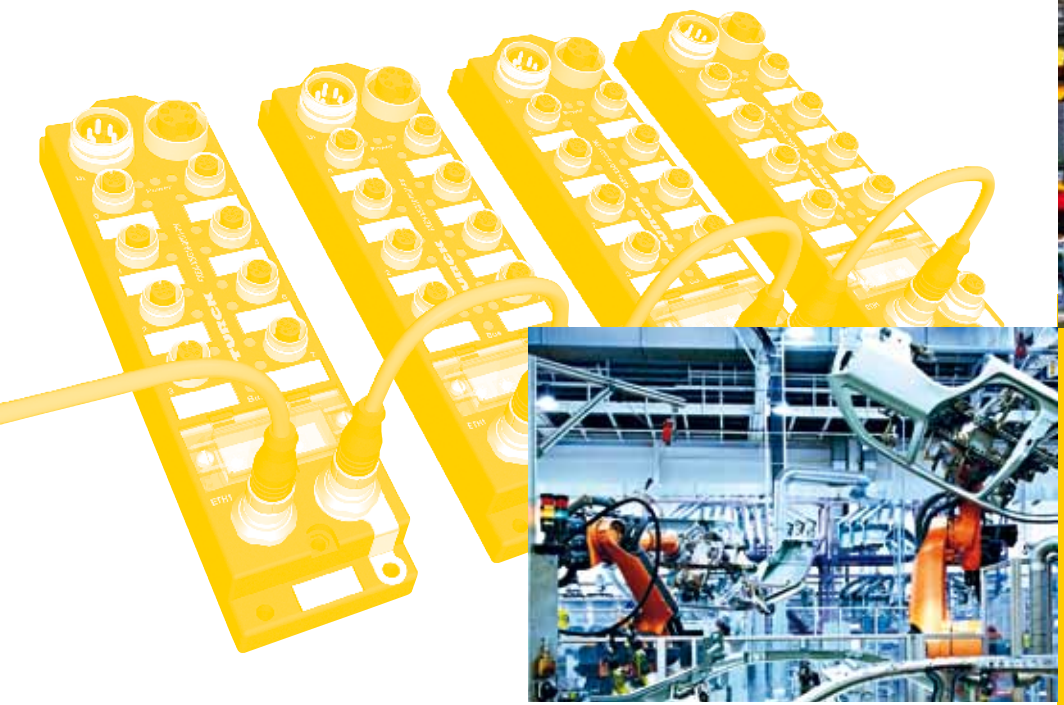
TURCK

Industrial
Automation

USER MANUAL

FGEN-AIM STATIONS

WITH MULTIPROTOCOL FUNTIONALITY



Sense it! Connect it! Bus it! Solve it!

Edition 10/2013

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1 About this manual

1.1 Documentation concept

This manual contains all information about the TURCK FGEN-product line in protection class IP67 with multi-protocol function.

The following chapters contain:

- the general technical data and station properties,
- a description of the function and the assembly of the single devices in the product line,
- a description of the stations' representation in the different Ethernet-protocols,
- a description of the devices' handling in the different PLC-applications,

1.2 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.

1.3 General

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 the FGEN-stations. It has been specially conceived for personnel with the necessary qualifications.

1.3.1 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.

1.3.2 Notes concerning planning/installation of this product

Warning

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

1.4 List of revisions

In comparison to the previous manual edition, the following changes/ revisions have been made:

Table 1-1: List of revisions

Chapter	Subject	new	changed
3	Web server - remote access/configuration (page 3-16)		x
5	Changes in th technical data of module, page 5-2		x
6	Changes in th technical data of module, page 6-2 and page 6-5		x
7	EtherNet/IP Communications Profile (page 7-2)	x	

Note

The publication of this manual renders all previous editions invalid.

2 Multi-protocol functionality

2.1 General

The compact I/O-stations of the product line FGEN combine the three Ethernet protocols EtherNet/IP™, Modbus TCP and PROFINET in one device.

A multi-protocol device can be operated without intervention of the user (which means, without changes in the parameterization) in all of the three Ethernet protocols mentioned.

During the start-up after a power-on, the module runs in "snooping" mode and detects the Ethernet protocol which requests a link connection by listening the traffic.

If a protocol is detected, the device automatically changes to the detected protocol and ignores the telegrams of the other two.

2.1.1 Protocol dependent functions

PROFINET

- Fast Start-UP (FSU)
- Topology discovery
- Address assignment via LLDP

EtherNet/IP™

- QuickConnect (QC), see page 8-13
- DLR (Device Level Ring)

3 FGEN – general technical properties

3.1 General

This chapter contains all information about the hardware of the FGEN-stations, the general technical data as well as the connection possibilities, the addressing,etc..

Note

Station-specific information can be found in the single station descriptions within the respective chapters of this manual.

3.2 General information on FGEN

The FGEN product family offers the following approved features:

- direct connection of up to 16 digital in- and outputs to an Ethernet-network
- Protocols: EtherNet/IP™, Modbus TCP and PROFINET RT in one single device
- channel-related short-circuit diagnosis of outputs and slot-related short-circuit diagnosis of inputs
- Ethernet-connection with two 4-pole, d-coded M12 x 1 round connectors
- integrated Ethernet-switch for building up a line-topology

3.3 General technical data

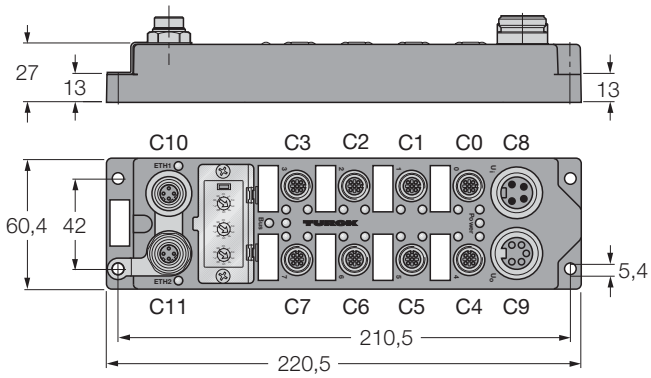
3.3.1 Technical data

Table 3-1: Technical data of the FGEN-stations

Power supply	
Operating voltage U_B (VI)	18 to 30 VDC
Load voltage U_L (VO)	18 to 30 VDC
Internal current consumption (from U_B)	< 200 mA
Connectors	
Ethernet	2 x M12-female (OUT), 4-pole, D-coded
Power supply	
FGEN-xxxx-**5**001	7/8" connector, 5-pole
FGEN-xxxx-**4**001	7/8" connector, 4-pole
Inputs / Outputs	M12 female, 5-pole
Isolation voltages	
U_{BL} (U_B against U_L)	none
U_{ETH} (supply voltage against Ethernet)	500 V AC
U_{ETHETH} (ETH1 against ETH 2)	500 V AC
Housing	Fibre-glass reinforced Polyamide (PA6-GF30)
Size	60.4 × 220.5 × 27 mm (B × L × H)
Mounting	via 4 through-holes, Ø 4.4 mm
Mounting distance station to station	≥ 50 mm Valid for operation in the ambient temperatures mentioned below, with sufficient ventilation as well as maximum load (horizontal mounting). In case of low simultaneity factors and low ambient temperatures, mounting distances of < 50 mm may be possible.
Protection class	IP67
Vibration test	to EN 60068-2-6, IEC 68-2-47
Shock test	acc. to EN 60068-2-27
EMC	acc. to EN 61131-2
Temperature range	
– operating	0 °C to 55 °C (32 °F to 131 °F)
– Storage and transport temperature range	-25 °C to 70 °C (-13 °F to 158 °F)

3.3.2 Dimension drawings

Figure 3-1: Dimensions for the FGEN-stations



3.3.3 LED-displays

Table 3-2: Dimensions for the FGEN-stations

LED	Display	Meaning	Remedy
ETHx	green	Link established,100 Mbps	
	green, flashing	Ethernet traffic (100 Mbps)	
	yellow	Link established,10 Mbps	
	yellow flashing	Ethernet traffic (10 Mbps)	
	off	No Ethernet link.	Check the Ethernet-connection.
Power	off	U_B < 18 V DC	Check the connected operating voltage.
	green	U_B and U_L in the operating range	
	red	U_L < 18 V DC	Check the load voltage.
Ix/Ox	green	24 V at input/ output	
	red	Overcurrent at the output or at the sensor supply	
BUS	green	Active connection to a master	-
	green, flashing	ready for operation	-
	red	IP address conflict or restore mode	Check the IP-addresses in the network or wait until the device is ready.
	red, flashing	Blink-/wink-command active	-
	red/green	Autonegotiation and / or waiting for DHCP- / BootP-address assignment.	

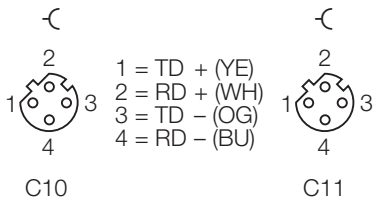
3.4 Connection possibilities

3.4.1 Ethernet

The connection to Ethernet via the integrated auto-crossing switch is done using two 4-pole, D-coded M12 x 1-Ethernet-female connectors.

Figure 3-2: Pin assignment of the M12 x 1-female connectors, 4-pole

Female connectors M12 x 1



Ethernet-connection in QC-/FSU-applications

Note

Please observe the following for QuickConnect (QC)- and Fast Start-Up (FSU)-applications:

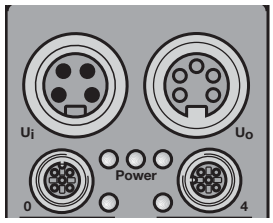
– **do not use a** crossover-cable
– ETH1 = connector for **incoming** Ethernet-line
– ETH2 = connector for **outgoing** Ethernet-line

3.4.2 Operating/load voltage

The power supply is realized via 7/8" connectors on the module.

These connectors are designed either 4- or 5-pole.

Figure 3-3: Power supply



U_I = voltage IN
U_O = voltage OUT for supplying the next node

Note

The operation voltage (U_B) and the load voltage (U_L) are fed and monitored separately. 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 communicates 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.

Voltage supply via 7/8", 5-pole (FGEN-xxxxx-5xx1)

Figure 3-4: 7/8" male and female, 5-pole

U_L and U_B galvanically isolated.

No galvanic isolation of U_L and U_B at the FGEN-XSG16-5001

Voltage supply via 7/8", 4-pole (FGEN-xxxxx-4xx1)

Figure 3-5: 7/8" male and female, 4-pole

U_L and U_B galvanically isolated.

No galvanic isolation of U_L and U_B at the FGEN-XSG16-4001!

3.4.3 Analog inputs and outputs

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

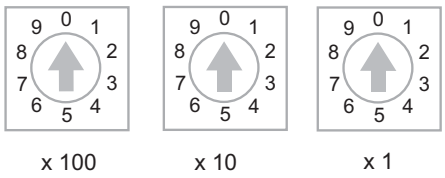
Note

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

3.5 Address assignment

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

Figure 3-6: Decimal rotary coding-switches for address setting



000: 192.168.1.254
1 - 254: static rotary
300: BootP
400: DHCP
500: PGM
600: PGM-DHCP
900: F_Reset

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.

Note

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

3.5.1 Default setting of the gateway

The stations' default-settings are as follows:

IP-address	192.168.1.254
subnet mask	255.255.255.0
default gateway	192.168.1.1

Note

The stations 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.

3.5.2 Resetting the IP-address, switch position "000"

By setting the rotary coding switches to "000" followed by a voltage reset, the module is set to the address 192.168.1.254 for IP-based services (seeDefault setting of the gateway (page 3-8)).

The I/O-ASSISTANT can, for example, communicate with the station in this switch position.

Note

Setting "000" is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

3.5.3 Address setting via the rotary-mode

- switch position: **001 - 254**

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

Addresses in the range from 0 to 255 can be allocated, whereas 1 is normally reserved for the default-gateway. 0 and 255 are reserved for broadcast messages in the subnet.

Note

We therefore recommend addresses in the range of 2-254.

3.5.4 Address setting via the mode BootP

- switch position: **300**

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

Note

The IP address, as well as the default subnet mask assigned to the station by the BootP-server, are stored in the station's EEPROM.

If the station 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.

PROFINET

Please assure, that in PROFINET -applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

3.5.5 Address setting via the mode DHCP

- switch position: **400**

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

Note

The IP address, as well as the default subnet mask assigned to the station by the DHCP-server, are stored in the station's EEPROM.

If the station 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.

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.

PROFINET

Please assure, that in PROFINET -applications, the address assigned via a BootP-server corresponds to the address, which is assigned in the configuration tool.

3.5.6 Address setting via mode PGM

- switch position: 500

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

Note

In the PGM-mode, all network settings (IP address, subnet mask, etc.) are send to the module's internal EEPROM and stored permanently.

3.5.7 Addressing via mode PGM-DHCP

- switch position: **600**

The device sends DHCP-requests until a IP-address is assigned (DHCP-server, PROFINET-controller).

The assigned IP-address is stored to the device and the DCHP-client is stopped.

Even after a restart of the device, the device sends no further DHCP-requests.

PROFINET

This mode assures a PROFINET-compliant operation of the modules.

Note

If a DHCP-server is used within the network, problems may occur during IP-assignment.

In this case, both, the DHCP-server as well as the PROFINET-controller (vie DCP), try an IP-address-assignment.

3.5.8 F_Reset (Factory Reset)

switch position: **900**

Setting 900 sets all device-settings back to the default values and deletes all data in the device's internal flash.

Note

Setting 900 is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

3.5.9 Addressing via I/O-ASSISTANT 3 (FDT/DTM)

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

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

Figure 3-7: BL Service Ethernet

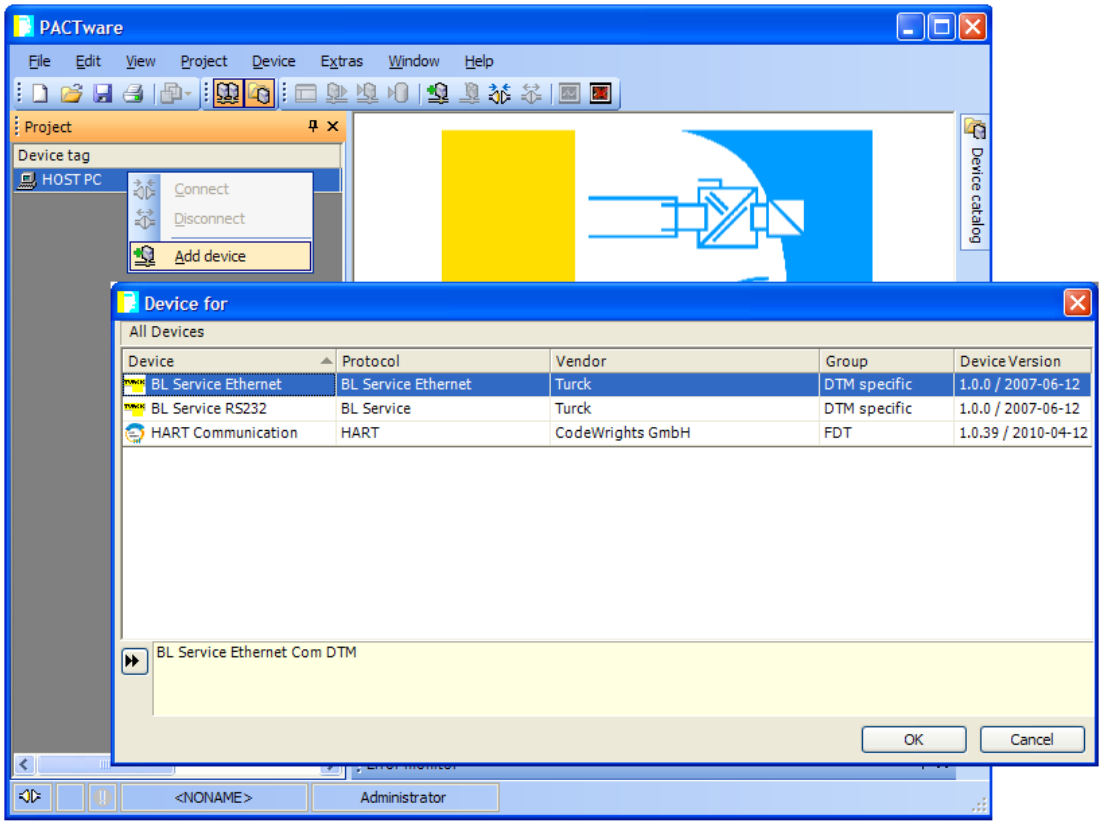


Figure 3-8: Busaddress management

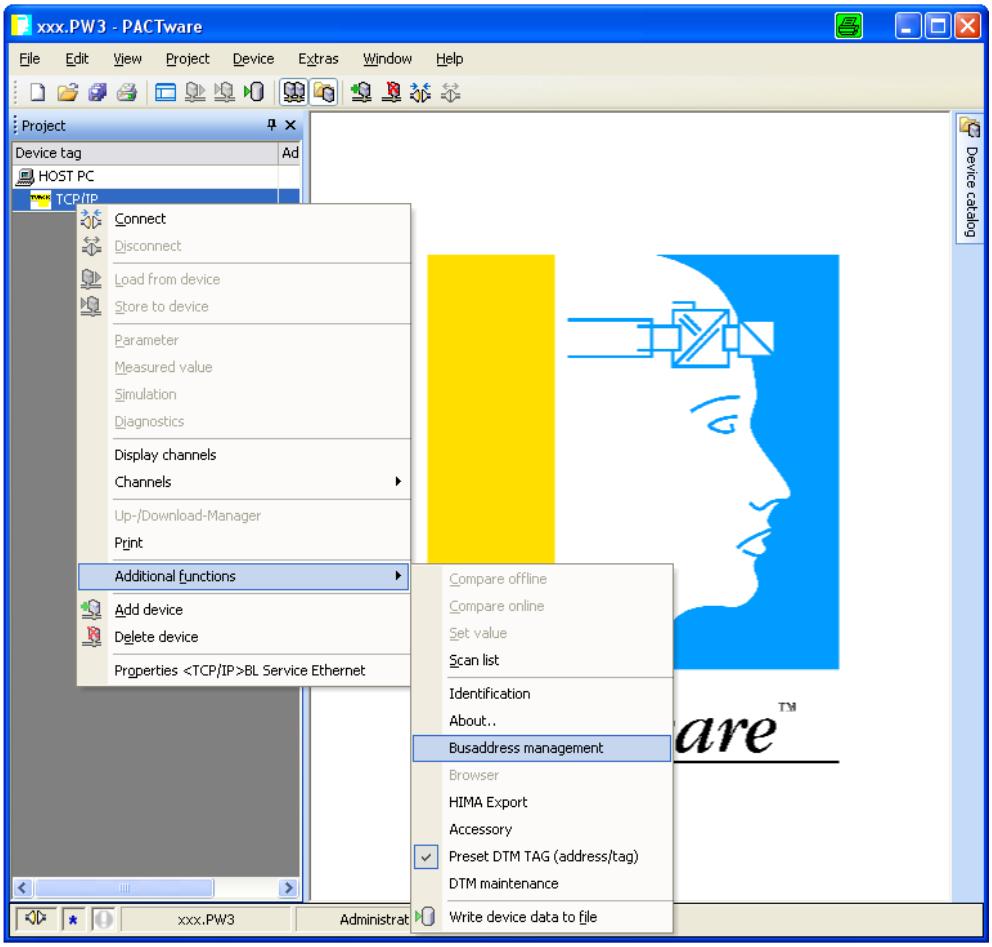
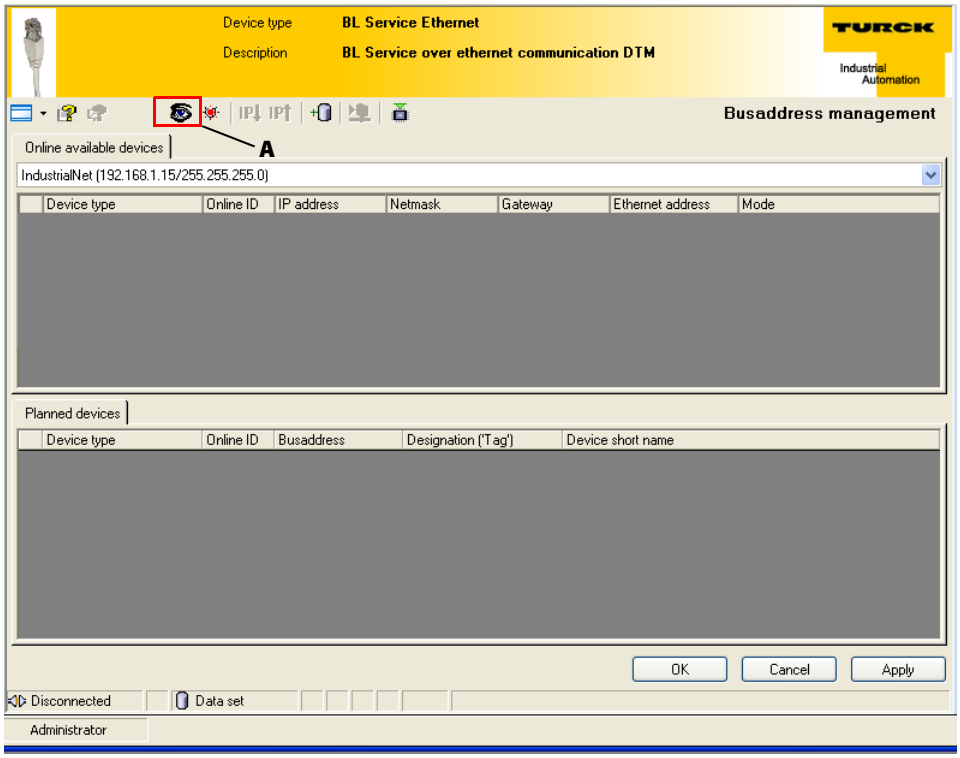


Figure 3-9: Searching network-Nodes in the Busaddress management

A *Search function in the Busaddress management*



Note

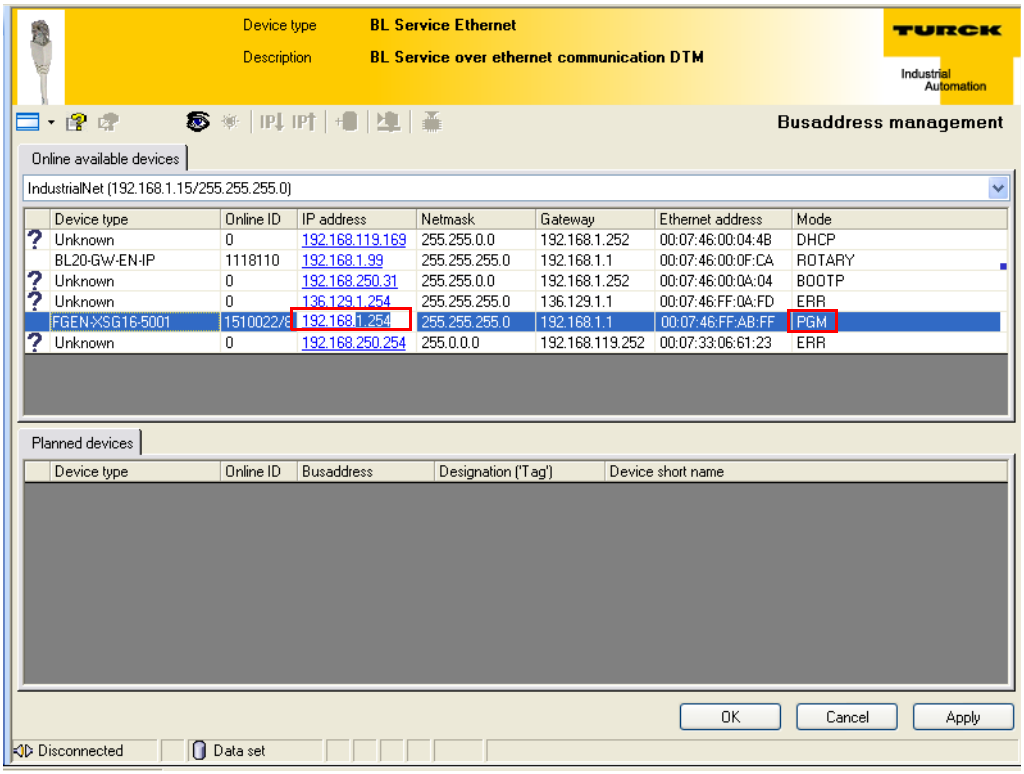
The access of the IO-ASSISTANT to the station is only possible, if the station already has an IP-address and if it is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode (see also Address assignment (page 3-8)).

Note

When using Windows XP as operating system, difficulties may occur with system-integrated firewall.

It may inhibit the access of PACTware™ (I/O-ASSISTANT V3) to the Ethernet-network. In this case, please adapt your firewall respectively or deactivate it.

Figure 3-10: Specify IP address change



3.5.10 Addressing via PGM-DHCP

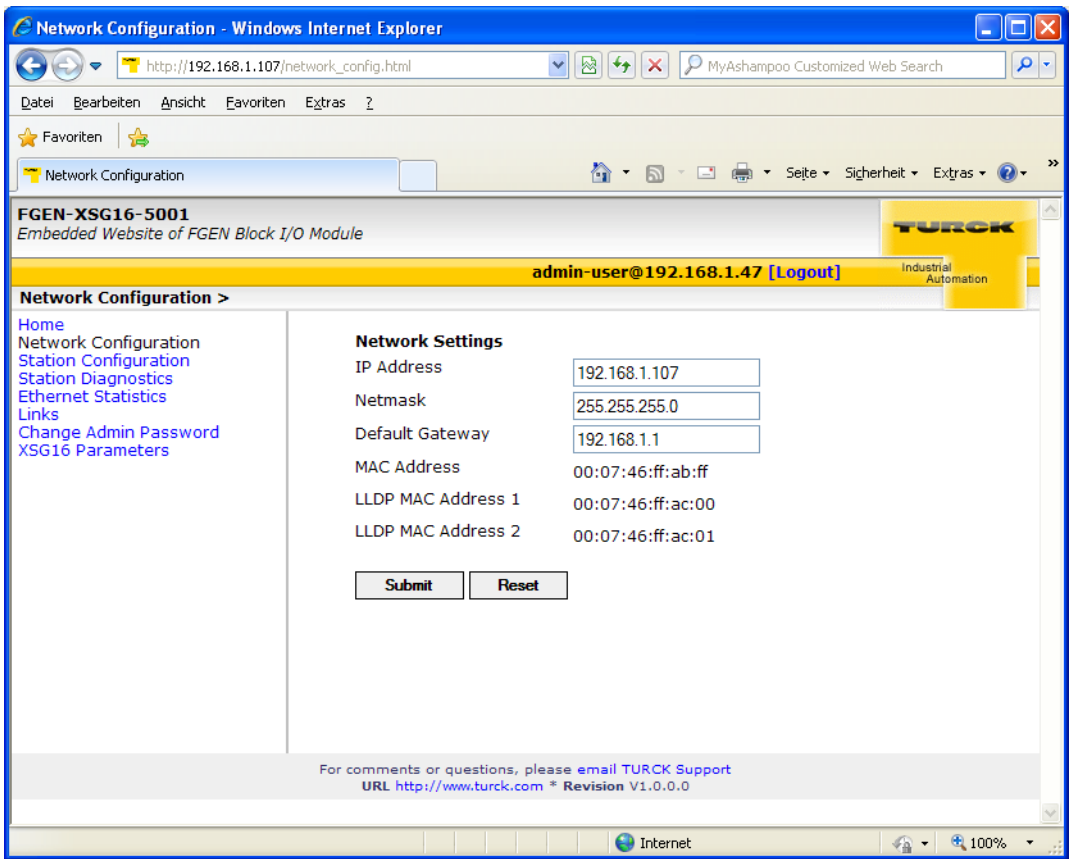
The device's network settings can be changed under "Network Configuration" only by users having administrator rights.

Further information concerning the web server of the FGEN-devices and it's use can be found under Web server - remote access/configuration (page 3-16).

Note

The access of the IO-ASSISTANT to the station is only possible, if the station already has an IP-address and if it is operated in switch position 500 = PGM or 600 = PGM-DHCP-mode (see also Address assignment (page 3-8)).

Figure 3-11: Web server with Network Configuration



3.6 SET-button

Pushing the SET-button causes a device-restart.

3.7 Device configuration files

The actual device configuration files for the stations can be downloaded from the TURCK-home page www.turck.com.

