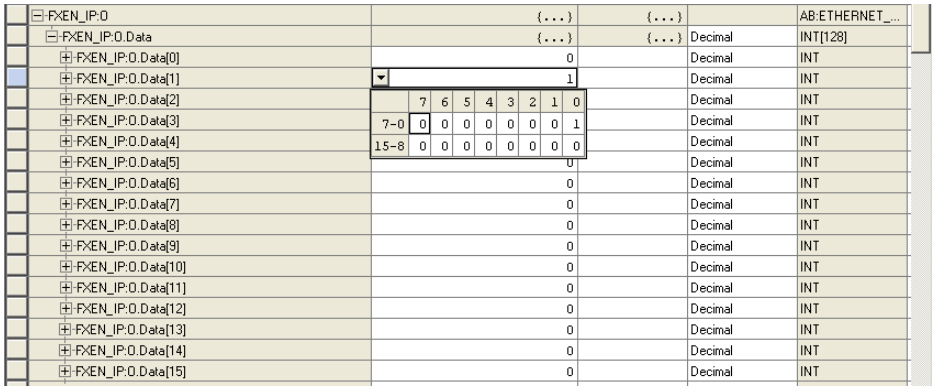
Example for process data access

Setting an output

Example:

To set the outputs "0" at the module, bit 0 in output data word 1 FXEN_IP:O.Data [1]) has to be set.

Figure 53: Setting an output



7 Guidelines for Electrical Installation

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– Cable Routing Outside Buildings 2
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Transmission Media 3

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General Notes

General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

Cable Routing

Correct cable routing prevents or suppresses the reciprocal influencing of parallel routed cables.

Cable Routing Inside and Outside of Cabinets

To ensure EMC-compatible cable routing, the cables should be grouped as follows:

Various types of cables within the groups can be routed together in bundles or in cable ducts.

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage ≤ 60 V
- unshielded cables for AC voltage ≤ 25 V

Group 2:

- unshielded cables for DC voltage > 60 V and ≤ 400 V
- unshielded cables for AC voltage > 25 V and ≤ 400 V

Group 3:

- unshielded cables for DC and AC voltages > 400 V

The following group combination can be routed only in separate bundles or separate cable ducts (no minimum distance apart):

- **Group 1/Group 2**

The group combinations:

- **Group 1/Group 3 and Group 2/Group 3**

must be routed in separate cable ducts with a minimum distance of 10 cm apart. This is equally valid for inside buildings as well as for inside and outside of switchgear cabinets.

Cable Routing Outside Buildings

Outside of buildings, cables should be routed in closed (where possible), cage-type cable ducts made of metal. The cable duct joints must be electrically connected and the cable ducts must be earthed.

Warning

Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

Lightning Protection

The cables must be routed in double-grounded metal piping or in reinforced concrete cable ducts.

Signal cables must be protected against overvoltage by varistors or inert-gas filled overvoltage arrestors. Varistors and overvoltage arrestors must be installed at the point where the cables enter the building.

Transmission Media

For a communication via Ethernet, different transmission media can be used:

- coaxial cable
  10Base2 (thin koax),
  10Base5 (thick koax, yellow cable)
- optical fibre (10BaseF)
- twisted two-wire cable (10BaseT) with shielding (STP) or without shielding (UTP).

Note

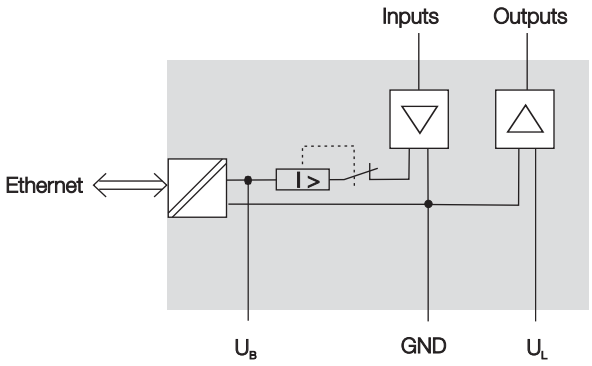
TURCK offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors.

The ordering information for the available cable types can be found in the fieldbus technology catalog.

Potential Relationships

The potential relationship of a Ethernet system realized with FXEN-modules is characterized as shown in the following figure:

Figure 54: Block diagram of FXEN-station



Electromagnetic Compatibility (EMC)

FXEN products comply in full with the requirements pertaining to EMC regulations.