3.8 Web server - remote access/configuration

Note

When working with the webserver of the module, it should be assured, that the browser always reloads the HTML-pages from the module's webserver (forced reload). The data should not be loaded from the browser's cache memory.
This guarantees that the data to be shown are always acutal (module type, module status etc.).
Short-cuts for browser:
Internet Explorer: Shift + F5
Mozilla Firefox: Ctrl + F5

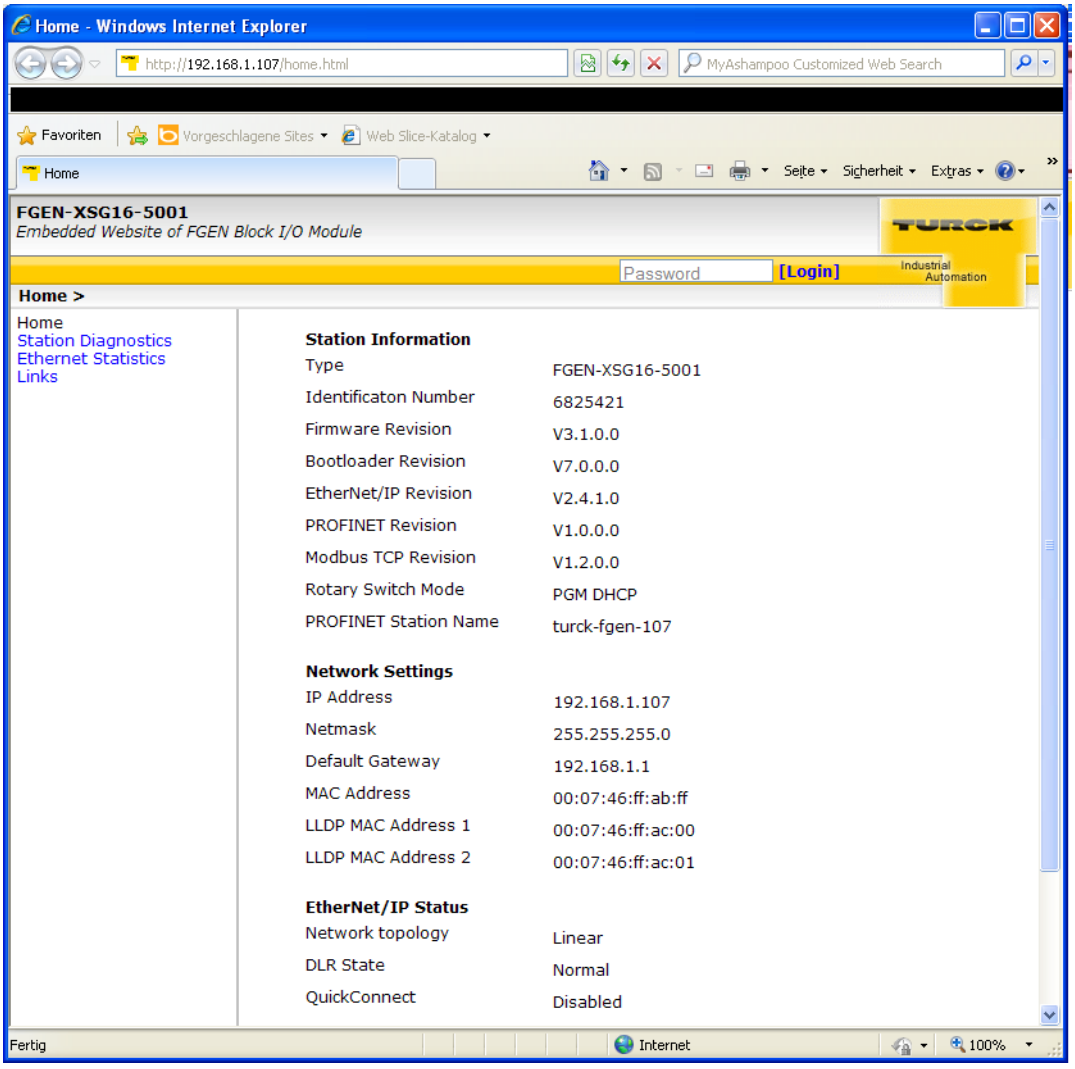


Figure 3-12: Web server of the FGEN-station

3.8.1 IP address

Open the web server by entering the device's IP-address in your web browser.

IF no IP-address is assigned to the device (DHCP-, BootP-server etc.), then the web server can be opened using the default IP-address 192.168.1.254.

3.8.2 Access rights

Without administrator rights, data as general product data and diagnosis data are read only.

In order to achieve administrator rights, please log-on to the web server, see Login / password (page 3-17).

3.8.3 Login / password

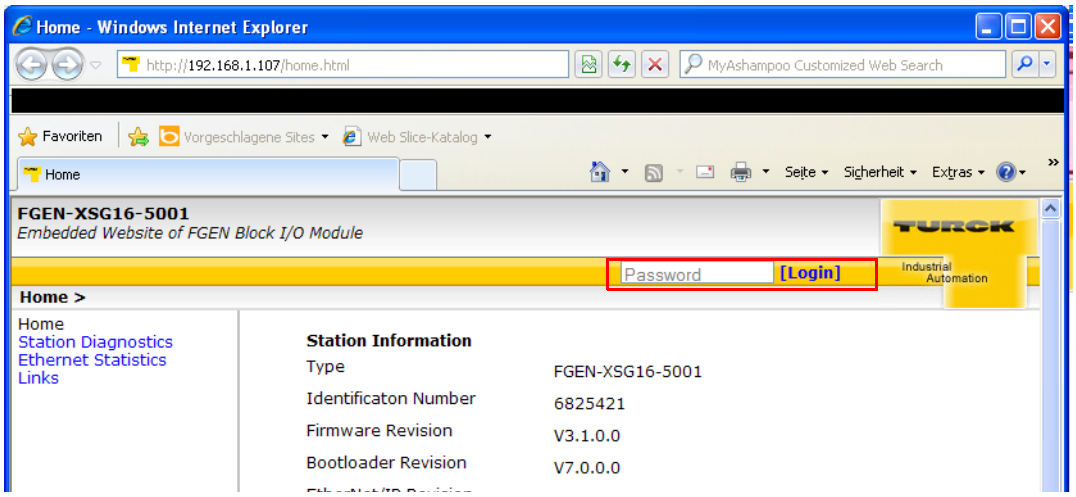
Login to the web server by using the default-password "password".

The default-password can be changed by the administrator at every time under Change Admin Password (page 3-20) .

Note

A reset of the device to the default-settings using the switch position 900 "F_Reset" also causes a reset of the password to "password".

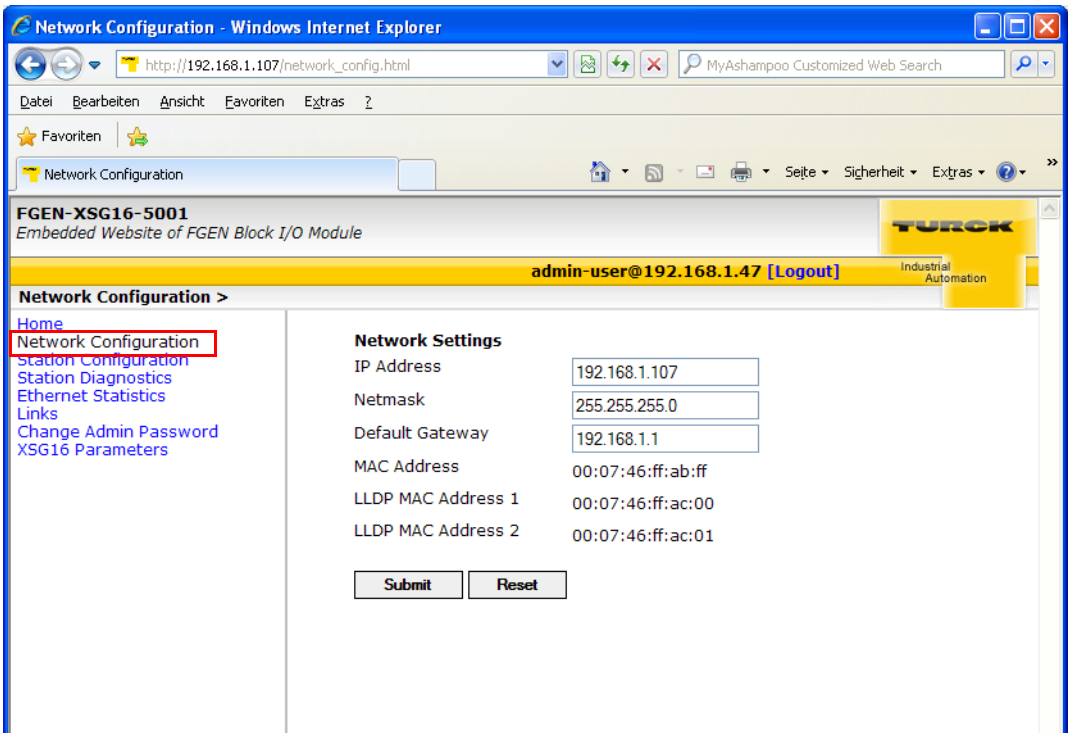
Figure 3-13: Web server "Home" screen



3.8.4 Network Configuration

On the "Network Configuration"-page, network-relevant settings can be changed.

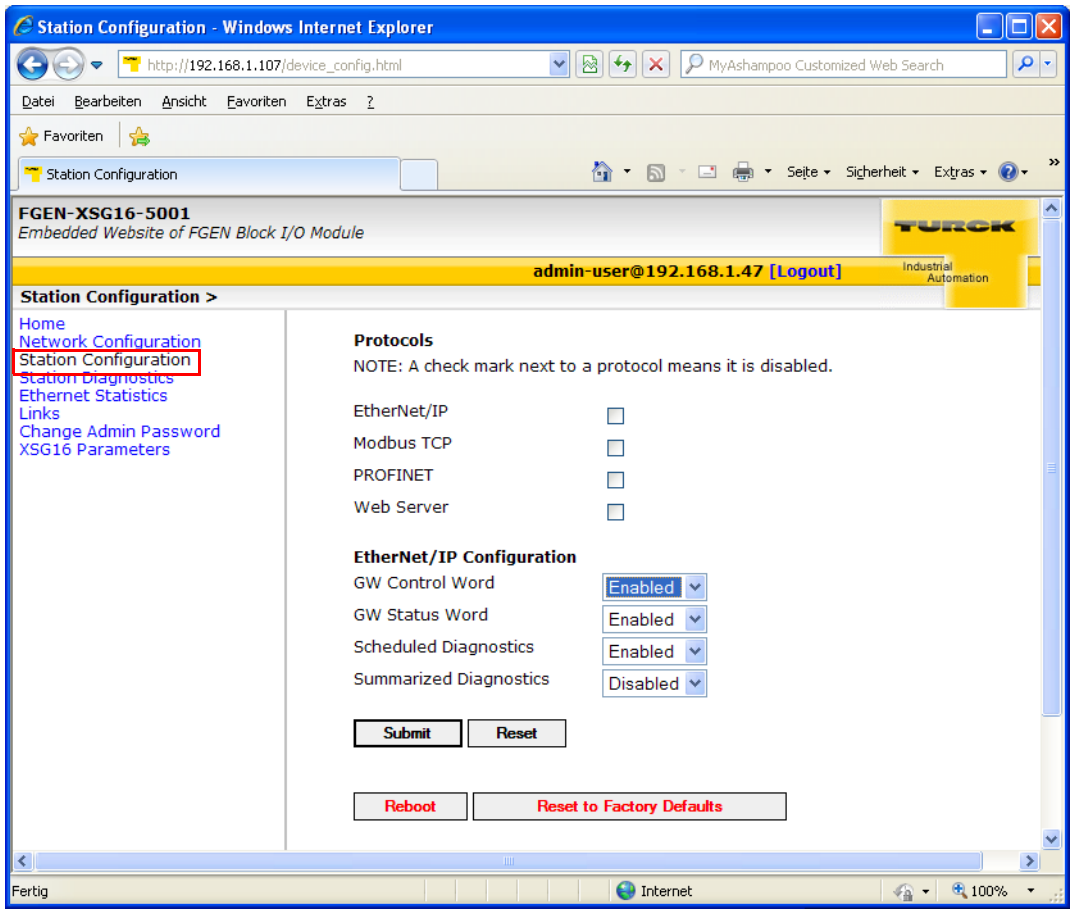
Figure 3-14: Web server "Network Configuration"



3.8.5 Station Configuration

The "Station Configuration"-page serves for parameterizing the device's fieldbus interface.

Figure 3-15: Web server "Station Configuration"



3.8.6 Station Diagnostics

Diagnostic messages of the device are displayed on the "Station Diagnostics"-page.

3.8.7 Ethernet Statistics

The page "Ethernet Statistics" shows information like the port-status, telegram and error counters etc. The page can above all be useful for analyzing network problems.

3.8.8 Links

This page contains for example a link to the product page on the TURCK-homepage.

3.8.9 Change Admin Password

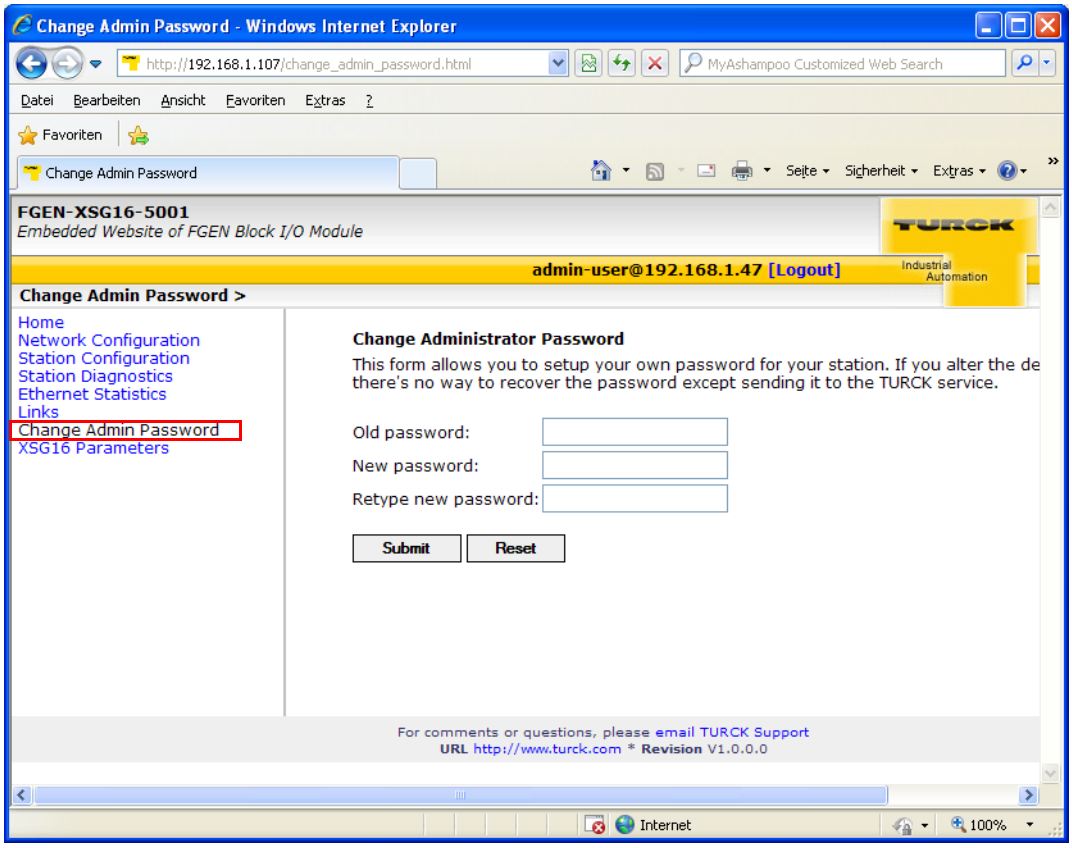
Please define an individual password for administrator rights.

Default-password: „password“

Note

A reset of the device to the default-settings using the switch position 900 "F_Reset" also causes a reset of the password to "password".

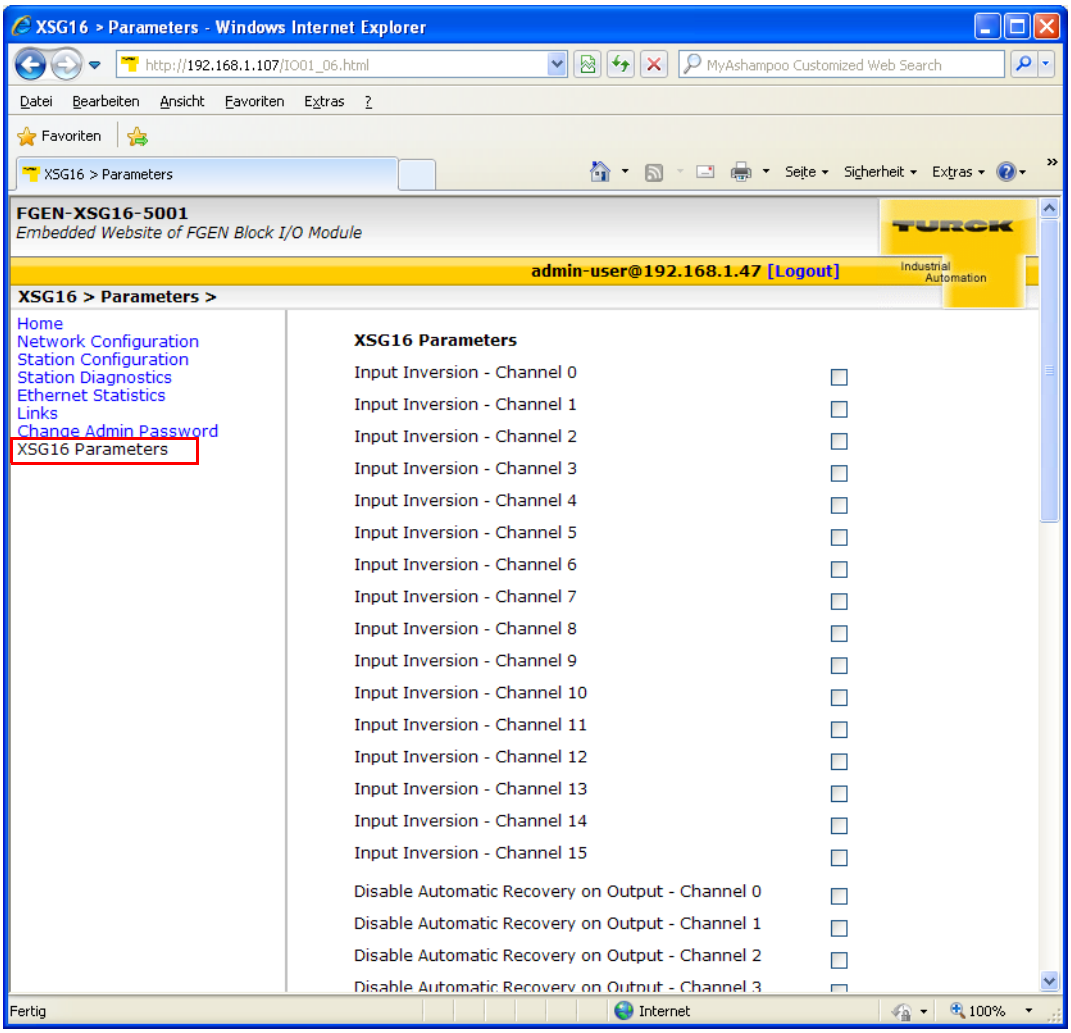
Figure 3-16: Change Admin Password



3.8.10 Parameters

The "Parameters"-page is used to parameterize the station's I/O-channels.

Figure 3-17: Web server "Parameters"



3.9 Status and Control Word of the FGEN-stations

The Status as well as the Control Word are mapped into the station's process data.

- EtherNet/IP™
  In EtherNet/IP™, the mapping can be disabled, see Gateway Class (VSC 100), GW Status register (page 7-30) and GW Control Register (page 7-30).
- Modbus TCP
  → see Register 100Ch: "Station status" (page 9-16)
- PROFINET
  → see PROFINET-Error Codes (page 11-4)

3.9.1 Status Word

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-

Meaning of the status bits

Table 3-3: Meaning of the status bits

Name	Meaning
DiagWarn	Summarized diagnosis of the device. At least 1 channel sends diagnostics.
U_L	Load voltage not within the permissible range (18 to 30 V)
U_B	System voltage not within the permissible range (18 to 30 V)
COM	I/O Communication Lost Error No Communication on the module bus.
CFG	I/O CfgModified Error The I/O-configuration has be changed and is no longer compatible.
FCE	Force Mode Active Error The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.

3.9.2 Control Word

The Control Word has no function at the moment, it is reserves for further use.

4 Digital inputs FGEN-IM16-x001

4.1 FGEN-IM16-x001

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

4.1.1 Technical data

Table 4-1: Technical data FGEN-IM16-x0001

Type designation	FGEN-IM16-x001
Number of channels	(16) 3-wire pnp-sensors
Supply (via U_B)	18 ... 30 VDC from operating voltage
Supply current	< 120 mA per connector, short-circuit protected
Switching threshold OFF/ON	2 mA / 4 mA
Low level signal voltage	-3 to 5 VDC (EN 61131-2, type 1 and 3)
High level signal voltage	11 to 30 VDC (EN 61131-2, type 1 and 3)
Max. input current	6 mA
Switch-on delay	2.5 ms
Switching frequency	≤ 500 Hz
Potential isolation	galvanic isolation against U_L and Ethernet

Note
General technical data for the products of the FGEN-product line can be found in chapter 3.

4.1.2 Wiring diagrams

Ethernet

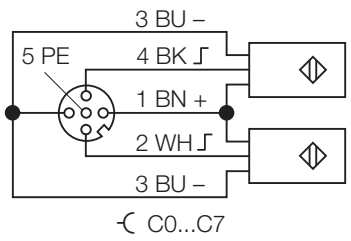
→ Ethernet (page 3-6)

Power supply

→ Operating/load voltage (page 3-6)

Input M12x1

Figure 4-1: Wiring diagram, input M12x1



4.1.3 Parameters

Table 4-2: Parameters

Parameter name	Value	Description
Digital input (Inv. DIx)	0 = normal **A**	
	1 = inverted	Inverts the digital input signal.

A *default setting*

Further information about the parameter data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.4.4, Digital Versatile Module Class (VSC117) (page 7-34) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.4, Parameters (page 11-5)

4.1.4 Diagnostic message of I/O-channels

Table 4-3: Diagnostic messages

Diagnostics	Description
SCSx	Short circuit at sensor supply of the respective channel

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.4.4, Process Data Class (VSC102) (page 7-31)
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.3, PROFINET-Error Codes (page 11-4)

5 Digital outputs FGEN-OM16-x001

5.1 FGEN-OM16-x001

The station offers 16 digital inputs for DC actuators.

5.1.1 Technical data

Table 5-1: Technical data FGEN-OM16-x001

Type designation	FGEN-OM16-x001
Number of channels	(16) DC actuators
Output voltage	18…30 V DC from load voltage
Output current per channel	2.0 A, short-circuit proof
Load type	resistive, inductive, lamp load
Simultaneity factor	0.25 for complete module, 1 × 2 A or 2 × 1 A per connector, but only max. 9 A total current per module
Potential isolation	galvanic isolation against U_B and Ethernet

Note

General technical data for the products of the FGEN-product line can be found in chapter 3.

5.1.2 Wiring diagrams

Ethernet

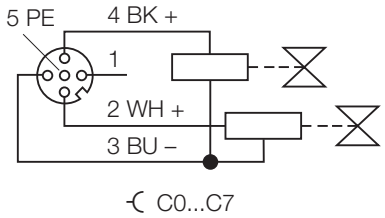
→ Ethernet (page 3-6)

Power supply

→ Operating/load voltage (page 3-6)

Input M12x1

Figure 5-1: Wiring diagram, output M12x1



5.1.3 Parameters

Table 5-2: Parameters

Parameter name	Value	Description
Output on overcurrent (SROx)	0 = activated **A**	The output switches on automatically after an overload.
	1 = deactivated	The output is switched-off after an overload until a new set-command is given (fall and rise).

A *default setting*

Further information about the parameters can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.4.4, Digital Versatile Module Class (VSC117) (page 7-34) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.4, Parameters (page 11-5)

5.1.4 Diagnostic messages

Table 5-3: Diagnostic messages

Diagnostics	Description
SCOx	Short circuit at output of the respective channel

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.4.3, Process Data Class (VSC102) (page 7-31) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.3, PROFINET-Error Codes (page 11-4)

6 Digital in-/outputs FGEN-IOM88-x001, FGEN-XSG16-x001

6.1 FGEN-IOM88-x001

The station offers 8 digital inputs for 3-wire pnp sensors and 8 digital outputs for DC actuators.

6.1.1 Technical data

Table 6-1: Technical data FGEN-IOM88-x001

Designation	FGEN-IOM88-x001
Inputs	(8) 3-wire pnp-sensors
Supply (via U_B)	18... 30 V DC from operating voltage
Supply current	< 120 mA per connector, short-circuit protected
Switching threshold OFF/ON	2 mA / 4 mA
Low level signal voltage	-3 to 5 VDC (EN 61131-2, type 1 and 3)
High level signal voltage	11 to 30 VDC (EN 61131-2, type 1 and 3)
Max. input current	6 mA
Switch-on delay	2.5 ms
Switching frequency	≤ 500 Hz
Potential isolation	galvanic isolation against U_L and Ethernet
Outputs	(8) DC actuators
Output voltage	18…30 V DC from load voltage
Output current per channel	2.0 A, short-circuit proof
Load type	resistive, inductive, lamp load
Simultaneity factor	0.25 for complete module, 1 × 2 A or 2 × 1 A per connector, but only max. 9 A total current per module
Potential isolation	galvanic isolation against U_B and Ethernet

Note

General technical data for the products of the FGEN-product line can be found in chapter 3.

6.1.2 Wiring diagrams

Ethernet

→ Ethernet (page 3-6)

Power supply

→ Operating/load voltage (page 3-6)

Figure 6-1: Wiring diagram input M12 x 1

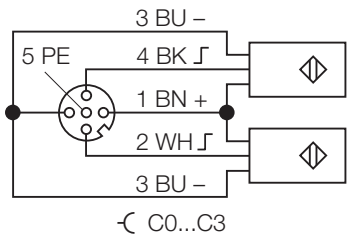
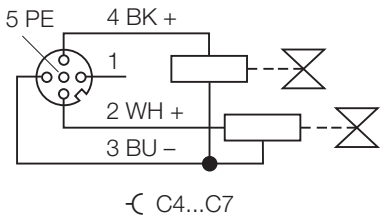


Figure 6-2: Wiring diagram output M12 x 1



6.1.3 Parameters

Table 6-2: Parameters

A *default setting*

Parameter name	Value	Description
Digital input (Inv. DIx)	0 = normal **A**	
	1 = inverted	Inverts the digital input signal.
Output on overcurrent (SROx)	0 = activated **A**	The output switches on automatically after an overload.
	1 = deactivated	The output is manually switched-off after an overload.until a new set-command is given (rise and fall).

Further information about the parameter data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.4.4, Digital Versatile Module Class (VSC117) (page 7-34) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.4, Parameters (page 11-5)

6.1.4 Diagnostic messages

Table 6-3: Diagnostic messages

Diagnostics	Description
SCSx	Short circuit at sensor supply of the respective channel
SCOx	Short circuit at output of the respective channel

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.3.3, Process data mapping FGEN-IM16-x001 (page 7-11) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.3, PROFINET-Error Codes (page 11-4)

6.2 FGEN-XSG16-000x

The station is equipped with 16 channels, which can be configured individually, depending on the specific application requirements. Up to sixteen 3 wire pnp sensors or sixteen DC actuators with a maximum output current of 1.4 A per output can be connected.

6.2.1 Technical data

Table 6-4: Technical data FGEN-XSG16-x00x

Designation	FGEN-XSG16-x001
Inputs	(16) 3-wire pnp-sensors
Supply (via U_B)	18 ... 30 V DC from operating voltage
Supply current	< 120 mA per connector, short-circuit protected
Switching threshold OFF/ON	2 mA / 4 mA
Low level signal voltage	-3 to 5 VDC (EN 61131-2, type 1 and 3)
High level signal voltage	11 to 30 VDC (EN 61131-2, type 1 and 3)
Max. input current	6 mA
Switch-on delay	2.5 ms
Switching frequency	≤ 500 Hz
Potential isolation	galvanic isolation against U_L and Ethernet
Outputs	(16) DC actuators
Output voltage	18…30 V DC from load voltage
Output current per channel	2.0 A, short-circuit proof
Load type	resistive, inductive, lamp load
Simultaneity factor	0.25 for complete module, 1 × 2 A or 2 × 1 A per connector, but only max. 9 A total current per module
Potential isolation	galvanic isolation against U_B and Ethernet

Note

General technical data for the products of the FGEN-product line can be found in chapter 3.