Nevertheless, an EMC plan should be made before installation. Hereby, all potential electro-mechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

Ensuring Electromagnetic Compatibility

The EMC of FXEN modules is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices. The grounding lug at the Ethernet-connectors has to be connected as low-impedance as possible to earth.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

Grounding of Inactive Metal Components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, tophat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.
- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

Warning

The grounding must never – including cases of error – take on a dangerous touch potential. For this reason, always protect the ground potential with a protective cable.

PE Connection

A central connection must be established between ground and PE connection (protective earth).

Shielding of Cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80 %.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

Attention

When installing, please pay attention to the following...

– the shield should be connected immediately when entering the
– system,
– the shield connection to the shield rail should be of low
– impedance,
– the stripped cable-ends are to be kept as short as possible,
– the cable shield is not to be used as a bonding conductor.

If the data cable is connected via a SUB-D connector, the shielding should never be connected via pin 1, but to the mass collar of the plug-in connector.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is not in operation. The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

Note

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor can be connected parallel to the capacitor, to prevent disruptive discharges of the capacitor when interference pulses occur.

A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

Potential Compensation

Potential differences can occur between installation components that are in separate areas and these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

A potential-compensation cable must be routed to the potential compensation.

Warning

Never use the shield as a potential compensation.

A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10 % of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 / 0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible.

Switching Inductive Loads

In the case of inductive loads, a protective circuit on the load is recommended.

Protection against Electrostatic Discharge (ESD)

Attention

Electronic modules and base modules are at risk from electrostatic discharge when disassembled. Avoid touching the bus connections with bare fingers as this can lead to ESD damage.

9 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable Logic Controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (Bit/s).

Baud rate

Unit of measurement for measuring data transmission speeds in Bit/s.

Bidirectional

Working in both directions.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, for example, parallel-routed signal cables, contactors and electrostatic discharges.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O modules of a station.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

D

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Fieldbus

Data network on sensor/actuator level. A fieldbus connects the equipment on the field level. Characteristics of a fieldbus are a high transmission security and real-time behavior.

G

GND

Abbreviation of ground (potential „0“).

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

GSD

Acronym for Electronic Device Data Sheet which contains standardized PROFIBUS DP station descriptions. They simplify the planning of the DP master and slaves. Default language is English.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0... 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then “waver“ at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

L

Load value

Predefined value for the counter module with which the count process begins.

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant Bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Master/slave mode

Mode of operation in which a station acting as a master controls the communication between other stations in a bus system.

Module bus

The module bus is the internal bus in a BL20 station. The BL20 modules communicate with the gateway via the module bus which is independent of the fieldbus.

MSB

Most Significant Bit

Multi-master mode

Operating mode in which all stations in a system communicate with equal rights via the bus.

N

NAMUR

German acronym for an association concerned with standardizing measurement and control engineering. NAMUR initiators are special versions of the two-wire initiators. NAMUR initiators are characterized by their high immunity to interference and operating reliability, due to their special construction (low internal resistance, few components and compact design).

O

Overhead

System administration time required by the system for each transmission cycle.

P

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O modules of the control and load circuits.

PROFIBUS-DP

PROFIBUS bus system with DP protocol. DP stands for decentralized periphery. PROFIBUS-DP is based on DIN 19245 Parts 1 + 3 and has been integrated into the European fieldbus standard EN 50170.
It ensures a fast cyclic data exchange between the central DP master and the decentralized periphery devices (slaves). Its universal use is realized by the multi master concept.

PROFIBUS-DP address

Each PROFIBUS-DP module is assigned an explicit PROFIBUS-DP address, with which it can be queried by the master.

PROFIBUS-DP master

The PROFIBUS-DP master is the central station on the bus and controls access of all stations to PROFIBUS.

PROFIBUS-DP slave

PROFIBUS-DP slaves are queried by the PROFIBUS-DP master and exchange data with the master on request.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are for example, sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g. radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

The phase and the amplitude of the electric data signals are regenerated during the transmission process by the repeater.
Further, it is possible to change the topology of the PROFIBUS network. It can be extended considerably by means of the repeater.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

SUB-D connector

9-pin connector for connecting the fieldbus to the I/O-stations.

T

Terminating resistor

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UART

Universal Asynchronous Receiver/Transmitter. UART is a logic circuit which is used to convert an asynchronous serial data sequence to a parallel bit sequence or vice versa.

Unidirectional

Working in one direction.

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