6.2.2 Wiring diagrams

Ethernet

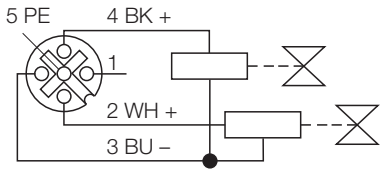
→ Ethernet (page 3-6)

Power supply

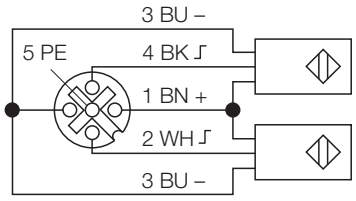
→ Operating/load voltage (page 3-6)

Figure 6-3: Wiring diagrams

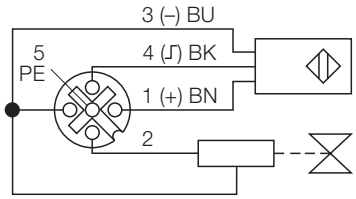
Connection of 2 actuators:

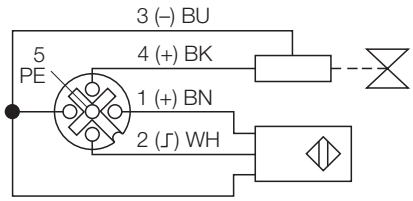


Connection of 2 sensors:



Combination of sensor and actuator:





6.2.3 Parameters

Table 6-5: Parameters

A *default setting*

Parameter name	Value	Description
Digital input (Inv. DI)	0 = normal **A**	
	1 = inverted	Inverts the digital input signal.
Output on overcurrent (SROx)	0 = activated **A**	The output switches on automatically after an overload.
	1 = deactivated	The output is manually switched-off after an overload.until a new set-command is given (rise and fall).
output	0 = deactivated	
	1 = activated **A**	

Further information about the parameter data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.3.3, Process data mapping FGEN-XSG16-x001 (page 7-17) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.4, Parameters (page 11-5)

6.2.4 Diagnostic messages

Table 6-6: Diagnostic messages

Diagnostics	Description
SCSx	Short circuit at sensor supply of the respective channel
SCOx	Short circuit at output of the respective channel

Further information about the diagnostic data mapping can be found in the fieldbus specific chapters.

- EtherNet/IP™: chapter 7.3.3, Process data mapping FGEN-IM16-x001 (page 7-11) ff.
- Modbus TCP: chapter 9.3.2, Register mapping of the FGEN-stations (page 9-11) ff.
- PROFINET: chapter 11.3, PROFINET-Error Codes (page 11-4)

7 Implementation of EtherNet/IP™

7.1 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.

7.1.1 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.

7.1.2 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.

- 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.

7.1.3 Communications profile of FGEN

FGEN 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:

- Unicast
- Multicast
- Cyclic Connection
- Unconnected (UCMM) Explicit Messaging
- Connected Explicit Messaging

Unicast

A point-to-point 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 gateway 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.

7.2 QC - QuickConnect

7.2.1 General

QuickConnect enables a PLC to build up connections to EtherNet/IP™-nodes in less than 300 ms after switching-on the power supply for the EtherNet/IP™-network. This fast start up of devices is above all necessary for robotic tool changes for example in the automobile industry.

Note

For correct cabling with FGEN in QC-applications, see Ethernet-connection in QC-/FSU-applications (page 3-6).

7.2.2 QuickConnect in FGEN

TURCK FGEN-stations support QuickConnect.

QuickConnect is activated:

- via the configuration data in the PLC-program per Assembly Class 0×04, Configuration Assembly 106, bit 9 = 1 (see also chapter 8, Activating QuickConnect (page 8-13)

or

- via Class Instance Attribute in TCP/IP Interface Object (0×F5), instance 1, attribute 12 (0×C0)

Note

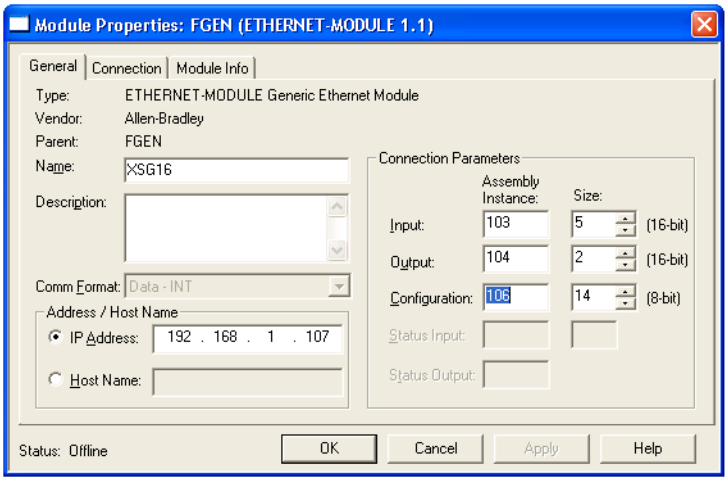
Activating the QuickConnect-function leads to the automatical setting of all necessary port-properties:

Autonegotiation	= deactivated
transmission speed	= 100BaseT
Duplex	= full duplex
Topology	= linear
AutoMDIX	= deactivated

QuickConnect via Configuration Assembly

The Configuration Assembly is part of the Assembly Class of the device and is defined during the station's configuration in the RS Logix-software by Rockwell Automation.

Figure 7-1: Configuration Assembly



Note

Further information about the configuration of FGEN-stations in the Rockwell software RS Logix can be found in chapter 8, Application example: FGEN for EtherNet/IP™ with Allen Bradley PLC and RS Logix 5000.

Quick Connect via Class Instance Attribute

Activate QuickConnect via Class Instance Attribute using the following setting:

Class	Instance	Attribute	Value
245 (0xF5)	1 (0x01)	12 (0x0C)	0: disabled (default) **1: enabled**

7.3 Classes and Instances of the EtherNet/IP™-stations

7.3.1 EtherNet/IP™ Standard Classes

The FGEN stations support the following EtherNet/IP™ Standard Classes in accordance with the CIP specification.

Table 7-1: EtherNet/IP™ Standard Classes

Class Code	Object name
01 (0×01)	Identity Object (0×01)
04 (0×04)	Assembly Object (0×04)
06 (0×06)	Connection Manager Object (0×06)
245 (0×F5)	TCP/IP Interface Object (0×F5)
246 (0×F6)	Ethernet Link Object (0×F6)

7.3.2 Identity Object (0×01)

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FGEN.

Class Attributes

Table 7-2: 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 7-3: Instance attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0×01)	VENDOR	G	UINT	Contains the vendor ID. 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_{dec} = 6A6F
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 7-4: 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]	e. g.: FGEN-XSG16-5001

Device Status

Table 7-4: Device Status

Bit	Name	Definition
0 to 1	reserved	Default = 0
2	Configured	TRUE = 1 → The application of the device has been configured (≠ default-settings).
3	reserved	Default = 0
4 to 7	Extended Device Status	0011 = no I/O connection 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 7-5: Common services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined list of the object's 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.

7.3.3 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 Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FGEN.

Class attributes

Table 7-6: 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 7-7: Instance attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
3 (0×03)	DATA	S	ARRAY OF BYTE	
4 (0×04)	SIZE	G	UINT	UINT Number of bytes in attr. 3 256 or variable

Common services

Table 7-8: Common services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	no	yes	Get_Attribute_Single

Configuration Assembly

Instance 106

- 14 byte configuration data

Byte 9, bit 1 is used to activate QuickConnect in the station (see also QuickConnect via Configuration Assembly (page 7-5)).

Process data instances

Instance 101

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

2 Bytes status information (see page 3-22)

+ process data

Instance 102

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

2 Bytes Control data (mapped, but not defined)

+ process data

Instance 103 und Instance 104

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

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

The effective size of the Assembly Instance can be determined using the Assembly Object (instance 0×67, attribute 0x04) and can be from 2 to 496 bytes large.

Process data mapping FGEN-IM16-x001

- No diagnostic message,
  Status- and control-word can be deactivated, see page 3-22.

IN = 4 Byte
OUT = 2 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	-	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of Process data bits (page 7-20)

- Summarized diagnostics activated, see page 7-36

IN = 6 Byte
OUT = 2 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	-	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of Process data bits (page 7-20)

- Manufacturer specific (scheduled diagnostics) activated, see page 7-36

IN = 8 Byte
OUT = 2 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	-	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	7	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							

→ Meaning of Process data bits (page 7-20)

Process data mapping FGEN-OM16-x001

- No diagnostic message,
  Status- and control-word can be deactivated, see page 3-22.

IN = 2 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

- Summarized diagnostics activated, see page 7-36

IN = 4 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

- Manufacturer specific (scheduled diagnostics) activated, see page 7-36

IN = 8 Byte
OUT = 4 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Diagnostics	2	-	-	-	-	-	-	-	I/O Diag
	3	-	-	Sched Diag	-	-	-	-	-
	4	-	-	-	-	-	-	-	-
	5	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
	6	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	7	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

Process data mapping FGEN-IOM88-x001

- No diagnostic message,
  Status- and control-word can be deactivated, see page 3-22.

IN = 4 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	-	-	-	-	-	-	-	-

→ Meaning of Process data bits (page 7-20)

- Summarized diagnostics activated, see page 7-36

IN = 6 Byte
OUT = 4 Byte

IN	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	-	-	-	-	-	-	-	-
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	-	-	-	-	-	-	-	-

→ Meaning of Process data bits (page 7-20)

- Manufacturer specific (scheduled diagnostics) activated, see page 7-36

IN = 8 Byte
OUT = 4 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
Diagnostics	3	-	-	-	-	-	-	-	-
	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	-	-	-	-	SCS3	SCS2	SCS1	SCS0
	7	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	-	-	-	-	-	-	-	-

→ Meaning of Process data bits (page 7-20)

Process data mapping FGEN-XSG16-x001

- No diagnostic message,
  Status- and control-word can be deactivated, see page 3-22.

IN = 4 Byte
OUT = 4 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C0P2	DI13 C0P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C3P4
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

- Summarized diagnostics activated, see page 7-36

IN = 6 Byte
OUT = 4 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C0P2	DI13 C0P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C3P4
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

- Manufacturer specific (scheduled diagnostics) activated, see page 7-36

IN = 10 Byte
OUT = 4 Byte

IN	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Status	0	U_L	-	-	-	-	-	-	Diag Warn
	1	-	FCE	-	-	CFG	COM	U_B	-
Inputs	2	DI7 C3P2	DI6 C3P4	DI5 C2P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
	3	DI15 C7P2	DI14 C0P2	DI13 C0P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C3P4
Diagnostics	4	-	-	-	-	-	-	-	I/O Diag
	5	-	-	Sched Diag	-	-	-	-	-
	6	SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
	7	SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
	8	SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
	9	-	-	-	-	-	-	-	-
OUT	**Byte**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Control	0	Control word (MSB)							
	1	Control word (LSB)							
Outputs	2	DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
	3	DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4

→ Meaning of Process data bits (page 7-20)

Meaning of Process data bits

Table 7-9: Meaning of Process data bits

Name	Meaning
I/O-data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = Pin
Diagnostics	
DiagWarn	see VSC 100, attr. 109 (6Dh), Status register 2 (page 7-30)
U_L	
U_B	
COM	
CFG	
FCE	
I/O Diag	Summarized diagnostic message of I/Os
SchedDiag	The mapping of the channel diagnostics to the process data is not activated.
SCSx	Short circuit at sensor supply of the respective channel
SCOx	Short circuit at output of the respective channel

7.3.4 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 Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to FGEN.

Common services

Table 7-10: 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

7.3.5 TCP/IP Interface Object (0×F5)

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 FGEN.

Class Attributes

Table 7-11: 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 7-12: Instance attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0×01)	STATUS	G	DWORD	Interface status (see page 7-23, Table 7-14: Interface Status)
2 (0×02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag (see page 7-23, Table 7-15: Configuration Capability)
3 (0×03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag (see page 7-24, Table 7-16: Configuration Control)
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 7-24)
	Specify IPaddress	G	UDINT	Current IP address
	NETWORK MASK	G	UDINT	Current network mask
	GATEWAY ADDR.	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
	DOMAIN NAME	G	UDINT	0 = no Domain Name configured
6 (0×06)	HOST NAME	G	STRING	0 = no Host Name configured (see page 7-24)
12 (0×0C)	Quick Connect	G/S	BOOL	0 = deactivate 1 = activate

Common services

Table 7-13: 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 7-2: 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 7-14: 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 7-15: 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.

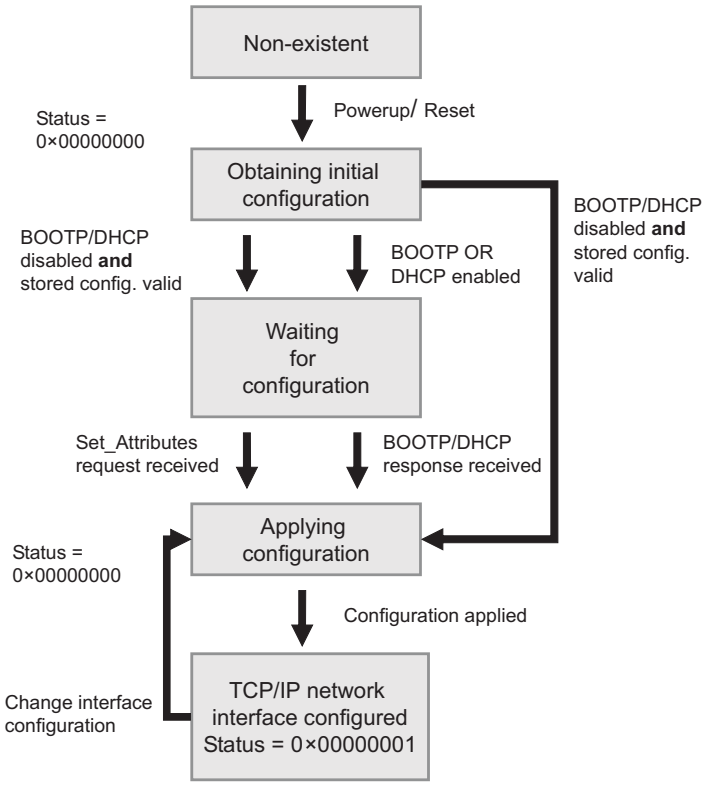
Table 7-16: Configuration Control

Bit(s)	Name	Definition
0-3	Startup Configuration	Determines how the device shall obtain its initial configuration at 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 0 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.

Figure 7-2: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)



7.3.6 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 FGEN.

Class Attributes

Table 7-17: 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 7-18: 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 7-19: Interface flags
3 (0×03)	PHYSICAL ADDRESS	G	ARRAY OF USINT	Contains the interface's MAC address (TURCK: 00:07:46:××:××:××)
6 (0×06)	INTERFACE CONTROL		2 WORD	Allows port-wise changes of the Ethernet-settings
7 (0×07)	INTERFACE TYPE			
10 (0×0A)	INTERFACE LABEL			

Table 7-19: 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 7-19: Interface flags

Bits	Name	Definition	Default value
2 to 4	Negotiation Status	Indicates the status of the automatic duplex-negotiation (auto-negotiation) 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). 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 7-20: 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

7.4 VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the FGEN-stations support the vendor specific classes described in the following.

Table 7-21: VSC-Vendor Specific Classes

Class Code dec. (hex.)	Name	Description
100 (64h)	Gateway Class, page 7-29	Contains data and settings concerning the fieldbus-specific part of the FGEN-stations.
102 (66h)	Process Data Class, page 7-31	Contains process data
117 (75h)	Digital Versatile Module Class, page 7-34	Describes the I/O-channels
126 (1Ah)	Miscellaneous Parameters Class, page 7-35	Describes the EtherNet/IP™-Port properties

7.4.1 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 7-22: Class instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	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.

7.4.2 Gateway Class (VSC 100)

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

Class instance

Note

Please refer to paragraph Class instance of the VSC (page 7-28) for the description of the class instance for the VSC.

Object Instance 1

Table 7-23: 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 station (USINT Maj./USINT Min.)
102 (66h)	Firmware revision	G	STRUCT	Contains the revision number of the Boot Firmware (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 station 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 7-24: 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 station status information: **Station** – Bit 15: reserved – Bit 14: "Force Mode Active Error" The Force Mode is activated. – Bit 13: reserved – Bit 12: reserved **Internal bus** – Bit 11 "I/O Cfg Modified Error" The configuration has been changed in an incompatible way. – Bit 10 "I/O Communication Lost Error" Communication on the internal module bus disturbed. **Voltage errors** – Bit 09 "U_{sys} too low" System voltage too low (< 18 VDC). – Bit 08: reserved – Bit 07: "U_L too low" Load voltage too low (< 18 VDC). – Bit 06: reserved – Bit 05: reserved – Bit 04: reserved **Warnings** – Bit 03: reserved – Bit 02: reserved – Bit 01: reserved – Bit 00: "I/O Diags Active Warning" At least one I/O-channel sends active diagnostics.
115 (73h)	ON IO CONNECTION TIMEOUT	G/S	ENUM USINT	Reaction to the I/O connection exceeding the time limit. SWITCH IO FAULTED (0): The modules are switched to Faulted State. SWITCH IO OFF (1): The gateway switches off the outputs of the modules. SWITCH IO HOLD (2): No further changes to the I/O-data. The outputs are held.
138 (0×8A)	GW Status register	Get/ Set	DWORD	Allows to enable/disable the status register which is part of the input data.
139 (0×8B)	GW Control Register	Get/ Set	DWORD	Allows to enable/disable the control register which is part of the output data.

Table 7-24: Object Instance 2, Gateway Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
140 (0×8C)	Disable Protocols	Get/ Set	UINT	Deactivation of the used Ethernet-protocols. Bit-assignment of the protocols: 0 = EtherNet/IP™ (can not be deactivated via the EtherNet/IP-interface) 1 = Modbus/TCP 2 = PROFINET 3 - 14 = reserved 15 = Web-server

7.4.3 Process Data Class (VSC102)

This class contains the process-relevant information.

Class instance

Note

Please refer to paragraph Class instance of the VSC, page 7-28, for the description of the class instances for VSC.

Object instance 1, standard input process data (compressed)

Table 7-25: Object instance 1, standard input process data (compressed)

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)	Attribute list	G	ARRAY OF USINT	List of all attributes that are supported by this Instance.
102 (66h)	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)

Table 7-26: Object instance 2, standard output process data (compressed)

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)	Attribute list	G	ARRAY OF USINT	List of all attributes that are supported by this Instance.
102 (66h)	Packed process input 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

Table 7-27: 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 7-36). Changes become valid after a start-up!
105 (69h)	GW manufacturer specific diagnostics (scheduled diagnostics)	G/S	BOOL	0 = disabled 1 = used for activating the mapping of the channel-specific diagnostic bits to the process input data page 7-36. Changes become valid after a start-up!
106 (6Ah)	reserved			-

Object Instance 4, COS/CYCLIC instance

Table 7-28: 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 station. Changes become valid after a start-up! 0 = standard: Data of COS message → input data. 1 = process input data (only the process data input image is transferred to scanner) 2 to 7: reserved

7.4.4 Digital Versatile Module Class (VSC117)

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

Object Instance

Table 7-29: 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 station-ID.
104 (68h)	Module order number	G	UDINT	Contains the ident number of the station.
105 (69h)	Module order name	G	SHORT STRING	Contains the name of the station.
106 (6Ah)	modules revision	G	USINT	Contains the revision number of the station.
107 (6Bh)	Module type ID	G	ENUM USINT	Describes the station type: 0×01: digital station
108 (6Ch)	Module command interface	G/S	ARRAY	The station's command interface. ARRAY OF: BYTE: Control byte sequence
109 (6Dh)	Module response interface	G	ARRAY	The station's response interface. ARRAY OF: BYTE: Response byte sequence
110 (6Eh)	modules registered index	G	ENUM USINT	Contains the index numbers specified in all the station lists.
111 (6Fh)	Module input channel count	G	USINT	Contains the number of input channels supported by the station.
112 (70h)	Module output channel count	G	USINT	Contains the number of output channels supported by the station.
Input data				
113 (71h)	Module input_1	G	DWORD	Input data of the respective I/Os.
Output data				
115 (73h)	Module output_1	G	DWORD	Output put data of the respective I/Os.

Table 7-29: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
Diagnostic data				
119 (77h)	Short circuit output error_1	G	DWORD	Short-circuit at output channel
121 (79h)	Short circuit sensor error_1	G	DWORD	Sensor short-circuit at channel
Parameter data				
127 (7Fh)	Invert input data_1	G/S	DWORD	The input signal is inverted (channel 1 to 16).
133 (85h)	Auto recovery output_1	G/S	DWORD	The outputs switch on automatically after an overload.
137 (89h)	Retriggered recovery output_1	G/S	DWORD	The outputs (channel 1 to 16) have to be retriggered in case of an overload.
139 (8Bh)	Enable high side output driver_1	G/S	DWORD	Enables the high side output driver of channels (channel 1 to 16).

7.4.5 Miscellaneous Parameters Class (VSC 126)

Instance 1 / Instance 2

Table 7-30: Object Instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (6Dh)	Ethernet port parameters	G/S	DWORD	0 = Autonegotiate, AutoMDIX **A** 1 = 100BaseT, half duplex, linear topology (AutoMDIX disabled) 2 = 10BaseT, full duplex, linear topology (AutoMDIX disabled) 3 = 100BaseT, half duplex, linear topology (AutoMDIX disabled) 4 = 10BaseT, full duplex, linear topology (AutoMDIX disabled)
112 (70h)	IO Controller Software revision	G	DWORD	The number of instances of this parameter depends on the number of I/O controllers.

7.5 Diagnostic messages via process data

Besides the evaluation of diagnostic data via Explicit Messages, FGEN with EtherNet/IP™ offers the possibility of mapping diagnostic data into the process data (see also the stations' process data mappings (page 7-11 ff.).

2 different forms of diagnostic data handling are provided:

- summarized diagnostics
- Scheduled Diagnostics

7.5.1 Summarized Diagnostics

If the summarized diagnostic data mode is activated, 1 bit indicates that at least one of the station channels sends a diagnosis.

This bit will be "0" if there are no diagnostic flags set on the device. If there are any diagnostic events on the device, the bit will be set to "1".

Bit „I/O Diag“

0 = OK, no diagnostics present

1 = at least one channel sends diagnostics

7.5.2 Scheduled Diagnostics (manufacturer specific diagnosis)

In FGEN-stations, the scheduled diagnostics feature (Process Data Class (VSC102) (page 7-31)) is used for mapping the channel diagnostic bits into the process data (see also the modules' process data mappings (page 7-11 ff.).

Bit „SchedDiag“

0 = no mapping of I/O-channel diagnostics to process data

1 = mapping of I/O-channel diagnostics to the process input data active

8 Application example: FGEN for EtherNet/IP™ with Allen Bradley PLC and RS Logix 5000

8.1 General

The following example shows detailed information about the connection of FGEN-stations for EtherNet/IP™ to an Allen Bradley PLC.

8.1.1 Used hard-/ software

Hardware

Hardware used in this example:

- Allen Bradley PLC 1756-L55/ A 1756-M12/A LOGIX5555
- Ethernet Bridge 1756-ENBT/A
- FGEN-IOM88-5001 (IP-address 192.168.1.90)
- FGEN-XSG16-5001 (IP-address 192.168.1.107)

Software

Software used in this example:

- RS Logix 5000 - used to configure the controller and the other network hosts

8.2 Network configuration

The FGEN-stations are delivered with the IP address **192.168.1.1**.

Note

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

To achieve this, you have either

- to adjust the FGEN'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 3, Connection possibilities, page 3-6.

  or

- to change the IP address of the used PC or network interface card (for detailed information, please read the Changing the IP address of a PC/ network interface card (page 14-2).

8.2.1 Configuration of the network in "RS Logix 5000"

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

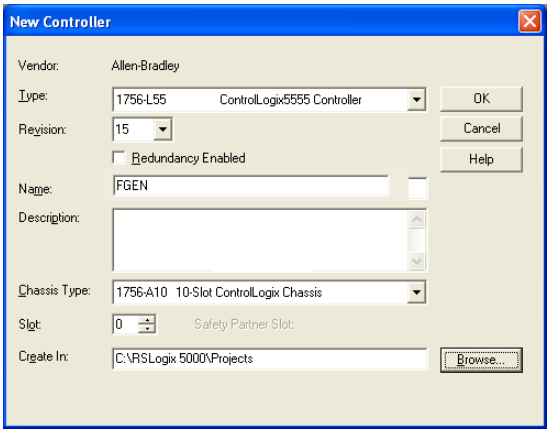
Start RS Logix and open a new project using the "File" menu.

Figure 8-1: Creating a new project in RS Logix

Configuration of the controller

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

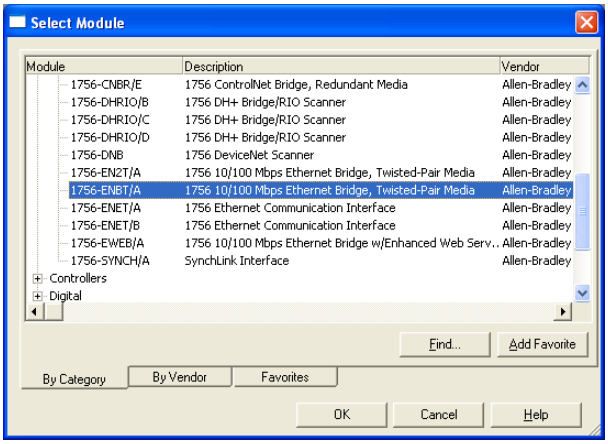
Figure 8-2: Configuration of the controller



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.

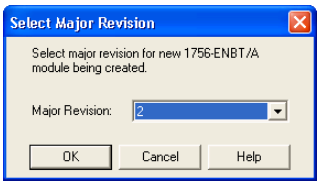
Open "Communications" and select the bridge. In this example this would be 1756-ENBT/A.

Figure 8-3: Configuration of the EtherNet/IP™ Bridge



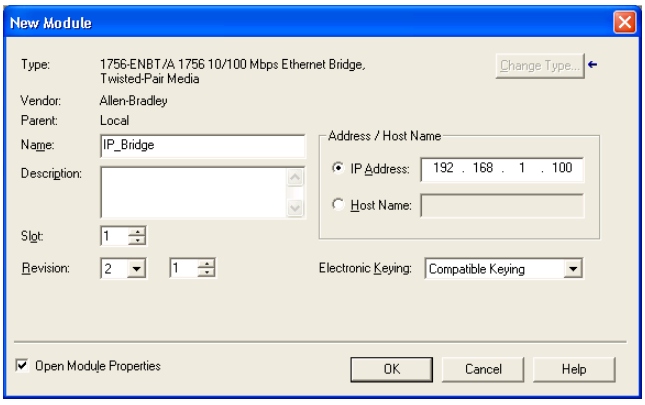
Enter the "Major Revision" of your EtherNet/IP™ bridge and click "OK".

Figure 8-4: 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 8-5: Configuration of the EtherNet/IP™ Bridge



In the following dialog box "Module Properties: Local..." press "OK".

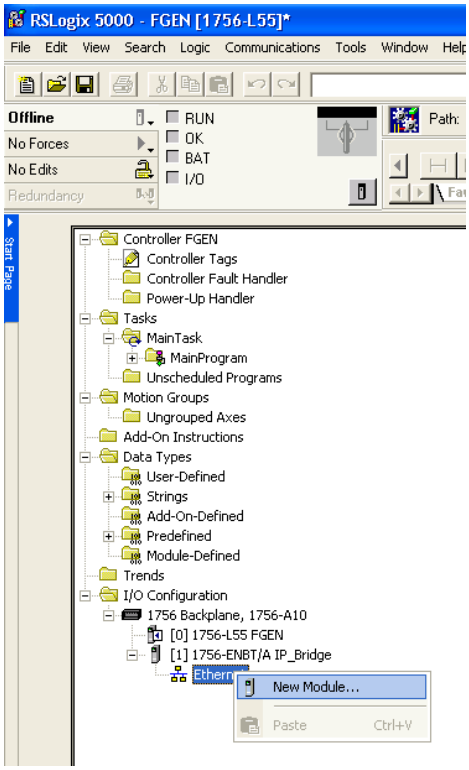
The configuration of the interface is completed.

Press "Finish" to close the dialog box

Dimensions for the FGEN-stations

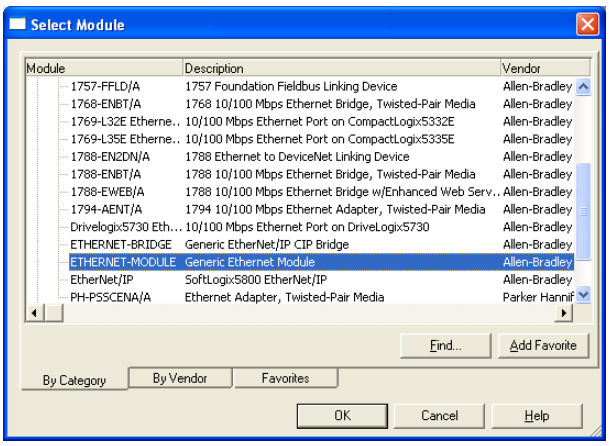
1 Add the stations to the I/O configuration by using a right-click on the EtherNet/IP™ bridge module 1756-ENBT/A and select "New Module".

Figure 8-6: Adding an FGEN to the I/O configuration



2 Open "Communications" and select the entry "Generic Ethernet Module" to configure the station.

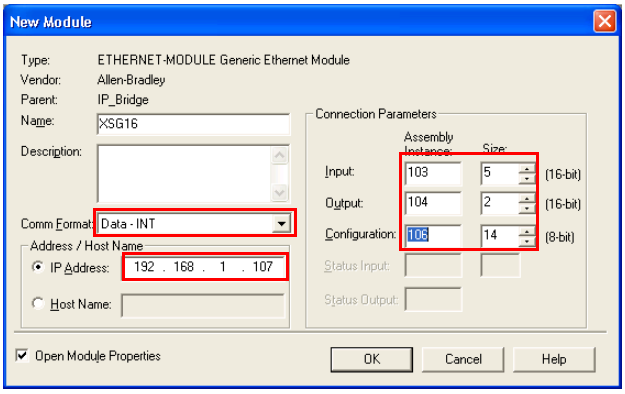
Figure 8-7: Add generic Ethernet module



3 Enter the necessary device information, like "Module name" and "Communication format" and define the station's IP-address and the connection parameters.

4 In the Assembly Instances 103 and 104, please enter the connection parameters of the station.

Figure 8-8: Configuration of FGEN-IOM-5001

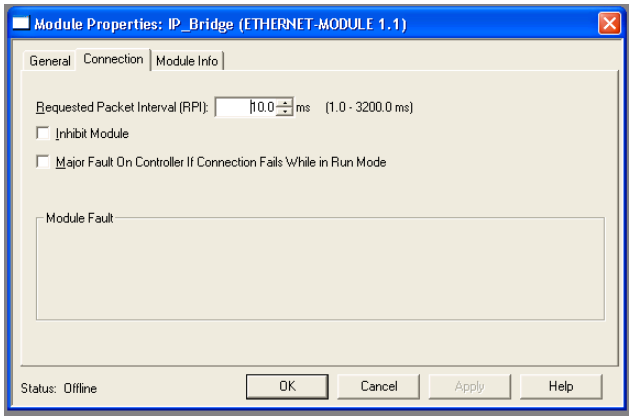


Note

If the variable Assembly Instances 103 and 104 (see page 7-9) are used, the Connection Parameters have to be set according to the actual station configuration which means, the in- and output sizes have to match the sizes definitely required by the station. This required in- and output size 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.

5 In the "Connection" tab set the "Requested Packet Interval" (RPI) to 10 ms, which normally should be the default setting. For FGEN, the RPI should be set to 5 ms or higher.

Figure 8-9: Set connection options for FGEN



6 Configuration of FGEN-IOM-5001

Figure 8-10: Configuration of FGEN-IOM-5001

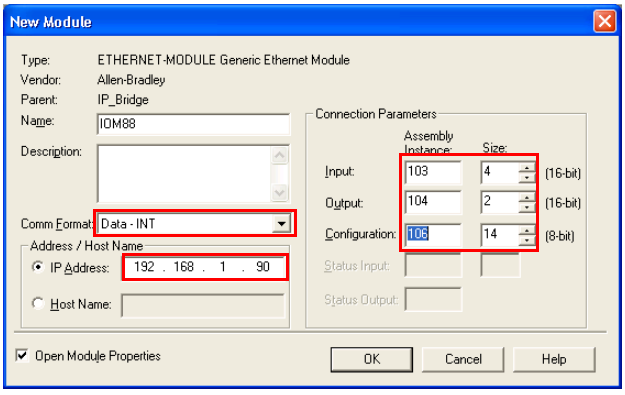
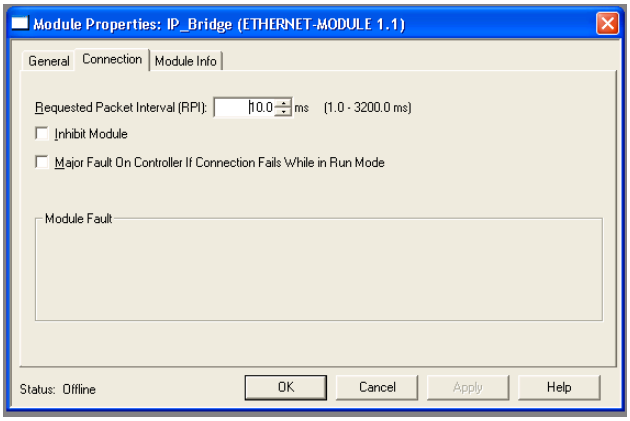
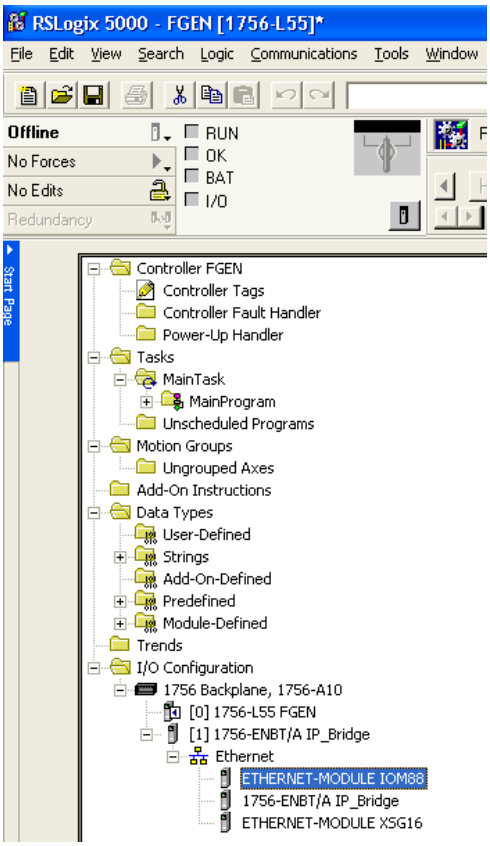


Figure 8-11: Set connection options for FGEN



7 The both stations are now added to the project tree.

Figure 8-12: Project tree with FGEN-stations

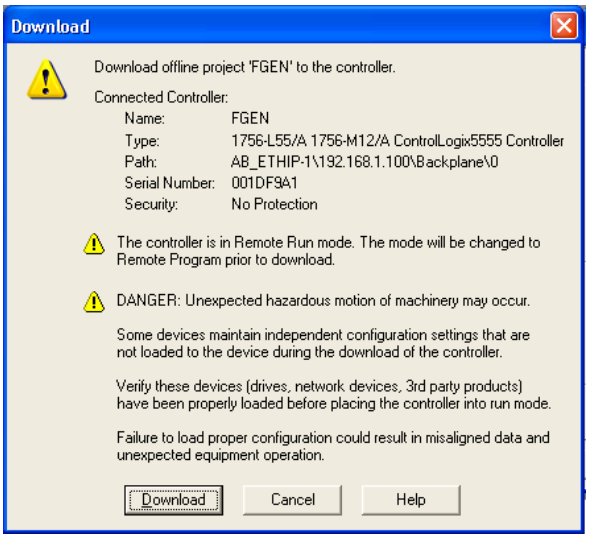


8.2.2 Downloading the I/O configuration

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

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

Figure 8-13: Download of the configuration



3 If an error message is generated, warning, that the communication path can not be found, please open the "Path" menu (see Figure 8-15:), select your controller and press "Set Project Path" (see Figure 8-16:).

Figure 8-14: Error message

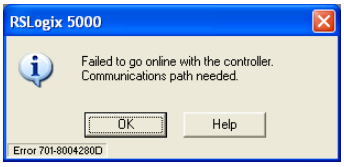


Figure 8-15: Communication path

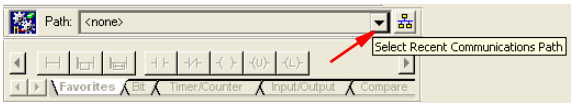
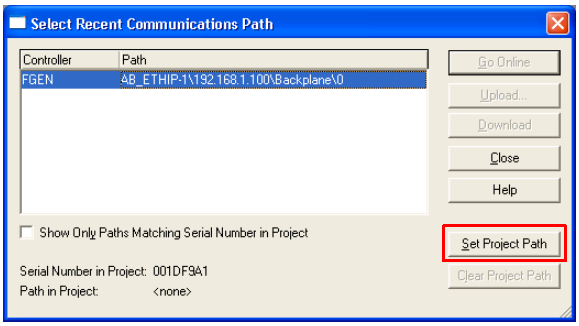


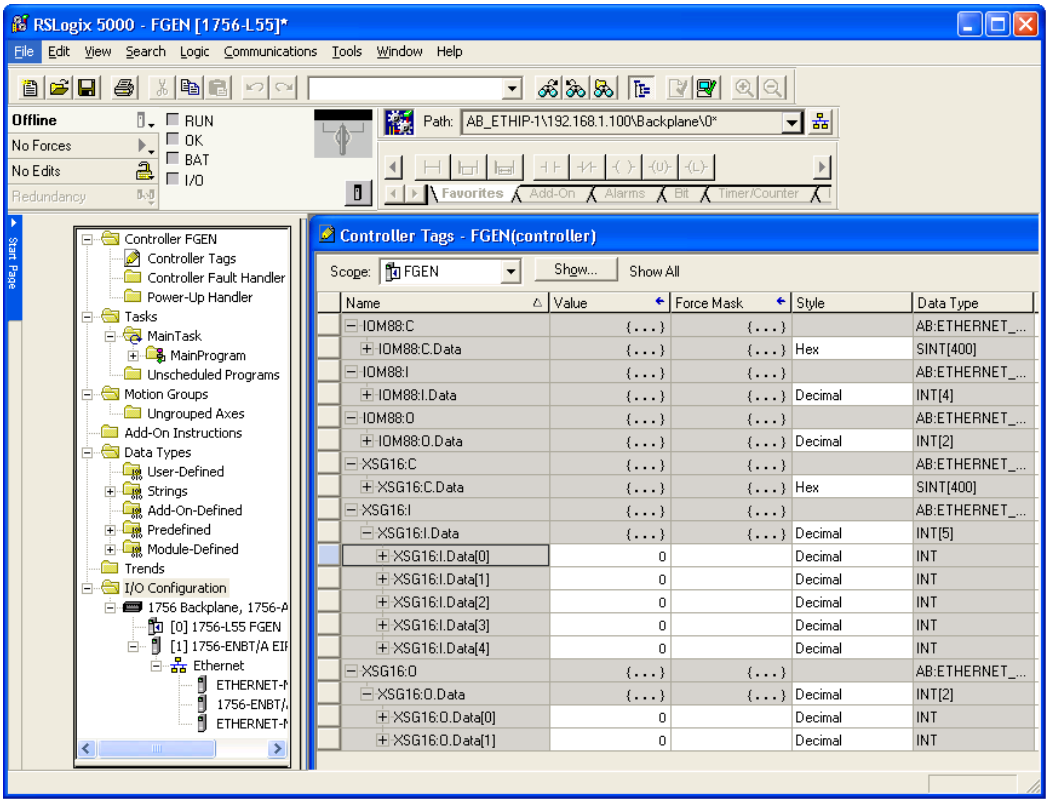
Figure 8-16: Communication path



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 FGEN-stations is shown in the "Controller Tags":

Figure 8-17: Controller Tags



The controller tags are divided into:

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

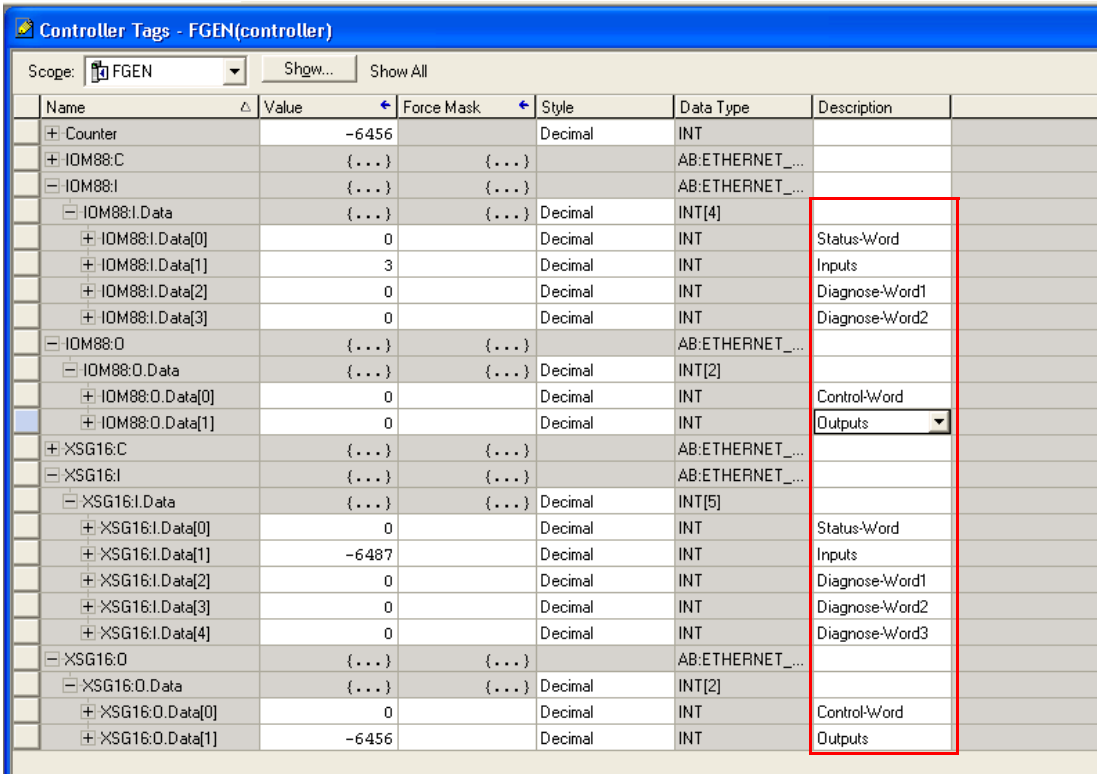
8.3 I/O data mapping

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

The data mapping depends on process data mappings of the configured FGEN-modules (see chapter 7.3.3, Assembly Object (0×04), Process data mapping FGEN-IM16-x001 (page 7-11) ff.).

For the configured FGEN-modules, the mapping is the following:

Figure 8-18: Dimensions for the FGEN-stations



Name	Value	Force Mask	Style	Data Type	Description
Counter	-6456		Decimal	INT	
IOM88:C	{...}	{...}		AB:ETHERNET_...	
IOM88:I	{...}	{...}		AB:ETHERNET_...	
IOM88:I.Data	{...}	{...}	Decimal	INT[4]	
IOM88:I.Data[0]	0		Decimal	INT	Status-Word
IOM88:I.Data[1]	3		Decimal	INT	Inputs
IOM88:I.Data[2]	0		Decimal	INT	Diagnose-Word1
IOM88:I.Data[3]	0		Decimal	INT	Diagnose-Word2
IOM88:O	{...}	{...}		AB:ETHERNET_...	
IOM88:O.Data	{...}	{...}	Decimal	INT[2]	
IOM88:O.Data[0]	0		Decimal	INT	Control-Word
IOM88:O.Data[1]	0		Decimal	INT	Outputs
XSG16:C	{...}	{...}		AB:ETHERNET_...	
XSG16:I	{...}	{...}		AB:ETHERNET_...	
XSG16:I.Data	{...}	{...}	Decimal	INT[5]	
XSG16:I.Data[0]	0		Decimal	INT	Status-Word
XSG16:I.Data[1]	-6487		Decimal	INT	Inputs
XSG16:I.Data[2]	0		Decimal	INT	Diagnose-Word1
XSG16:I.Data[3]	0		Decimal	INT	Diagnose-Word2
XSG16:I.Data[4]	0		Decimal	INT	Diagnose-Word3
XSG16:O	{...}	{...}		AB:ETHERNET_...	
XSG16:O.Data	{...}	{...}	Decimal	INT[2]	
XSG16:O.Data[0]	0		Decimal	INT	Control-Word
XSG16:O.Data[1]	-6456		Decimal	INT	Outputs

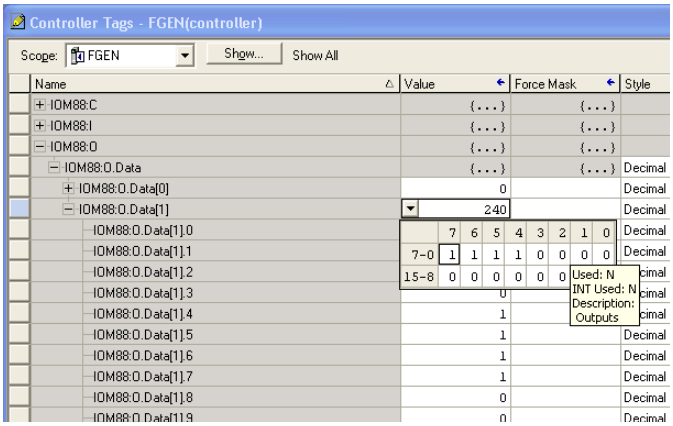
8.4 Process data access

8.4.1 Setting outputs

Example:

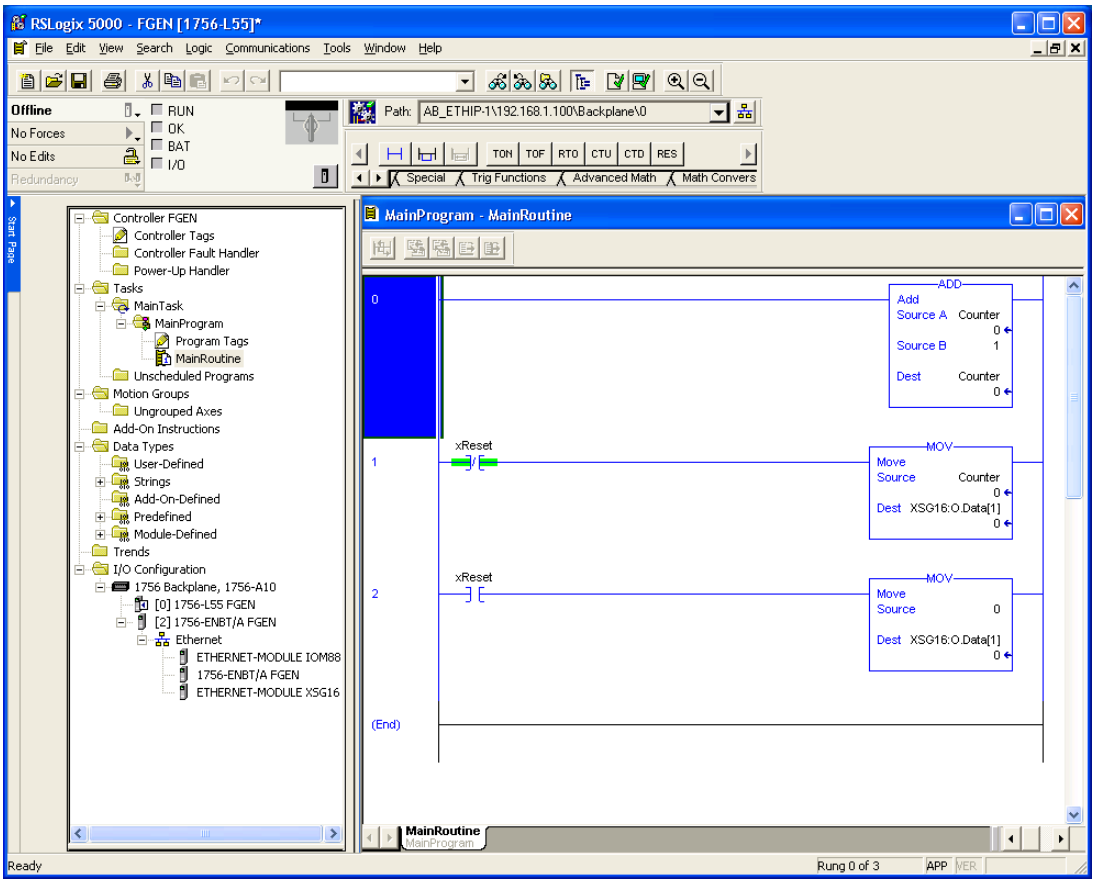
To set the outputs "0" and "1" at the station **FGEN-IOM88-5001**, bit 0 bit 1 in output data word 1 (IOM88:O.Data [1]) have to be set (see above Figure 8-16:, I/O data mapping).

Figure 8-19: Setting outputs at FGEN-IOM88-5001



8.4.2 Example program

Figure 8-20: Example program

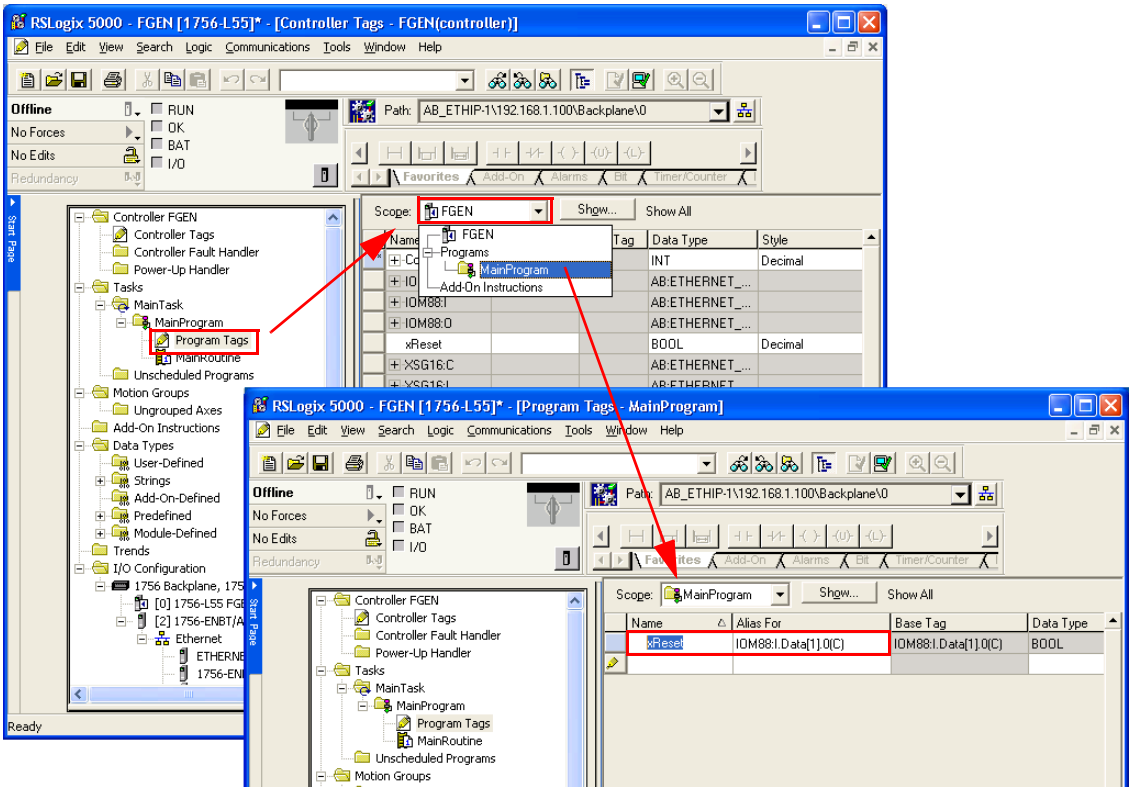


1 The counter counts upwards.

2 The counter value is moved to the outputs of the FGEN-XSG16-4001, Word XSG16:0.Data [1].

3 The counter is set to "0" by setting the variable "xReset" (BOOL) to "1".
"xReset" has been defined and mapped to Bit IOM88:I.Data[1].0 by building an Alias in the Main Program :

Figure 8-21: Definition and mapping of xReset

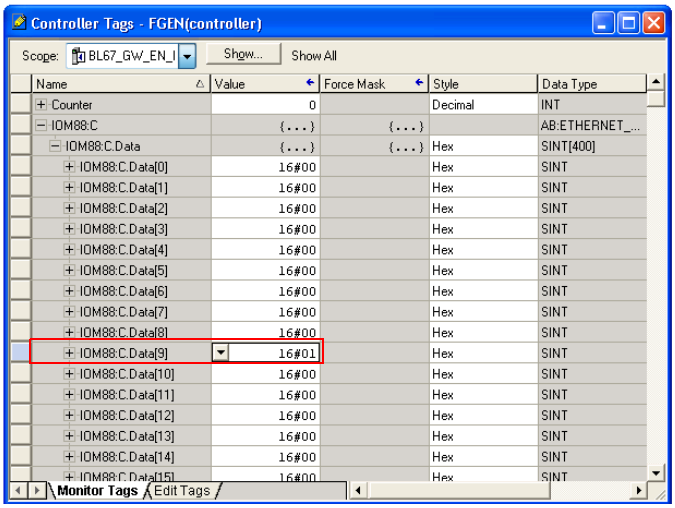


8.5 Activating QuickConnect

The QuickConnect-function of the FGEN-stations is activated via:

- Configuration Assembly,
  byte 9, bit 1.

Figure 8-22: Activating the QuickConnect-function



Note

Further information about QuickConnect can also be found in chapter 7, QuickConnect in FGEN (page 7-4).

9 Implementation of Modbus TCP

9.1 Common Modbus description

Note

The following description of the Modbus protocol is taken from the Modbus Application Protocol Specification V1.1 of Modbus-IDA.

Modbus is an application layer messaging protocol, positioned at level 7 of the OSI model, that provides client/server communication between devices connected on different types of buses or networks.

The industry's serial de facto standard since 1979, Modbus continues to enable millions of automation devices to communicate. Today, support for the simple and elegant structure of Modbus continues to grow.

The Internet community can access Modbus at a reserved system port 502 on the TCP/IP stack.

Modbus is a request/reply protocol and offers services specified by function codes. Modbus function codes are elements of Modbus request/reply PDUs (Protocol Data Unit).

It is currently implemented using:

- TCP/IP over Ethernet. (that is used for the FGEN-modules and described in the following)
- Asynchronous serial transmission over a variety of media (wire: RS232, RS422, RS485, optical: fiber, radio, etc.)
- Modbus PLUS, a high speed token passing network.

Schematic representation of the Modbus Communication Stack (according to Modbus Application Protocol Specification V1.1 of Modbus-IDA):

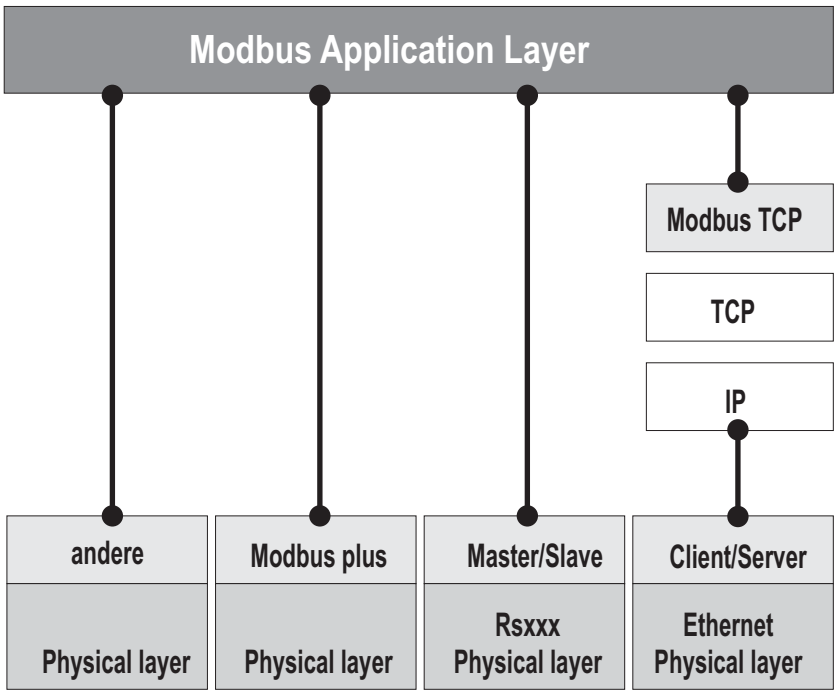


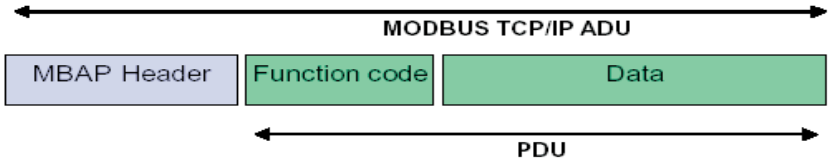
Figure 9-1: Schematic representation of the Modbus Communication Stack

9.1.1 Protocol description

The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers.

The mapping of Modbus protocol on specific buses or network can introduce some additional fields on the application data unit (ADU).

Figure 9-2: Modbus telegram acc. to Modbus-IDA



The Modbus application data unit is built by the client that initiates a Modbus transaction.

The function code indicates to the server what kind of action to perform.

The Modbus application protocol establishes the format of a request initiated by a client.

The field function code of a Modbus data unit is coded in one byte. Valid codes are in the range of 1... 255 decimal (128 – 255 reserved for exception responses).

When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid.

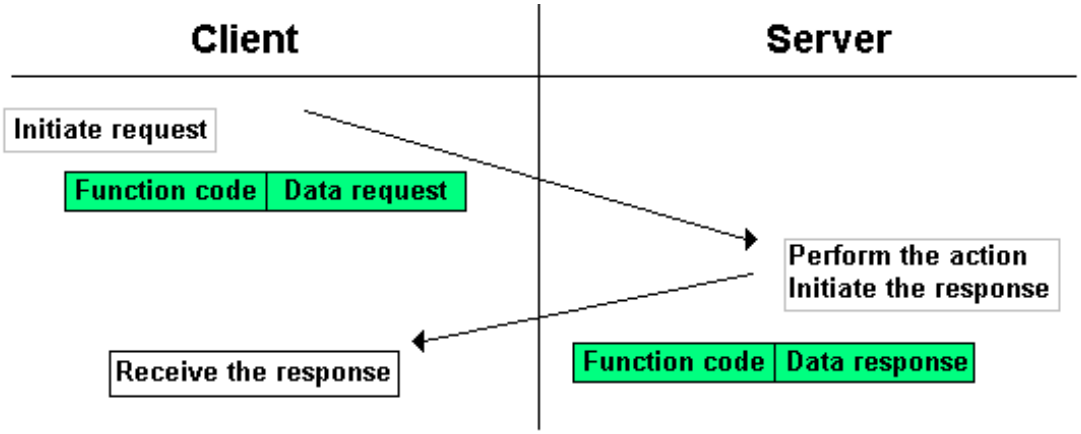
Sub-function codes are added to some function codes to define multiple actions.

The data field of messages sent from a client to server devices contains additional information that the server uses to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of items to be handled, and the count of actual data bytes in the data field.

The data field may be non-existent (= 0) in certain kinds of requests, in this case the server does not require any additional information. The function code alone specifies the action.

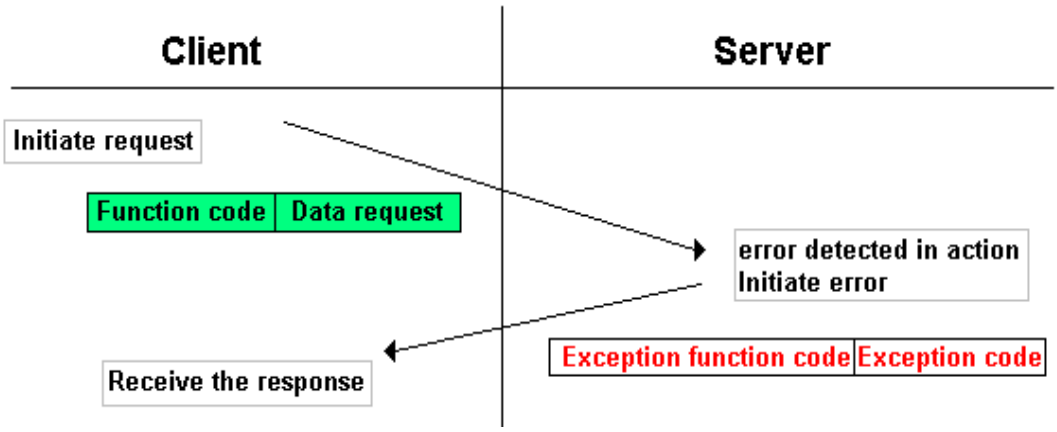
If no error occurs related to the Modbus function requested in a properly received Modbus ADU the data field of a response from a server to a client contains the data requested.

Figure 9-3: Modbus data transmission (acc. to Modbus-IDA)



If an error related to the Modbus function requested occurs, the field contains an exception code that the server application can use to determine the next action to be taken.

Figure 9-4: Modbus data transmission (acc. to Modbus-IDA)



9.1.2 Data model

The data model distinguishes 4 basic data types:

Table 9-1: Data types for Modbus

Data Type	Object type	Access	Comment
Discrete Inputs	Bit	Read	This type of data can be provided by an I/O system.
Coils	Bit	Read-Write	This type of data can be alterable by an application program.
Input Registers	16-bit, (word)	Read	This type of data can be provided by an I/O system.
Holding Registers	16-bit, (word)	Read-Write	This type of data can be alterable by an application program.

For each of these basic data types, the protocol allows individual selection of 65536 data items, and the operations of read or write of those items are designed to span multiple consecutive data items up to a data size limit which is dependent on the transaction function code.

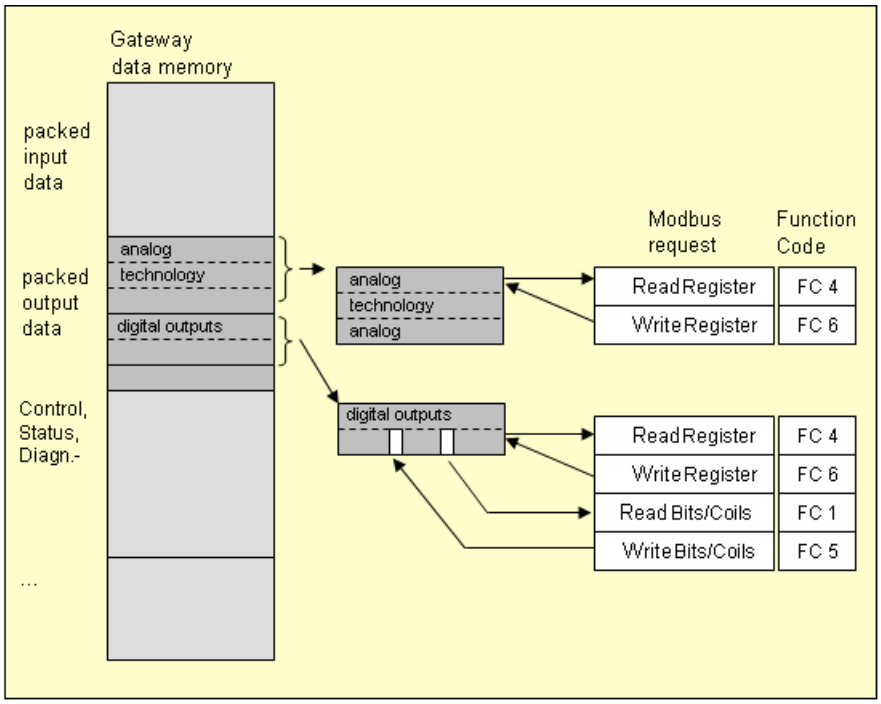
It's obvious that all the data handled via Modbus (bits, registers) must be located in device application memory.

Access to these data is done via defined access-addresses (see „Modbus registers“, page 9-7).

The example below shows the data structure in a device with digital and analog in- and outputs.

FGEN devices have only one data block, whose data can be accessed via different Modbus functions. The access can be carried out either via registers (16-bit-access) or, for some of them, via single-bit-access.

Figure 9-5: Picture of the data memory of the FGEN modules



9.2 Implemented Modbus functions

The FGEN stations for Modbus TCP support the following functions for accessing process data, parameters, diagnostics and other services.

Table 9-2: Implemented functions

Function codes	
No.	**Function** Description
1	**Read Coils**
	Serves for reading multiple output bits.
2	**Read Discrete Inputs**
	Serves for reading multiple input bits.
3	**Read Holding Registers**
	Serves for reading multiple output registers.
4	**Read Input Registers**
	Serves for reading multiple input registers.
5	**Write Single Coil**
	Serves for writing a single output bit.
6	**Write Single Register**
	Serves for writing a single output register.
15	**Write Multiple Coils**
	Serves for writing multiple output bits.
16	**Write Multiple Registers**
	Serves for writing multiple output registers.
23	**Read/Write Multiple Registers**
	Reading and writing of multiple registers.

9.3 Modbus registers

Note

The Table 9-5:, page 9-10 shows the register mapping for the different Modbus addressing methods.

Table 9-3: Ident number of the station

A *ro = read only*
rw = read/write

Address (hex.)	Access A	Description
0x0000 to 0x01FF	ro	packed process data of inputs (process data length of the modules → see Table 9-5: (process data length of the stations)
0x0800 to 0x09FF	rw	packed process data of outputs (process data length of the modules → see Table 9-5: (process data length of the stations)
0x1000 to 0x1006	ro	Station Identifier
0x100C	ro	Station status (see Table 9-7: Register 100Ch: Station status)
0x1012	ro	process image length in bit for the intelligent output modules
0x1013	ro	process image length in bit for the intelligent input modules
0x1017	ro	Register-mapping-revision (always 1, if not, mapping is incompatible with this description)
0x1020	ro	watchdog, actual time [ms]
0x1120	rw	watchdog predefined time [ms] (default: 0), see also Error behavior of outputs (watchdog) (page 9-20))
0x1130	rw	Modbus connection mode register, page 9-17
0x1131	rw	Modbus connection timeout in sec. (Def.: 0 = never), page 9-17
0x113C to 0x113D	rw	Modbus parameter restore, page 9-17 (reset of parameters to default values)
0x113E to 0x113F	rw	Modbus parameter save, page 9-18 (permanent storing of parameters)
0x1140	rw	deactivate protocol Deactivates explicitly the selected Ethernet-protocol: 0 = EtherNet/IP™ 1 = Modbus/TCP 2 = PROFINET 15 = web server

Table 9-3: Ident number of the station

Address (hex.)	Access A	Description
0x1141	ro	active protocol 0 = EtherNet/IP™ 1 = Modbus/TCP 2 = PROFINET 15 = web server
0x2400	ro	System voltage U_{SYS} [mV]: 0 if < 18 V
0x2401	ro	Load voltage U_L [mV]: 0 if < 18 V
0x8000 to 0x8400	ro	process data inputs (32 registers per station)
0x9000 to 0x9400	rw	process data outputs (32 registers per station)
0xA000 to 0xA400	ro	diagnostics (32 registers per station)
0xB000 to 0xB400	rw	parameters (32 registers per station)

The following table shows the register mapping for the different Modbus addressing methods

Table 9-4: Mapping of Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
packed input data	0×0000 to 0×01FF	0 to 511	40001 to 40512	400001 to 400512
packed output data	0×0800 to 0×09FF	2048 to 2549	42049 to 42560	402049 to 402560
Station Identifier	0×1000 to 0×1006	4096 to 4102	44097 to 44103	404097 to 404103
Station status	0×100C	4108	44109	404109
process image length in bit for the intelligent output modules	0x1010	4112	44113	404113
process image length in bit for the intelligent input modules	0x1011	4113	44114	404114
process image length in bit for the digital output modules	0x1012	4114	44115	404115
process image length in bit for the digital input modules	0x1013	4115	44116	404116
watchdog, actual time	0x1020	4128	44129	404129
watchdog, predefined time	0x1120	4384	44385	404385
Modbus connection mode register	0x1130	4400	44401	404401
Modbus connection timeout in sec.	0x1131	4401	44402	404402
Modbus parameter restore	0x113C to 0x113D	4412 to 4413	44413 to 44414	404413 to 404414
Modbus parameter save	0x113E to 0x113F	4414 to 4415	44415 to 44416	404415 to 404416
deactivate protocol	0x1140	4416	44417	404417
active protocol	0x1141	4417	44418	404418
System voltage U_{SYS} [mV]	0x2400	9216	49217	409217
Load voltage U_L [mV]	0x2401	9217	49218	409218
process data inputs (max. 2 registers per station)	0×8000, 0×8001	32768 32769	-	432769 432770
process data outputs (max. 2 registers per station)	0×9000, 0×9001	36864, 36865	-	436865, 436866

Table 9-4: Mapping of Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
diagnostics (max. 2 registers per station)	0×A000, 00A001	40960, 40961	-	440961, 440962
diagnostics (max. 4 registers per station)	0×B000, 0×B001	45056, 45057	-	445057, 445058

9.3.1 Data width of the I/O-modules in the modbus-register area

The following table shows the data width of the FGEN-stations within the modbus register area and the type of data alignment.

Table 9-5: (process data length of the stations

Station	Process input	Process output	Alignment
FGEN-IM16-x001	16 Bit	-	bit by bit
FGEN-OM16-x001	-	16 Bit	bit by bit
FGEN-IOM88-x001	8 Bit	8 Bit	bit by bit
FGEN-XSG16-x001	16 Bit	16 Bit	bit by bit

9.3.2 Register mapping of the FGEN-stations

FGEN-IM16-x001

register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
packed input data									
0×0000	Inputs	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
		DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
0×0001	Status Word	-	-	-	-	-	-	-	Diag Warn
		-	FCE	-	-	CFG	COM	U_B	-
0×0002	group diagnostics	-	-	-	-	-	-	-	I/O Diag
		-	-	-	-	-	-	-	-
Inputs									
0×8000		DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
		DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
Diagnostic data									
0×A000		SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
		-	-	-	-	-	-	-	-
Parameters									
0×B000		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
0×B001		Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
		Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8

→ Meaning of the register bits (page 9-15)

FGEN-OM16-x001

register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
packed input data									
0×0001	Status Word	U_L	-	-	-	-	-	-	Diag Warn
		-	FCE	-	-	CFG	COM	U_B	-
0×0002	group diagnostics	-	-	-	-	-	-	-	I/O Diag
		-	-		-	-	-	-	-
packed output data									
0×0800		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Outputs									
0×9000		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Diagnostic data									
0×A000		-	-	-	-	-	-	-	-
		SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
0×A001		SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
		-	-	-	-	-	-	-	-
Parameters									
0×B000		SROx7	SROx6	SROx5	SROx4	SROx3	SROx2	SROx1	SROx0
		SROx15	SROx14	SROx13	SROx12	SROx11	SROx10	SROx9	SROx8

→ Meaning of the register bits (page 9-15)

FGEN-IOM88-x001

register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
packed input data									
0×0000	Inputs	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
		-	-		-	-	-	-	-
0×0001	Status Word	U_L	-	-	-	-	-	-	Diag Warn
		-	FCE	-	-	CFG	COM	U_B	-
0×0002	group diagnostics	-	-	-	-	-	-	-	I/O Diag
		-	-	-	-	-	-	-	-
Inputs									
0×8000		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		-	-		-	-	-	-	-
packed output data									
0×0800		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 0P2	DO0 C0P4
		-	-	-	-	-	-	-	-
Outputs									
0×9000		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		-	-	-	-	-	-	-	-
Diagnostics									
0×A000		-	-	-	-	SCS3	SCS2	SCS1	SCS0
		SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
Parameters									
0×B000		Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
		SROx7	SROx6	SROx5	SROx4	SROx3	SROx2	SROx1	SROx0

→ Meaning of the register bits (page 9-15)

FGEN-XSG16-x001

register		Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
packed input data									
0×0000	Inputs	DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
		DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
0×0001	Status Word	U_L	-	-	-	-	-	-	Diag Warn
		-	FCE	-	-	CFG	COM	U_B	-
0×0002	group diagnostics	-	-	-	-	-	-	-	I/O Diag
		-	-	-	-	-	-	-	-
Inputs									
0×8000		DI7 C3P2	DI6 C3P4	DI5 C0P2	DI4 C2P4	DI3 C1P2	DI2 C1P4	DI1 C0P2	DI0 C0P4
		DI15 C7P2	DI14 C7P4	DI13 C6P2	DI12 C6P4	DI11 C5P2	DI10 C5P4	DI9 C4P2	DI8 C4P4
packed output data									
0×0800		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Outputs									
0×9000		DO7 C3P2	DO6 C3P4	DO5 C2P2	DO4 C2P4	DO3 C1P2	DO2 C1P4	DO1 C0P2	DO0 C0P4
		DO15 C7P2	DO14 C7P4	DO13 C6P2	DO12 C6P4	DO11 C5P2	DO10 C5P4	DO9 C4P2	DO8 C4P4
Diagnostics									
0×A000		SCS7	SCS6	SCS5	SCS4	SCS3	SCS2	SCS1	SCS0
		SCO7	SCO6	SCO5	SCO4	SCO3	SCO2	SCO1	SCO0
0×A001		SCO15	SCO14	SCO13	SCO12	SCO11	SCO10	SCO9	SCO8
		-	-	-	-	-	-	-	-
Parameters									
0×B000		-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
0×B001		Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
		Inv. DI5	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
0×B002		SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
		SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
0×B003		EN DO7	EN DO6	EN DO5	EN DO4	EN DO3	EN DO2	EN DO1	EN DO0
		EN DO15	EN DO14	EN DO13	EN DO12	EN DO11	EN DO10	EN DO9	EN DO8

→ Meaning of the register bits (page 9-15)

Meaning of the register bits

Table 9-6: Meaning of the register bits

Name	Meaning
I/O-data	
DIx	DI = digital input
DOx	DO = digital output
Cx	C = connector
Px	P = Pin
Diagnostics	
DiagWarn	See Register 100Ch: "Station status" (page 9-16)
U_B	
U_L	
COM	
CFG	
FCE	
I/O Diag	Summarized diagnostic message of I/Os
SCSx	Short circuit at sensor supply of the respective channel
SCOx	Short circuit at output of the respective channel
Parameters	
Inv. DIx	The input signal at the respective channel is inverted.
SROx	0 = activated **A** The output switches on automatically after an overload. 1 = deactivated The output is manually switched-off and on again.
EN DOx	Deactivates or resp. activates the output at the respective connector of the device. 0 = deactivated 1 = activated **A**

9.3.3 Register 100Ch: "Station status"

This register contains a general gateway/ station status.

Table 9-7: Register 100Ch: Station status

Bit	Name	Description
Station		
15	-	-
14	FCE	The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.
13	-	-
12	-	-
Module bus		
11	CFG	I/O configuration error
10	COM	Communication on the internal module bus disturbed.
Voltage errors		
9	U_B	System supply voltage too low (< 18 V DC).
8	-	-
7	U_L	Load voltage too low (< 18 V DC).
6	-	-
5	-	-
4	-	-
Warnings		
3	-	-
2	-	-
1	-	-
0	DiagWarn	Diagnostic messages are available.

9.3.4 Register 1130h: „Modbus-Connection-Mode“

This register defines the behavior of the Modbus connections:

Table 9-8: Register 1130h: Modbus-Connection-Mode

Bit	Name – Description
15 to 2	reserved
1	**MB_ImmediateWritePermission** – **0**: With the first write access, a write authorization for the respective Modbus-connection is requested. If this request fails, an exception response with exception-code 01h is generated. If the request is accepted, the write access is executed and the write authorization remains active until the connection is closed. – **1**: The write authorization for the respective Modbus-connection is already opened during the establishment of the connection. The first Modbus-connection thus receives the write authorization, all following connections don’t (only if bit 0 = 1).
0	**MB_OnlyOneWritePermission** – **0**: all Modbus-connections receive the write authorization – **1**: only one Modbus-connection can receive the write permission. A write permission is opened until a Disconnect. After the Disconnect the next connection which requests a write access receives the write authorization.

9.3.5 Register 1131h: „Modbus-Connection-Timeout“

This register defines after which time of inactivity a Modbus-connection is closed through a Disconnect.

9.3.6 Register 0×113C und 0×113D: „Restore Modbus-Connection-Parameters”

Registers 0×113C and 0×113D serve for resetting the parameter-register 0×1120 and 0×1130 to 0×113B to the default settings.

For this purpose, write "0×6C6F" in register 0×113C. To activate the reset of the registers, write "0×6164" ("load") within 30 seconds in register 0×113D.

Both registers can also be written with one single request using the function codes FC16 and FC23.

The service resets the parameters without saving them. This can be achieved by using a following "save" service.

9.3.7 Register 0×113E und 0×113F: „Save Modbus-Connection-Parameters“

Registers 0×113E and 0×113F are used for the non-volatile saving of parameters in registers 0×1120 and 0×1130 to 0×113B.

or this purpose, write "0×7361" in register 0×113E. To activate the saving of the registers, write "0×7665" ("save") within 30 seconds in register 0×113F.

Both registers can also be written with one single request using the function codes FC16 and FC23.

9.4 Bit areas: mapping of input-discrete- and coil-areas

The digital in- and outputs can be read and written (for outputs) as registers in the data area of the packed in- and output process data.

Note

In the packed process data, the digital I/O data are stored following the variable in- and output data area of the intelligent I/Os, which means they are stored with a variable offset, depending on the station's I/O-configuration.

In order to set for example a single output (single coil), the following functions are available for reading and writing single bits:

- FC1 („Read Coils"),
- FC2 („Read Discrete Inputs"),
- FC 5 („Write Single Coil")
- FC15 („Write Multiple Coils")

Data mapping in the input-discrete- and coil-areas:

- Mapping: input-discrete
  All digital inputs are stored in this area (offset "0").
- Mapping: coils
  All digital outputs are stored in this area (offset "0").

9.5 Error behavior of outputs (watchdog)

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120, page 9-7):

- watchdog = 0 ms (default)
  → outputs hold the momentary value
- watchdog > 0 ms
  → outputs switch to **0** after the watchdog time has expired (setting in register 0×1120) .

Note

Setting the outputs to predefined substitute values is not possible in Modbus TCP. Eventually parameterized substitute values will not be used.

9.6 Parameters and diagnostic messages of the I/O channels

Note

Please find explanations regarding parameters and diagnostic messages in the section Register mapping of the FGEN-stations (page 9-11).

10 Application example FGEN for Modbus TCP with CODESYS Win V3

10.1 Used hard-/ software

10.1.1 Hardware

- FGEN-IOM88-5001 (IP-address 192.168.1.90)
- FGEN-XSG16-5001 (IP-address 192.168.1.107)

10.1.2 Software

- CODESYS 3.4, SP3, Patch 1
- PLC: CODESYS Control Win V3 (3.4.3.10)

10.2 Network configuration

FGEN-stations are delivered in the address-mode "PGM-DHCP", switch-position "600" and can be reached using IP-address **192.168.1.254** .

Note

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

To achieve this, you have either

- to adjust the FGEN'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 3, Connection possibilities, page 3-6.

  or

- to change the IP address of the used PC or network interface card (for detailed information, please read the Changing the IP address of a PC/ network interface card, page 14-2.

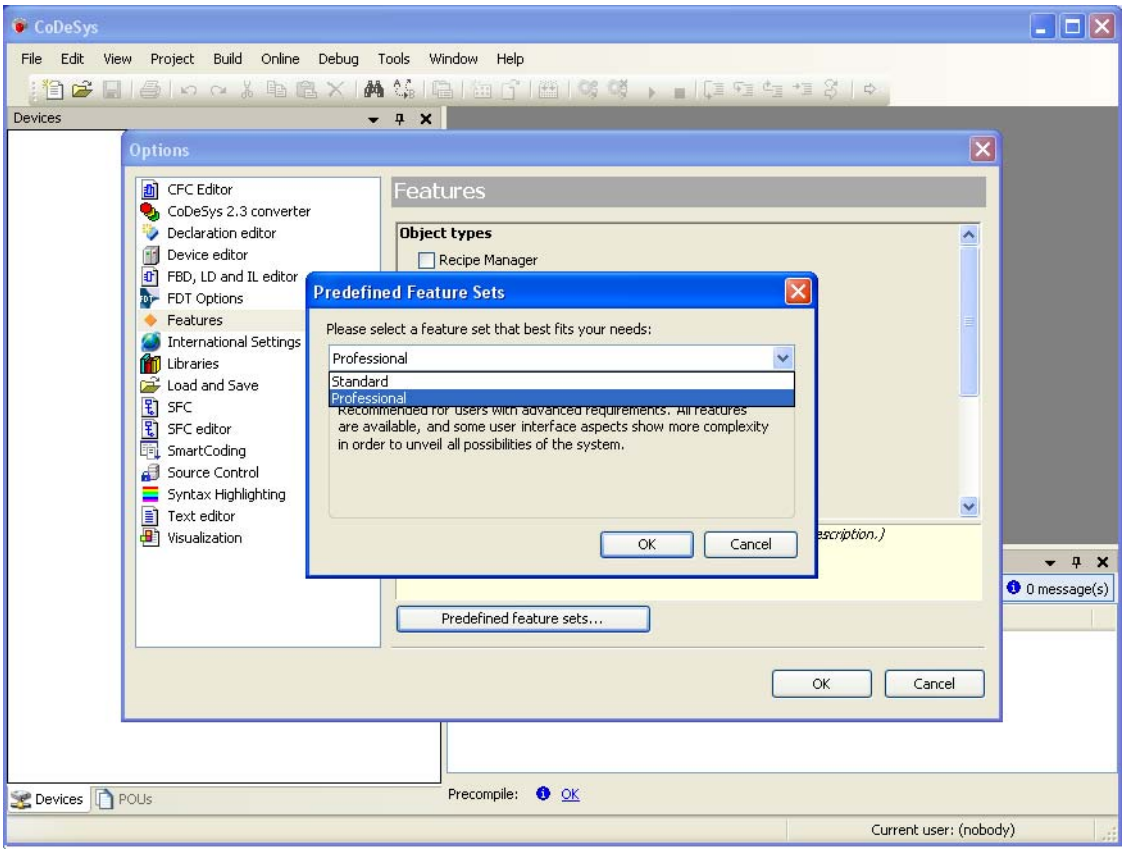
10.3 Programming with CODESYS

Open CODESYS via "Start → All programs → 3S CoDeSys → CoDeSys → CoDeSys V 3.4".

10.3.1 Predefined feature sets

In this example, CODESYS is run with the "Professional feature set" not with the "Standard feature set". This setting has influence on different CODESYS functions and can be changed via "Tools → Options..." in the "Features" under "Predefined feature sets...". For further information concerning this topic, please read the CODESYS online help.

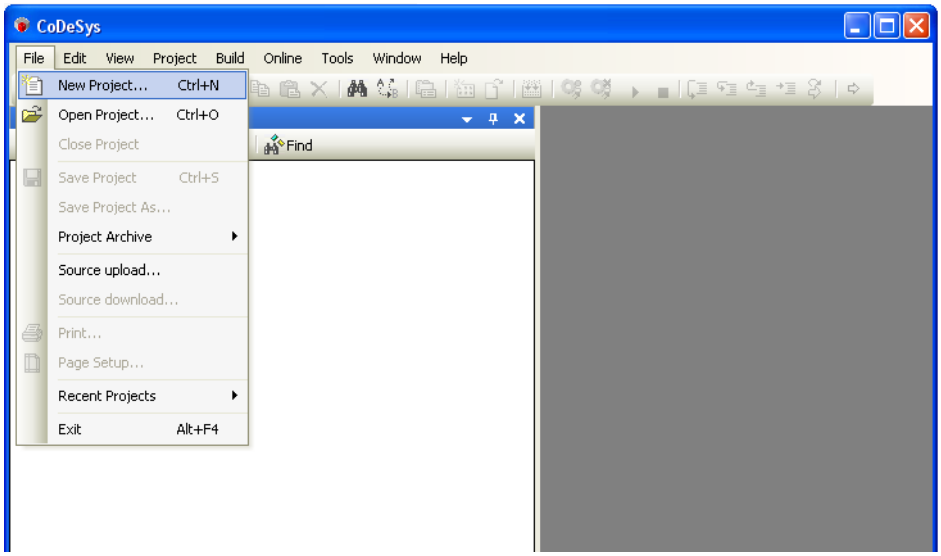
Figure 10-1: Predefined feature sets



10.3.2 Creating a new project

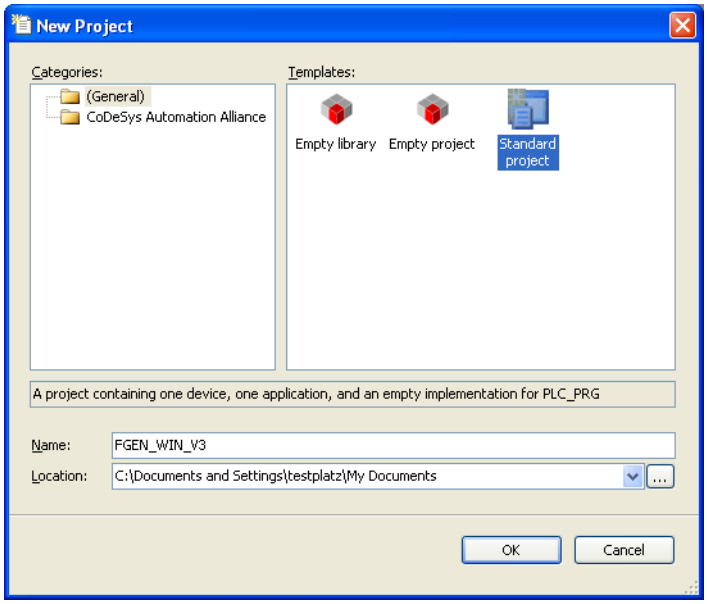
1 Create a new CODESYS-project using the "File → New project" command.

Figure 10-2: New project



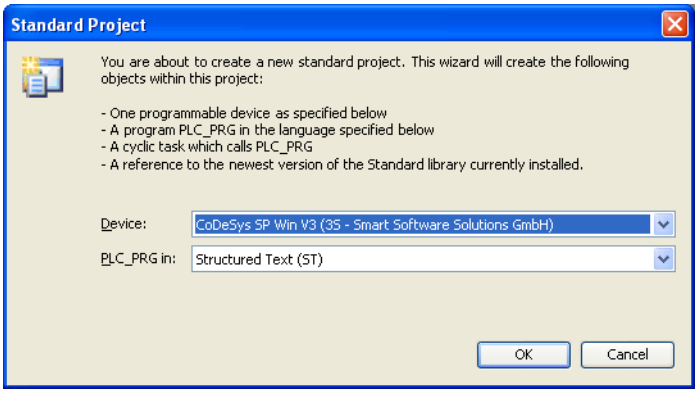
2 Select "Standard project" and define a project name.

Figure 10-3: Standard project



3 Please define also your preferred programming language.
In this example, Structured Text is used.

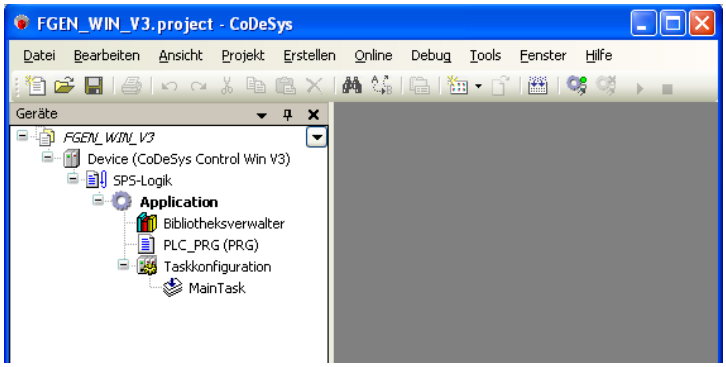
Figure 10-4: Selection of CODESYS Control Win V3



4 The new project is created.

5 In CODESYS, the project tree is build up as follows:

Figure 10-5: Project tree



Note

If the window "devices" should not be displayed, it can be activated via "View → Devices".

10.3.3 Defining the communication settings

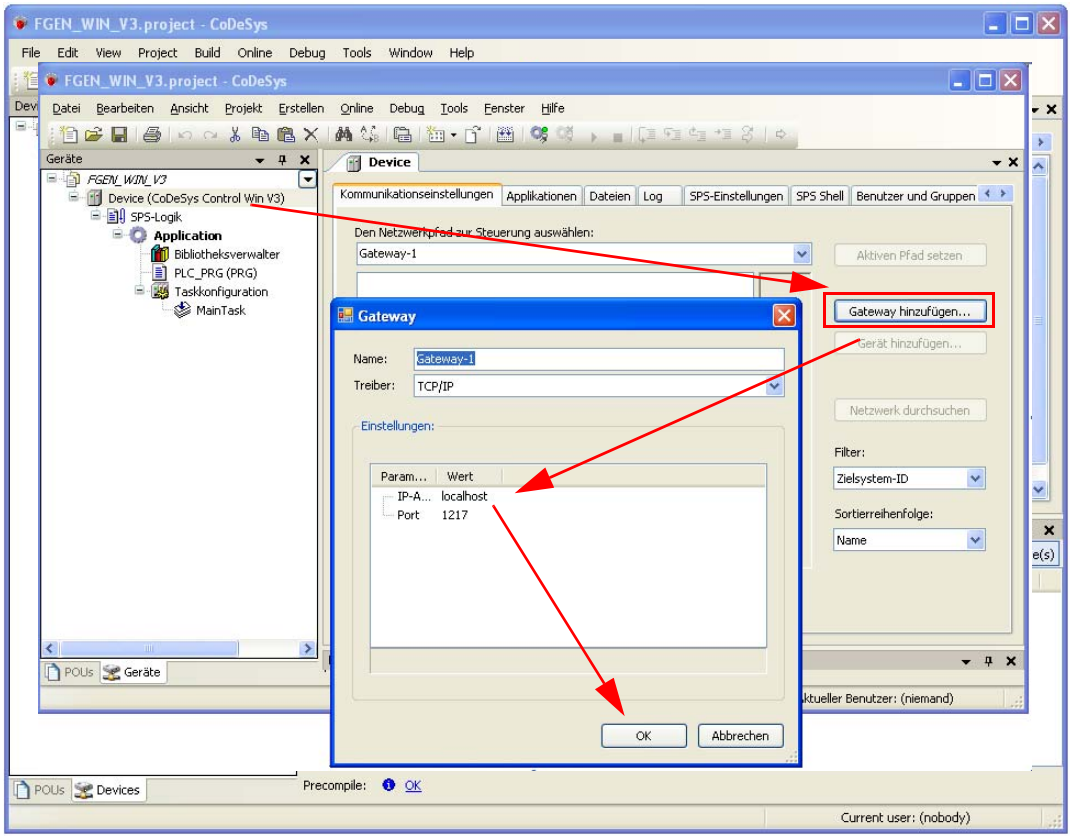
Double-clicking the "Device (CODESYS Control Win V3)" opens the corresponding editors.

The communication path (Gateway) to the HMI is defined in the "Communication Settings" tab.

Gateway definition

1. Use the "Add gateway"-button to open the dialog box "Gateway" and, where necessary, assign a new gateway name.
2. Keep the setting "localhost" or define an IP-address for the gateway instead.
   When using the setting "localhost“, the CODESYS-communication-gateway of the PC, on which this CODESYS-installation is running, is used as programming interface.

Figure 10-6: Communication settings



Setting the communication path

1 Mark the gateway and scan the network via the respective button.

2 The network card of your PC will be found and set as active path.

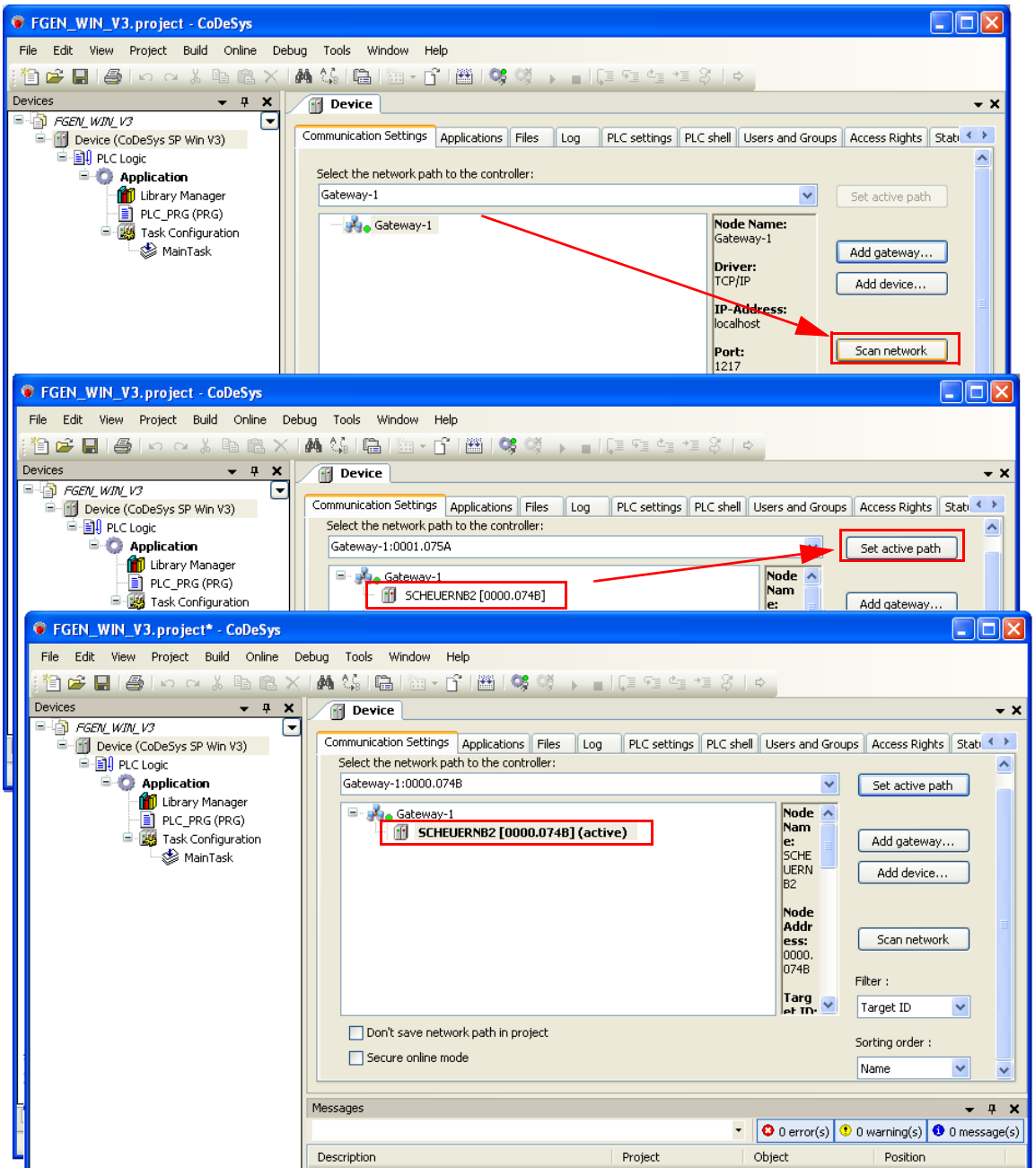


Figure 10-7: Set communication path

10.3.4 Adding the Ethernet Adapter

Open again the context menu by right-clicking the Device entry. In the dialog "Add Device" select the 3S Ethernet Adapter under "fieldbusses → Ethernet Adapter" and add it to the project tree.

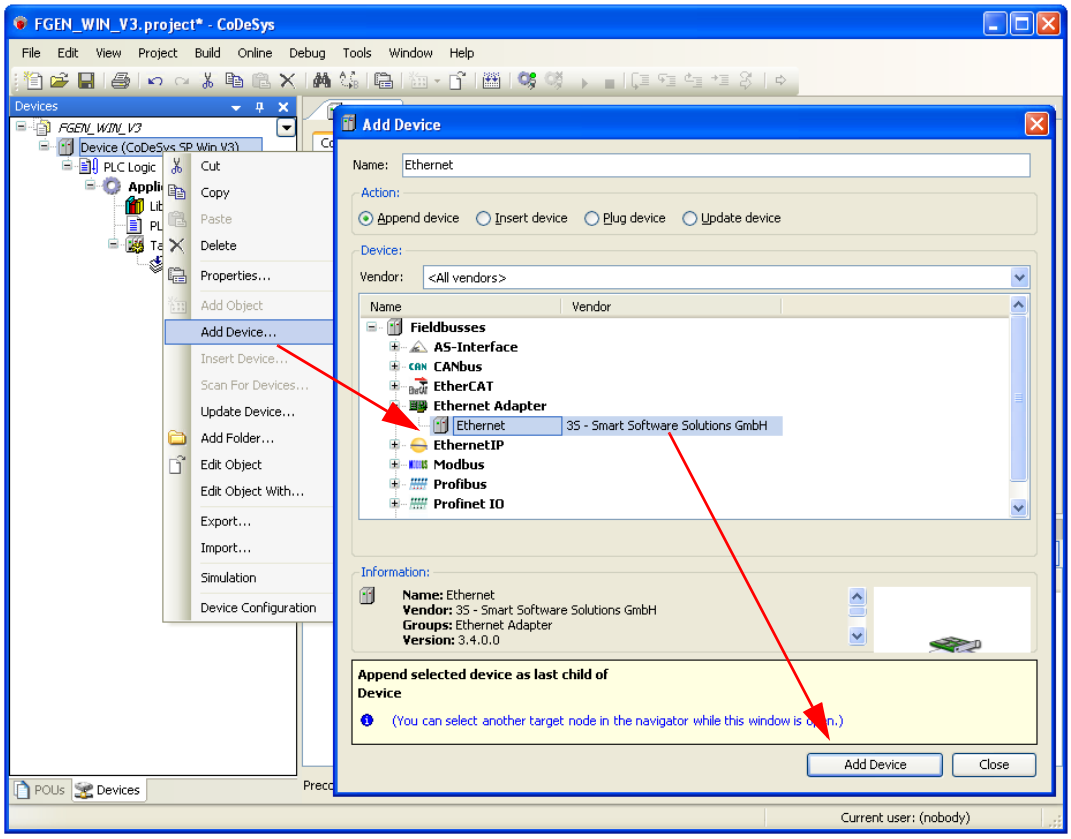
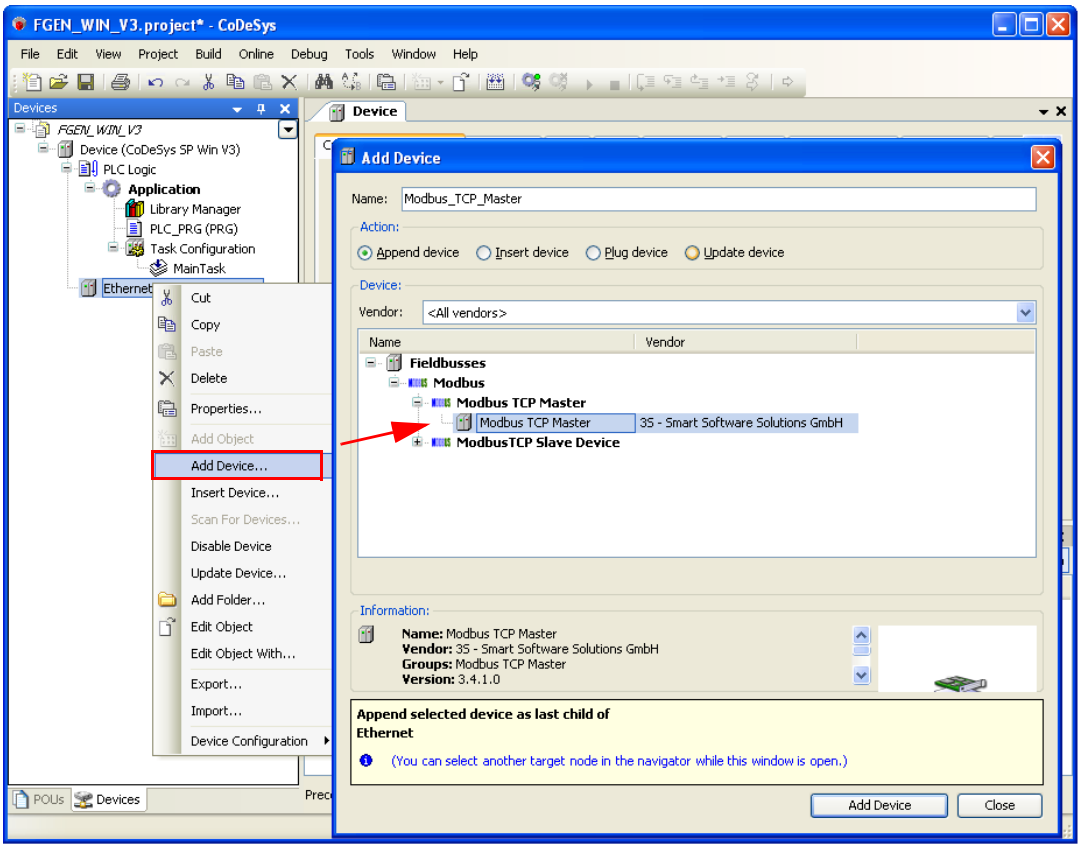


Figure 10-8: Adding the Ethernet Adapter as device

10.3.5 Adding the Modbus master

A right-click on the Ethernet-master opens the context menu. Select "Add Device" and add the Modbus TCP-master to the network.

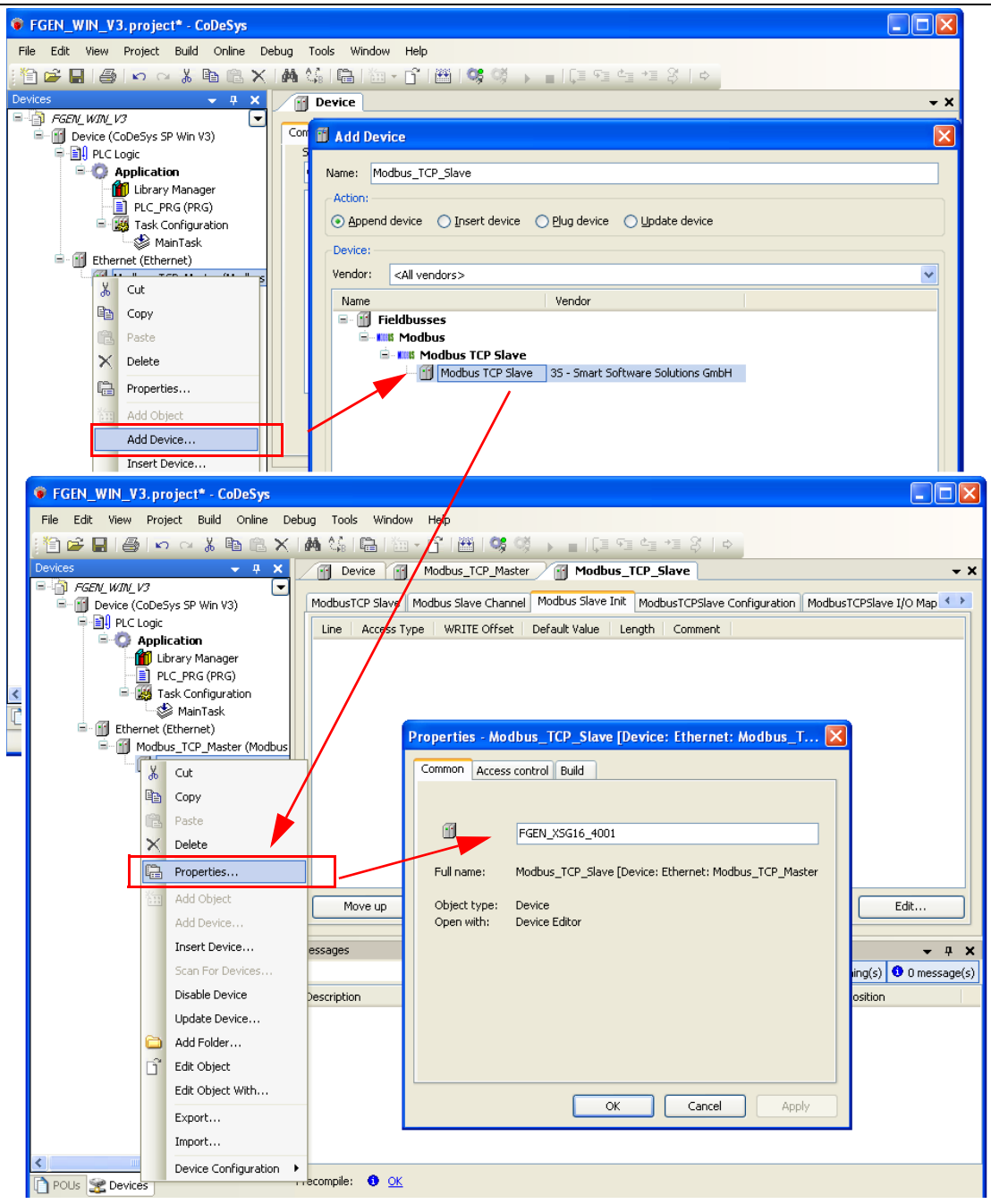
Figure 10-9: Adding the Modbus master



10.3.6 Adding a Modbus TCP slave

1 Now, add the Modbus TCP slaves to the project and rename them if necessary.

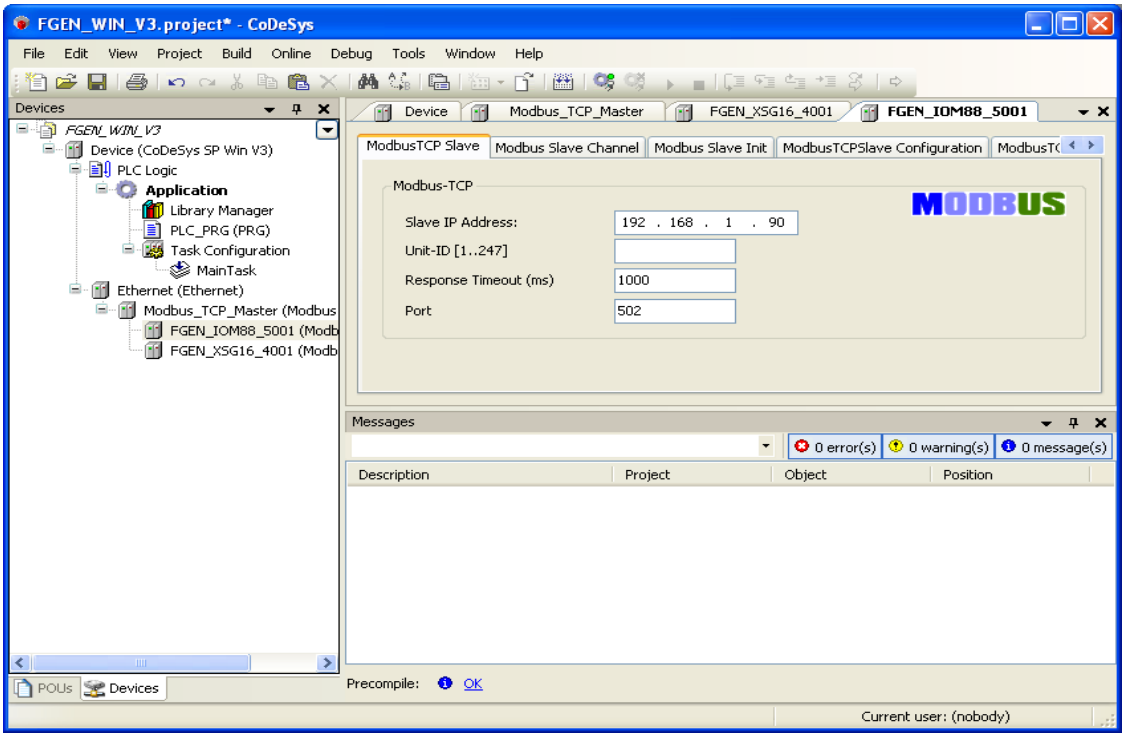
Figure 10-10: Selecting a slave



2 Again, a double-click onto the slave in the project tree opens the respective editors.

3 In the "Modbus TCP Slave""-tab, set the nodes IP-address (in this example: **192.168.1.90** for FGEN-IOM88-5001 und **192.168.1.107** for FGEN-XSG16-5001).
All other settings can be kept.

Figure 10-11: Setting the IP address at the slave



10.3.7 Programming (example program)

The programming is done under PLC-PRG in the project tree. This example is programmed in Structured Text (ST) as defined under Creating a new project (page 10-5).

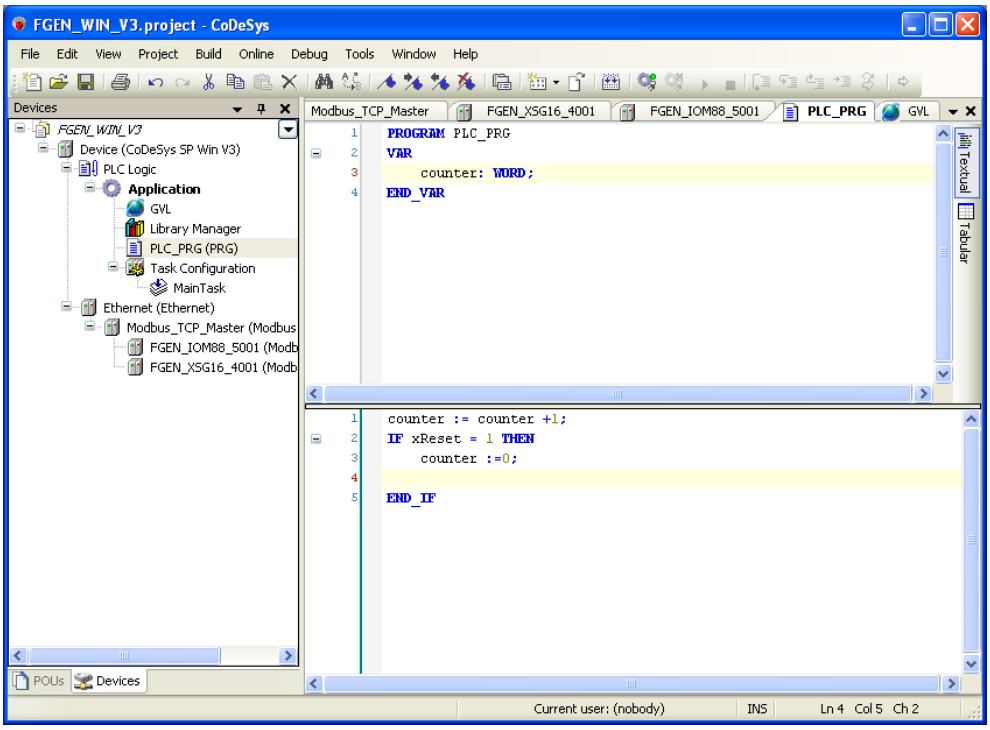
Small example program

1. The counter counts
2. Counter-reset via setting the variable "xReset" (BOOL) to "1".
   "xReset" has been defined in the global variables (see also page page 10-14)

Note

The status of process values is only shown in the process image if a program refers to them or if the function "Always update variables" in the "MobusTCPSlave I/O Mapping" (see Reading out the process data, page 10-25) is enabled.

Figure 10-12: Example program



10.3.8 CODESYS: Global variables

Global variables are defined either in the Global Variable List (see page 10-15) or directly in the I/O Mappings of the single stations.

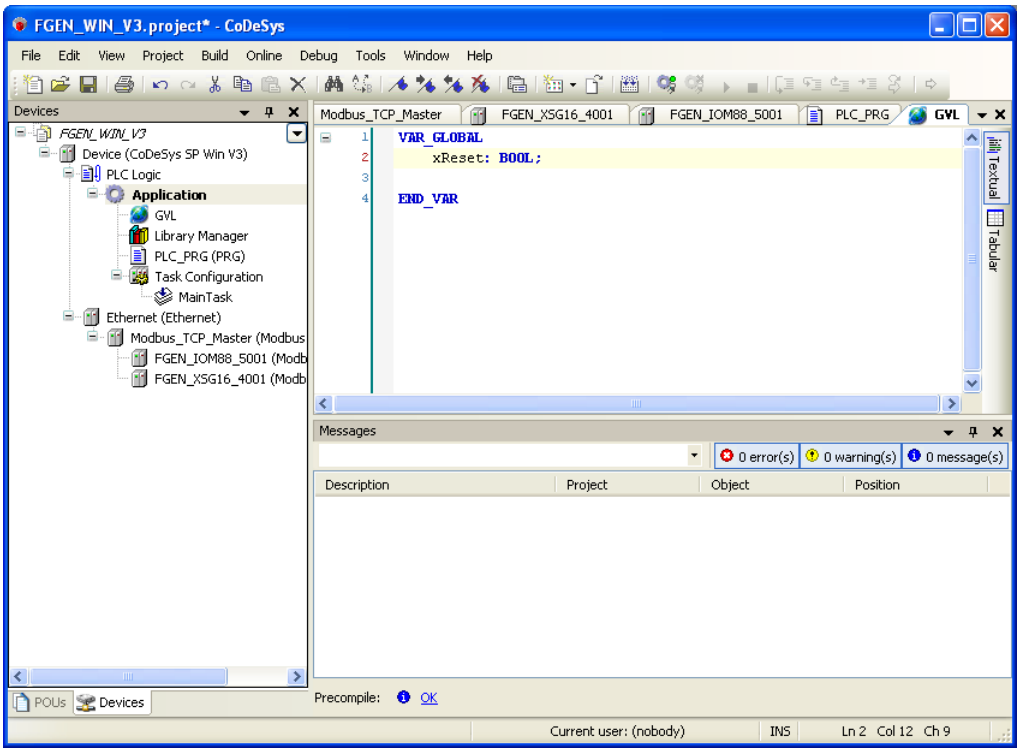


Figure 10-13: Example for the definition of a global variable

Global variable list

The creation of a "Global Variable List" is possible, too:
right-click to "APPL → Add object → Global Variable List".

Define the global variables The global variables are also automatically exported when building the project, if they have been chosen for export in the symbol configuration. (see also Predefined feature setsFigure 10-1:, page 10-4).

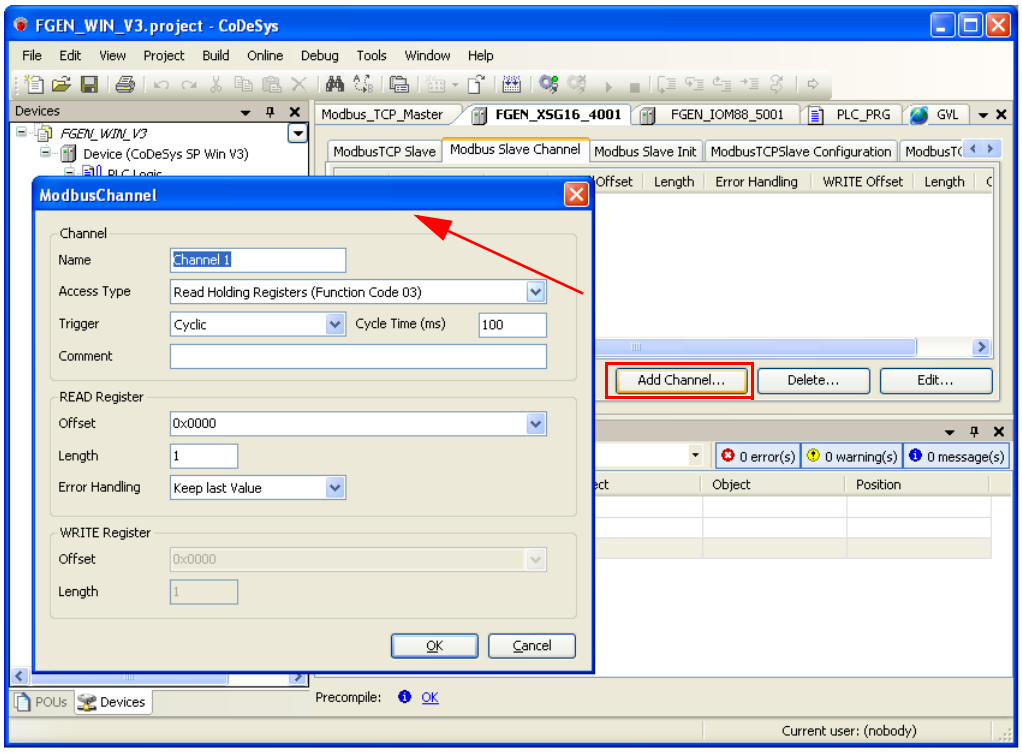
10.3.9 Modbus channels

The communication between Modbus TCP master and Modbus slaves is realized through defined Modbus channels.

These channels are set in the register-tab "Modbus Slave Channel" using the "Add Channel..." button.

The process data of a slave can then be monitored under
"ModbusTCPSlave I/O Mapping" (see 10.3.11, Reading out the process data, page 10-25)

Figure 10-14: Setting the Modbus channels, examples



The Modbus communication channels are defined by:

- "Access Type":
  Modbus function code, which defines the access method (bit- or word wise, read or write).
- "READ Register" or "WRITE Register" →"Offset":
  Specification of the start address for the Modbus Slave's register that has to be read or written.
  These specifications have to be taken from the slave's Modbus documentation!

Modbus data mapping

The mapping for the input and output data of a FGEN Modbus station depends on it's configuration.

The data mapping of the single FGEN stations can be found in chapter 9, section Register mapping of the FGEN-stations (page 9-11).

The TURCK-Software "I/O-ASSISTANT" offers the feature of creating a Modbus report for each Modbus-station, which shows the mapping for the respective station (see below).

Modbus mapping (I/O-ASSISTANT)

Figure 10-15: Modbus report in the I/O-ASSIS-TANT

2.1. Station description

Station address: 192.168.1.107

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	FGEN-XSG16-4001	192.168.1.107/FGEN -XSG16-4001	16 bit	0 bit
1	Intern-XSG16	01/Intern-XSG16	16 bit	16 bit
	Local I/O data incl. status/control		1 Word	1 Word
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**3 Words**	**1 Word**

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

2.2. I/O map for input data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	0000	01.15	01.14	01.13	01.12	01.11	01.10	01.09	01.08	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0001	0001	GW.15	GW.14	GW.13	GW.12	GW.11	GW.10	GW.09	GW.08	GW.07	GW.06	GW.05	GW.04	GW.03	GW.02	GW.01	GW.00
**0x0002	0002	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	M00

Description: 1.Column=Register address, n. Column=Modul number.bitposition
*) GW: gateway status-/diagnostics bits
**) M: module diagnostics (1 bit for each module)

Process input data: 3 Words

2.3. I/O map for output data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	2048	01.15	01.14	01.13	01.12	01.11	01.10	01.09	01.08	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00

Description: 1.Column=Register address, n. Column=Modul number.bitposition

Process output data: 1 Word

Note

Detailed information about the modbus registers of the FGEN-stations can be found in the descriptions in chapter 9.

Setting the Modbus channels (examples)

1 Reading of **%QW0** and mapping of the counter value (VAR "Counter", see PLC_PRG, page 10-13) to the output byte of the station FGEN-XSG16-5001 (%QW0).

1.1 Write: %QW0

- Access Type:
  Write Single Register (function code **06**)
- Write Register, Offset:
  0×9000 (see Register mapping of the FGEN-stations, FGEN-XSG16-x001 (page 9-14))
  The process output data of the station can be found in register 0×9000.

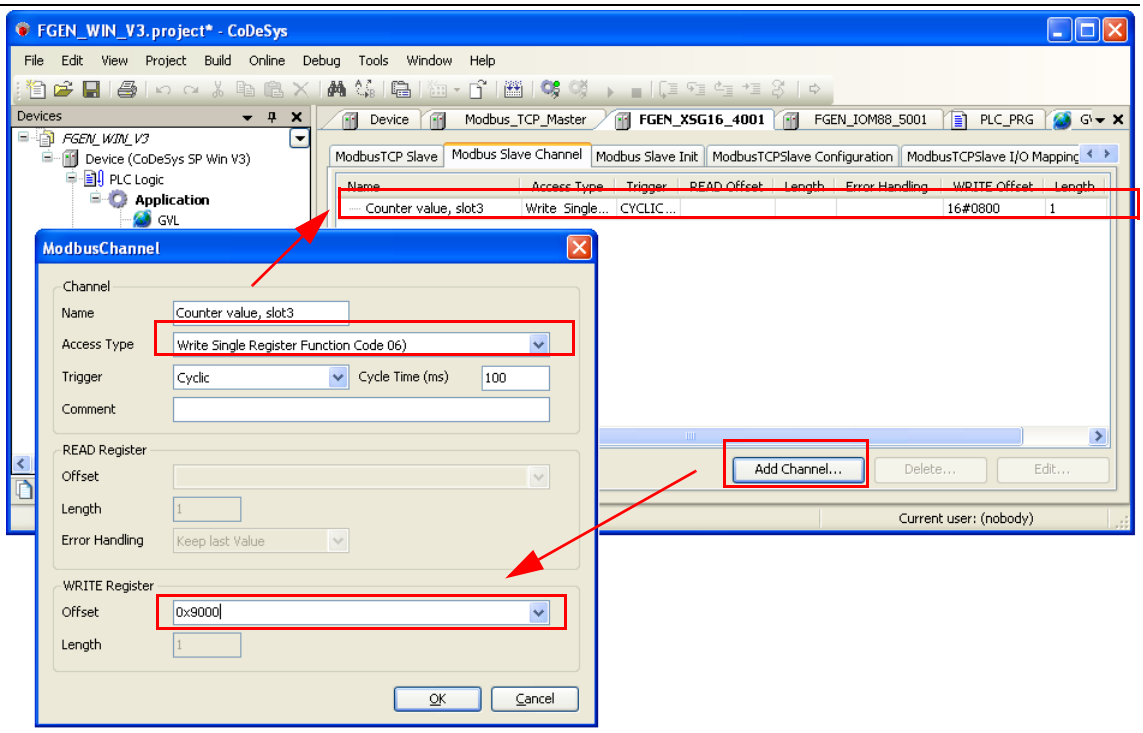


Figure 10-16: Modbus channel, counter value, FC06

1.1 Mapping: counter value to %QW0

– The mapping of the counter value (VAR "Counter") to the station 's output register is done the the "ModbusTCPSlave I/O Mapping".
Double click the field "variable" in the respective line. Use the "..."-button to open the dialog box "Input Assistant" .

– Select the variable to be mapped. As "Counter" been defined in PLC_PRG, see Programming (example program), it can be found there.

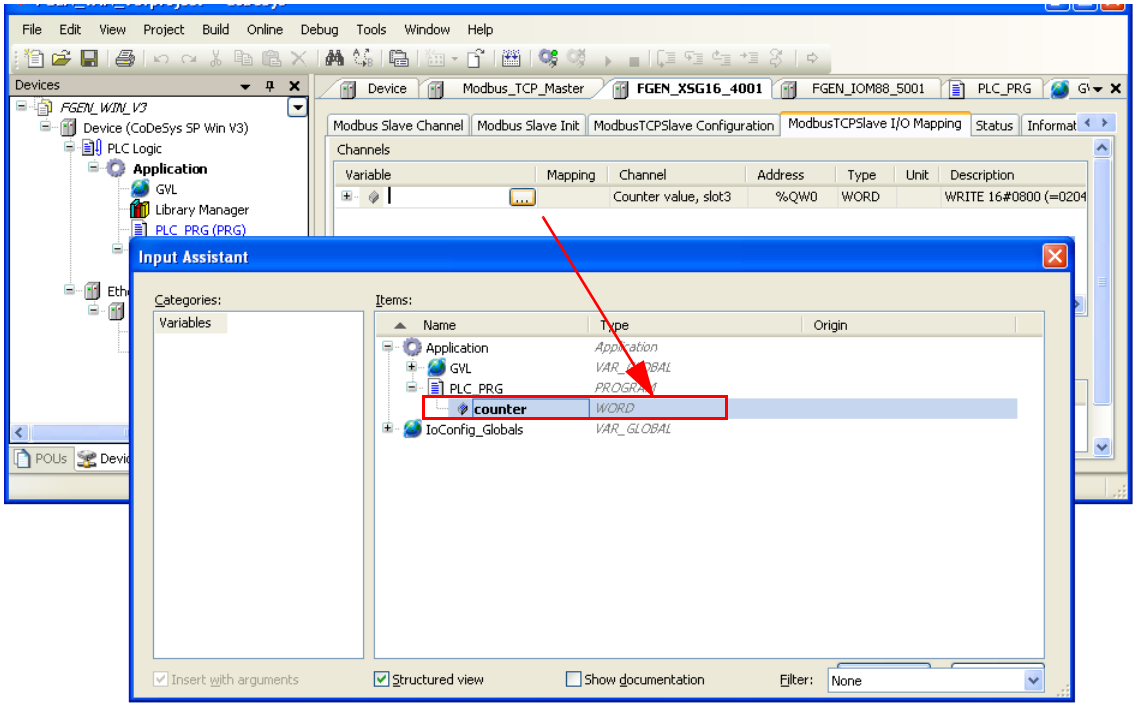


Figure 10-17: Mapping of the counter value to %QW0

– Confirm with "OK". The counter value is now mirrored to %QW0 of the station and given out.

2 Read:
Bit 0 at FGEN-IOM88-5001 → resetting the counter (with "xReset" = 1)

2.1 Read: %IW0

– Access Type:
Read Holding Registers (function code **03**)

– Read Register, Offset:
0x0000 (see Register mapping of the FGEN-stations, FGEN-XSG16-x001 (page 9-14))

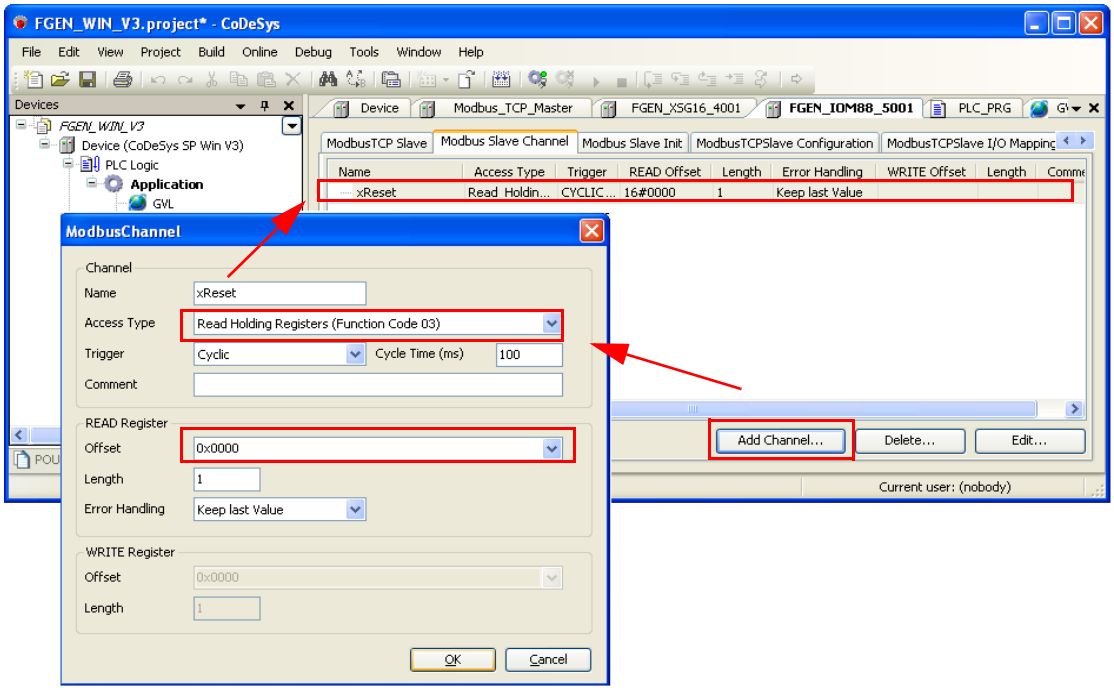


Figure 10-18: Modbus channel, read "xReset", FC03

1.2 Mapping: "xReset" (global variable) to %IX0.0 in %IW2

- "xReset" is mapped to the first bit in %IW0 of FGEN-IOM88-5001. This is done in the "ModbusTCPSlave I/O Mapping".
- Double click the field "variable" in the respective line. Use the "..."-button to open the dialog box "Input Assistant" .
- Select the variable to be mapped. "xReset" can be found in the global variables as it has been defined there, see CODESYS: Global variables.
- Confirm with "OK". A "1" at bit %IX0.0 will now reset the counter to zero.

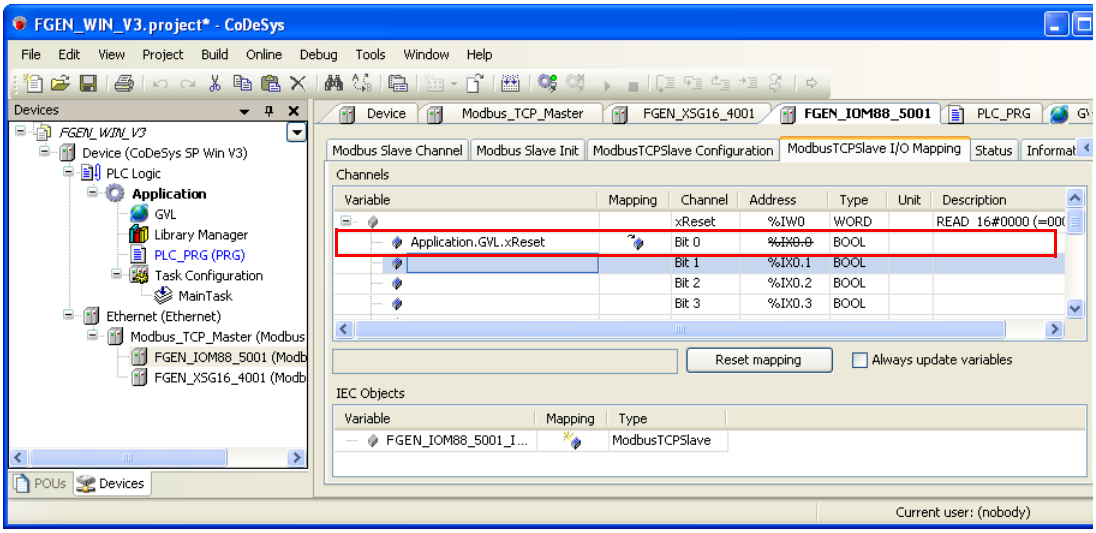


Figure 10-19: Mapping of "xReset" to bit %IX0.0

3 Read:
Status byte of the station FGEN-XSG16-5001

- Access Type:
  Read Holding Registers (function code **03**)
- Read Register, Offset:
  0x0001 (see Register mapping of the FGEN-stations, FGEN-XSG16-x001 (page 9-14))
- The status word of the FGEN-XSG16-5001 is read from register 0x0001.

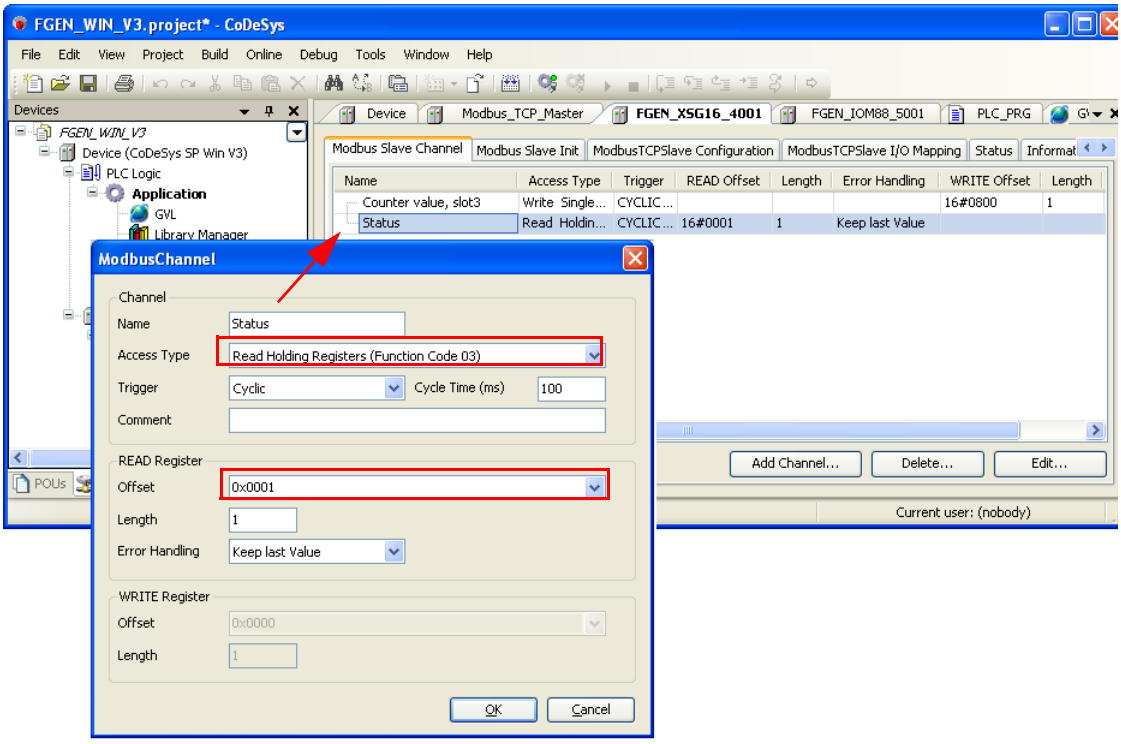


Figure 10-20: Setting the Modbus channel for reading the status word

4 Write:
Parameters of the station FGEN-XSG16-5001
target → inverting the input signal at channel 5
Writing parameters is normally done once during the program start and is thus not set as a "normal" Modbus channel under "ModbusSlave Channel", but as an Initialization channel under "**Modbus Slave Init**" (see Figure 10-21: Setting the initialization channel for the parameterization).

- Access Type:
  Write Single Register (function code **06**)
- Write Register, Offset:
  0×B001 (see Register mapping of the FGEN-stations, FGEN-XSG16-x001 (page 9-14))

The parameters of the station can be found in register 0xB000 to 0×B003.

Parameterization of the station

The parameterization to be done here is to invert the input signal at channel 5 (I.5) of the station (register 0×B001, bit 5).

The parameter register is build up as follows:

Reg.	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0×B000	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
0×B001	Inv. DI7	Inv. DI6	Inv. DI5	Inv. DI4	Inv. DI3	Inv. DI2	Inv. DI1	Inv. DI0
	Inv. DI15	Inv. DI14	Inv. DI13	Inv. DI12	Inv. DI11	Inv. DI10	Inv. DI9	Inv. DI8
0×B002	SRO7	SRO6	SRO5	SRO4	SRO3	SRO2	SRO1	SRO0
	SRO15	SRO14	SRO13	SRO12	SRO11	SRO10	SRO9	SRO8
0×B003	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	

A 2^5 = **32** will be written to register **0×B001**, which results from the station's the parameter byte assignment.

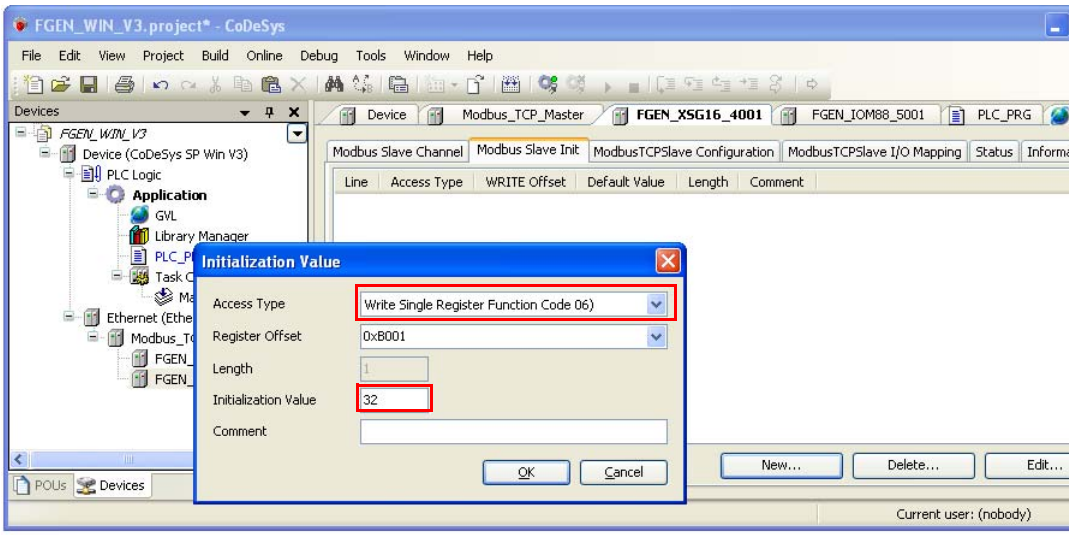
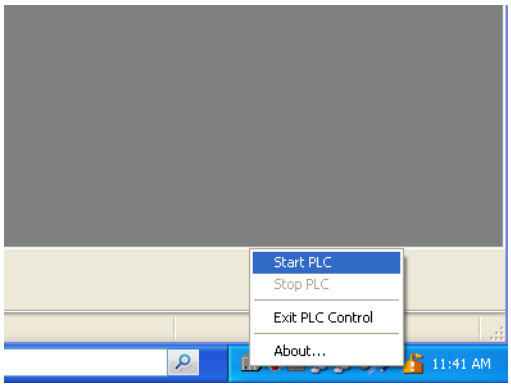


Figure 10-21: Setting the initialization channel for the parameterization

10.3.10 Building, login and start

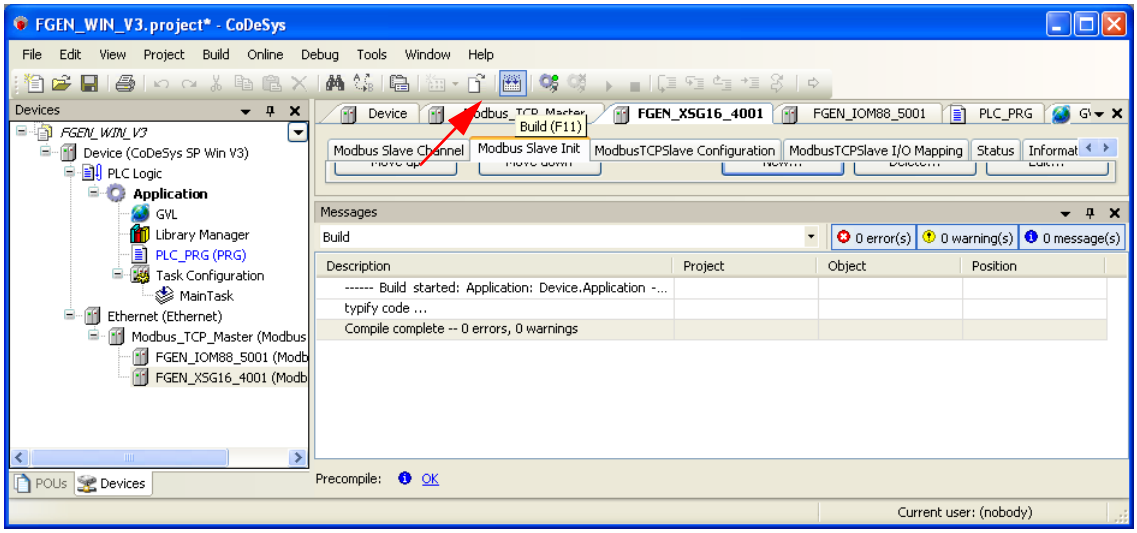
1 The WIN V3-PLC has to be running. This is done in the Windows-task bar:

Figure 10-22: Starting the WIN V3-PLC



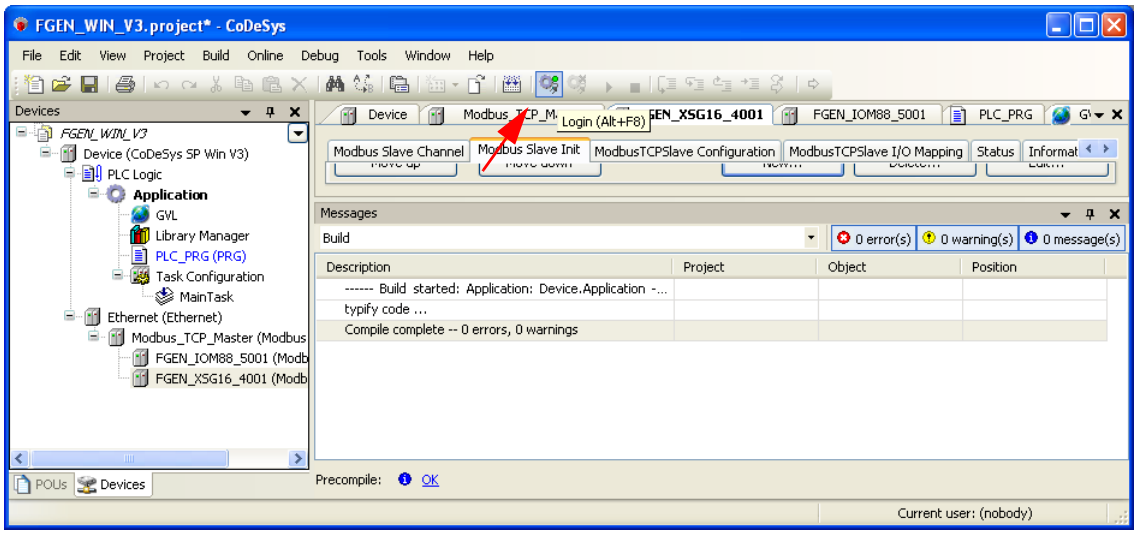
2 Building the program:

Figure 10-23: Building the program



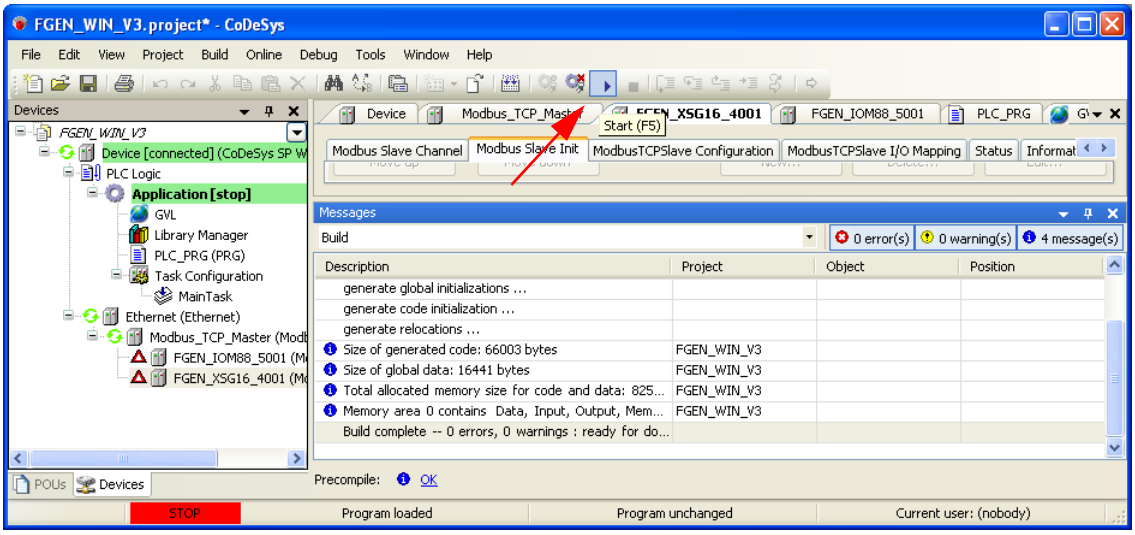
3 Login:

Figure 10-24: Login



4 Start the program:

Figure 10-25: Starting the program



10.3.11 Reading out the process data

The station's process data are shown in the register tab "ModbusTCPSlave I/O Mapping".

Note

In order assure a regular updating of the process data, activate the function "Always update variables".

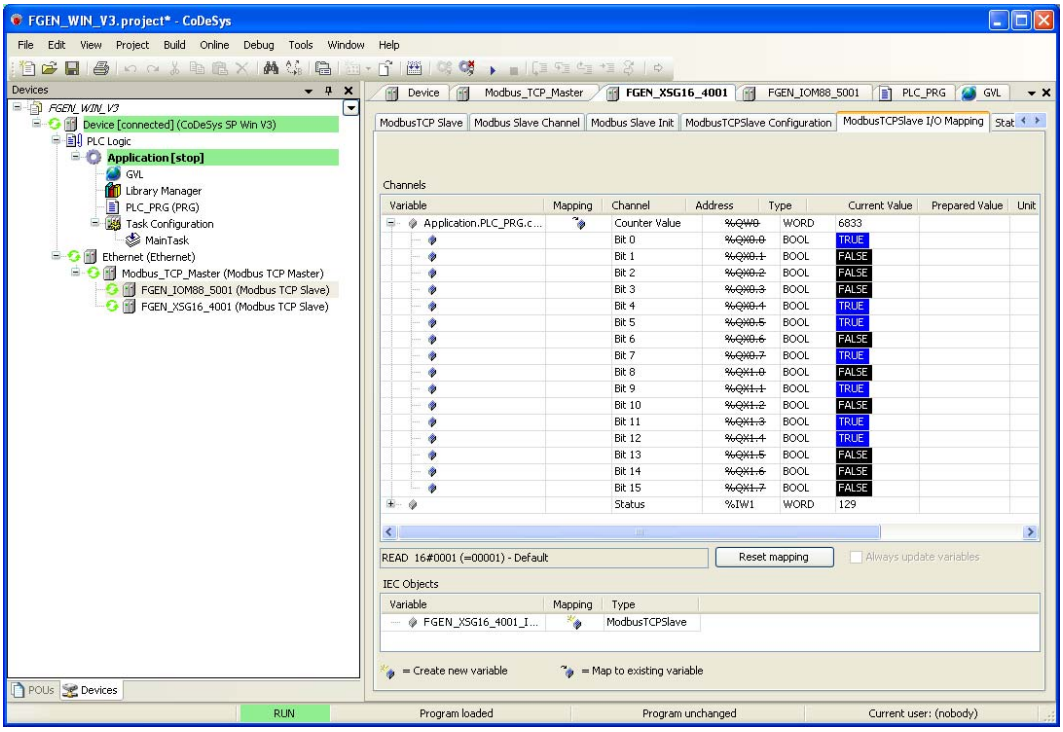


Figure 10-26: Modbus TCP Slave I/O Mapping

10.3.12 Evaluation of the status word of FGEN-XSG16-5001 (%IW1)

According to the definition of the Modbus communication channel (see Setting the Modbus channels (examples), example 4, page 10-21), %IW1 contains station's the status-word.

the message is to be interpreted as follows:

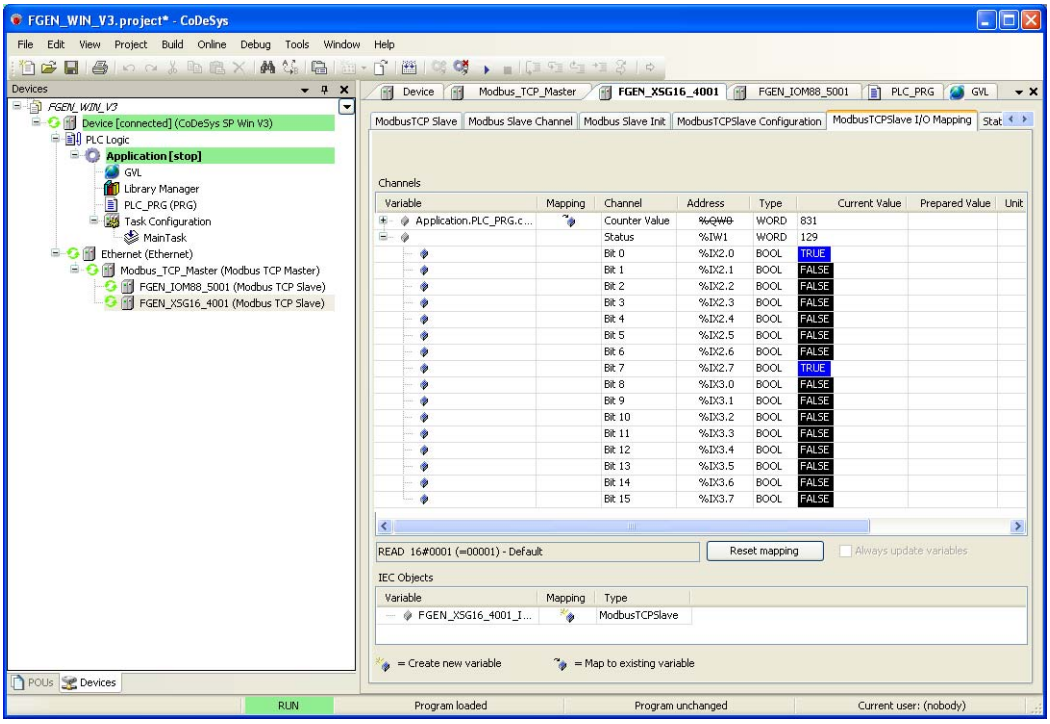
%IW 2, "actual value" = 129

register	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0×0001	U_L	-	-	-	-	-	-	Diag Warn
	-	FCE	-	-	CFG	COM	U_B	-

1 Byte 0, bit 0 = 1
→ status message: „DiagWarn“ = active diagnosis

2 Byte 0, bit 7 = 1
→ status message: „U_L“ = load voltage not within the permissible range (< 18 V).

Figure 10-27: Status word of the station



11 Implementation of PROFINET

11.1 FSU - Fast Start-Up (prioritized startup)

11.1.1 General

FSU enables a PLC to build up connections to PROFINET-nodes in less than 500 ms after switching-on the network power supply. This fast start up of devices is above all necessary for robotic tool changes for example in the automobile industry.

Note

For correct cabling with FGEN in FSU-applications, see Ethernet-connection in QC-/FSU-applications (page 3-6).

11.1.2 FSU in FGEN

TURCK FGEN-stations support the prioritized start-up FSU.

In order to enable FSU, the field bus nodes have to be configured respectively in the configurator HW Config in the Step 7-software (Siemens).

Note

Please read chapter 12, section Fast Start-Up - configuration of fieldbus nodes (page 12-16).

11.2 GSDML-file

The actual device configuration file for FGEN can be downloaded from the TURCK-home page www.turck.com.

Table 11-1: Designation of the GSDML-files

Station	GSD file
FGEN	GSDML-V2.0-Turck-FGEN-JJJJMMTT-xxxxxx.xml

11.3 PROFINET-Error Codes

The channel specific diagnostic messages are defined as follows:

Table 11-2: Channel-specific diagnostics

Value (dec.)	Diagnosis
Error codes (1 to 9 according to the standards)	
1	Short-circuit at output
2	Undervoltage: Undervoltage channel 0: Undervoltage at U_B Undervoltage channel 1: Undervoltage at U_L
Error codes (16 to 31 manufacturer specific)	
26	External error: Overload sensor supply The station detected a load dump at the sensor supply.

11.4 Parameters

Two types of parameters have to be distinguished for the FGEN-stations, the PROFINET parameters of a station and the specific parameters of the I/O-channels.

11.4.1 General module parameters - parameters for slot 0 (turck-fgen)

Table 11-3: Parameters for measurement mode

A *default setting*

Parameter name	Value	Meaning
Outputs behavior at communication loss	00 = set to 0 **A**	The station switches the outputs to "0". No error information is transmitted.
	10 = keep last value	The station maintains the actual output data.
Disable all diagnosis	0 = inactive **A**	Diagnostic messages and alarms are generated.
	1 = active	Diagnostic messages and alarms are not generated.
Disable output power diagnosis	0 = inactive **A**	The monitoring of the load voltage U_L is activated.
	1 = active	An undervoltage at U_L is not monitored.
I/O-ASSISTANT Force Mode disable	0 = inactive **A**	The single fieldbus protocols can be deactivated.
	1 = active	
EtherNet/IP™ deactivate	0 = inactive **A**	
	1 = active	
Modbus TCP deactivate	0 = inactive **A**	
	1 = active	
Web server deactivate	0 = inactive **A**	
	1 = active	

11.4.2 Parameters for I/O channels

Table 11-4: Parameters for I/O channels

A *default setting*

Parameter name	Value	Meaning
digital input x	0 = normal **A**	
	1 = inverted	The input signal is inverted.

Table 11-4: Parameters for I/O channels

Parameter name	Value	Meaning
Output on overcurrent	0 = automatic recovery **A**	The output switches on automatically after an overload.
	1 = recovery at signal change	The output is manually switched-off and on again.
output	0 = deactivate	
	1 = activate **A**	

11.5 Description of user data for acyclic services

The acyclic data exchange is done via Record Data CRs (CR-> Communication Relation).

Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data
- Writing of configuration data
- Reading and writing of device data
- Reading of diagnostic data
- Reading of I/O data
- Reading of Identification Data Objects (I&M functions)

11.5.1 Description of the acyclic gateway user data

Table 11-5: Module Application Instance

Index (dec.)	Name	Data Type	r/w	Comment
1	Station parameters	WORD	r/w	Parameter data of the station (slot 0).
2	Station designation	STRING	r	Designation of the station (slot 0).
3	Station revision	STRING	r	Firmware revision of the station
4	Vendor-ID	WORD	r	Ident number for TURCK
5	Station name	STRING	r	The device name assigned to the station.
6	Station type	STRING	r	Device type of the station
7	Device-ID	WORD	r	Ident number of the station
8 to 23	reserved			
24	Station diagnosis	WORD	r	Diagnostic data of the station (slot 0).
25 to 31	reserved			
32	Input list	Array of BYTE	r	List of all input channels in the station
33	Output list	Array of BYTE	r	List of all output channels in the station
34	Diag. list	Array of BYTE	r	List of all I/O-channel diagnostics
35 (0×23)	Parameter list	Array of BYTE	r	List of all I/O-channel parameters
36 to 45039	reserved			
45040 (0×AFF0)	I&M0-functions		r	Identification & Maintaining-services

Table 11-5: Module Application Instance

Index (dec.)	Name	Data Type	r/w	Comment
45041 (0×AFF1)	I&M1-functions	STRING [54]	r/w	I&M tag function and location
45042 (0×AFF2)	I&M2-functions	STRING [16]	r/w	I&M tag function and location
45043 (0×AFF3)	I&M3-functions	STRING [54]		
45044 (0×AFF4)	I&M4-functions	STRING [54]		
45045 (0×AFF5) to 45055 (0×AFFF)	I&M5 to I&M15-functions			not supported
0×7000	Station parameters	WORD	r/w	Activate active fieldbus protocol

11.5.2 Description of the acyclic I/O-channel user data

Table 11-6: I/O channel user data

Index (dec.)	Name	Data type	r/w	Comment
1	Station parameters	specific	r/w	Parameters the station
2	Station type	ENUM UINT8	r	Contains the station type
3	Station version	UINT8	r	Firmware version of I/O-channels
4	Station-ID	DWORD	r	indent no. of I/Os
5 to 9	reserved			
10	Slave Controller Version	UINT8 array [8]	r	Versions number of the slave controllers.
11 to 18	reserved			
19	Input data	specific	r	Input data of the respective I/O channel
20 to 22	reserved			
23	Output data	specific	r/w	Output data of the respective I/O-channel

12 Application example: FGEN for PROFINET with a Siemens S7

12.1 Application example

12.1.1 General

In order to configure the connection of FGEN-stations for PROFINET to a Siemens PLC S7, the software package "SIMATIC Manager" version 5.5 from Siemens is used.

12.1.2 Example network

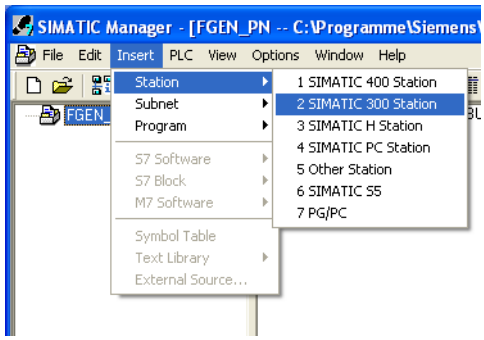
- Siemens PLC S7, CPU 315-2 PN/DP, 6ES7 315-2EH14-0AB0, V3.2
  IP-address 192,168,144,112
- Siemens switch, 4-port (2 RJ45, 2 LWL)
  - Device name: SCALANCE-X202-2P IRT
  - IP address: 192,168,144,166
- ET200S, IM-151-3 PN
  - Device name: ET200-S
  - IP address: 192,168,144,188
- FGEN-IOM88-x001
  - Device name: not assigned, yet
  - IP-address: not assigned, yet
- FGEN-XSG16-x001
  - Device name: not assigned, yet
  - IP-address: not assigned, yet

12.1.3 New project in the Simatic Manager

1 Create a new project in the Simatic Manager using the "File →New"-command

2 Add a Simatic station to the project using the "Insert → station..."-command. In this example a "Simatic 300 station" is used.

Figure 12-1: Selecting a Simatic station



The configuration of the PROFINET-network is then done in the software's hardware configuration

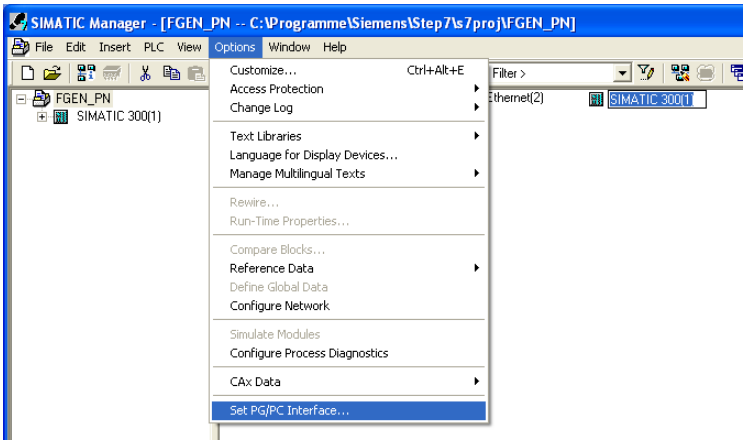
12.1.4 Setting the PG/PC-interface

In order to be able to build up communication between the PLC and your PG/PC via Ethernet, the respective interface/ network card of the PG/PC has to be activated.

The configuration of the interface is done via the "Set PG/PC Interface" command.

Open this dialog in the Simatic software for example via the "Options → Set PG/PC Interface..." command or directly in the Windows Control Panel for your PG/PC.

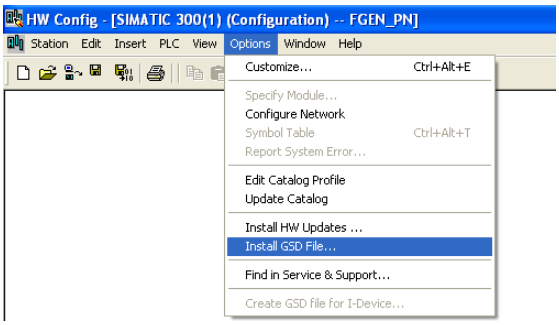
Figure 12-2: Command "Set PG/PC Interface..."



12.1.5 Installation of the GSDML-files

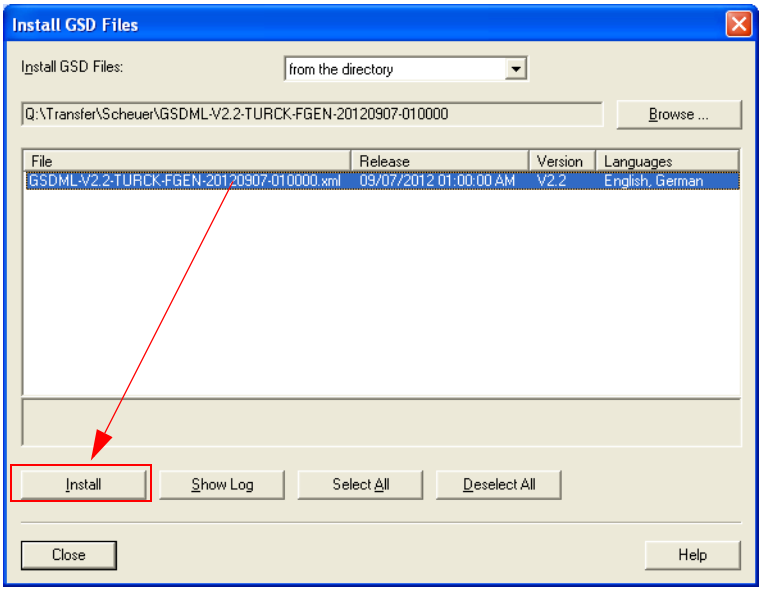
1 In the hardware configuration "HW config", open the "Options→ Install GSD file" command in order to install new GSD-files.

Figure 12-3: Install GSD file



2 Define the directory for the TURCK GSDML-files by browsing the directories and add the FGEN-modules to the hardware catalog.

Figure 12-4: Install GSD file



The FGEN-stations can now be found under "PROFINET IO → Additional Field Devices → I/O → TURCK".

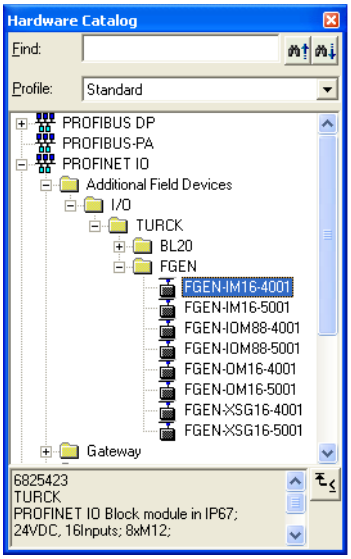
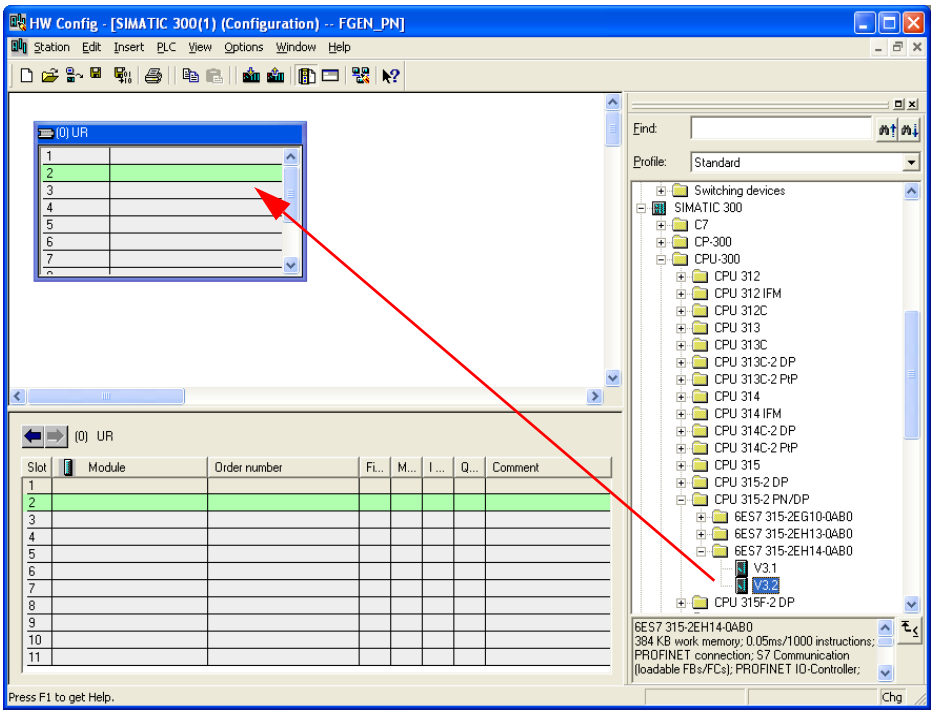


Figure 12-5: FGEN-modules in the hardware catalog

3 Chose the profile rack "RACK-300" for the Siemens CPU from the catalog and add it to the network window.

4 After this, select the Siemens CPU from the hardware catalog. In this example a CPU 315-2 PN/DP, version 6ES7 315-2EH14-0AB0 (V 3.2). is used.

Figure 12-6: Selecting the CPU



5 In the dialog "Properties Ethernet Interface", define the IP address and the subnet mask for the S7 CPU and add the subnet using the "New..." button.

Figure 12-7: Properties Ethernet interface

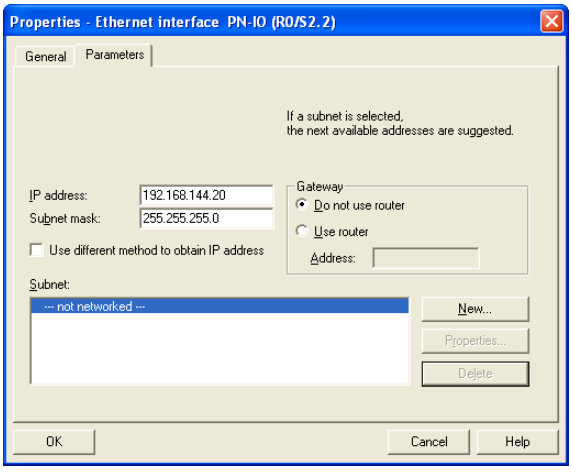
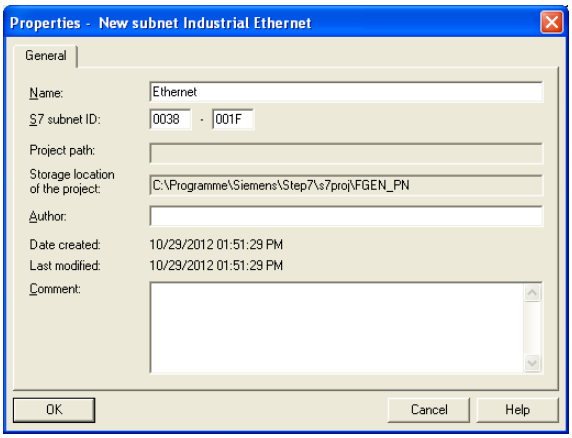


Figure 12-8: Add new Ethernet subnet

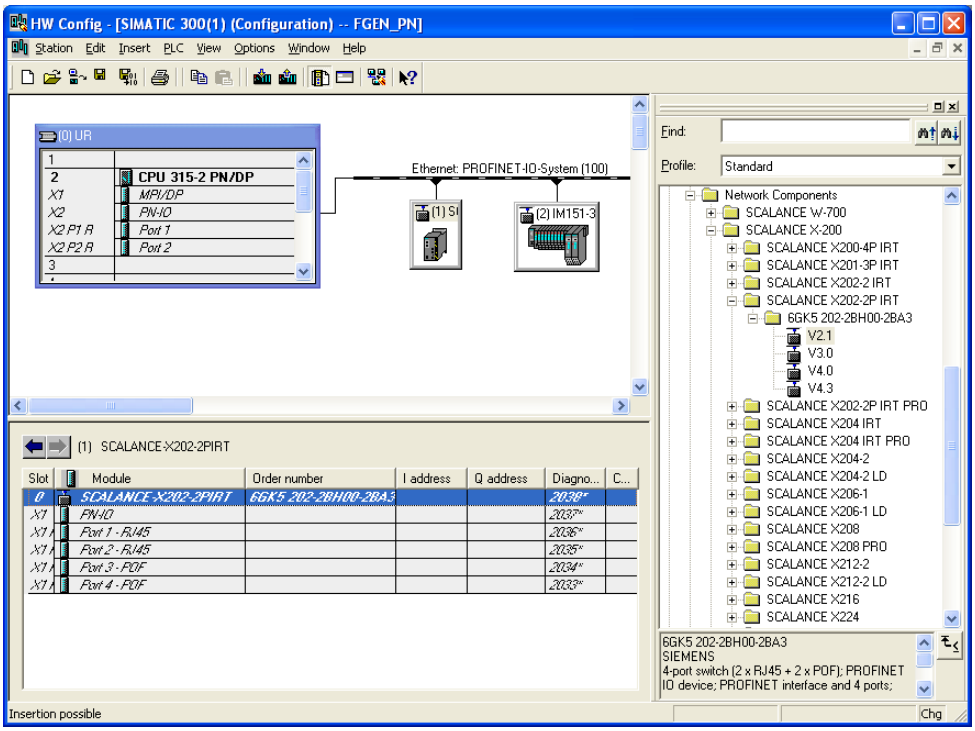


12.1.6 Adding PROFINET network nodes

The nodes of the example network (see page 12-2) are added to the PROFINET as follows:

- Siemens-switch
  - Device name: SCALANCE-X202-2P
  - IP address: 192,168,144,166
- ET200S
  - Device name: ET200-S
  - IP address: 192,168,144,188

Figure 12-9: Add network node



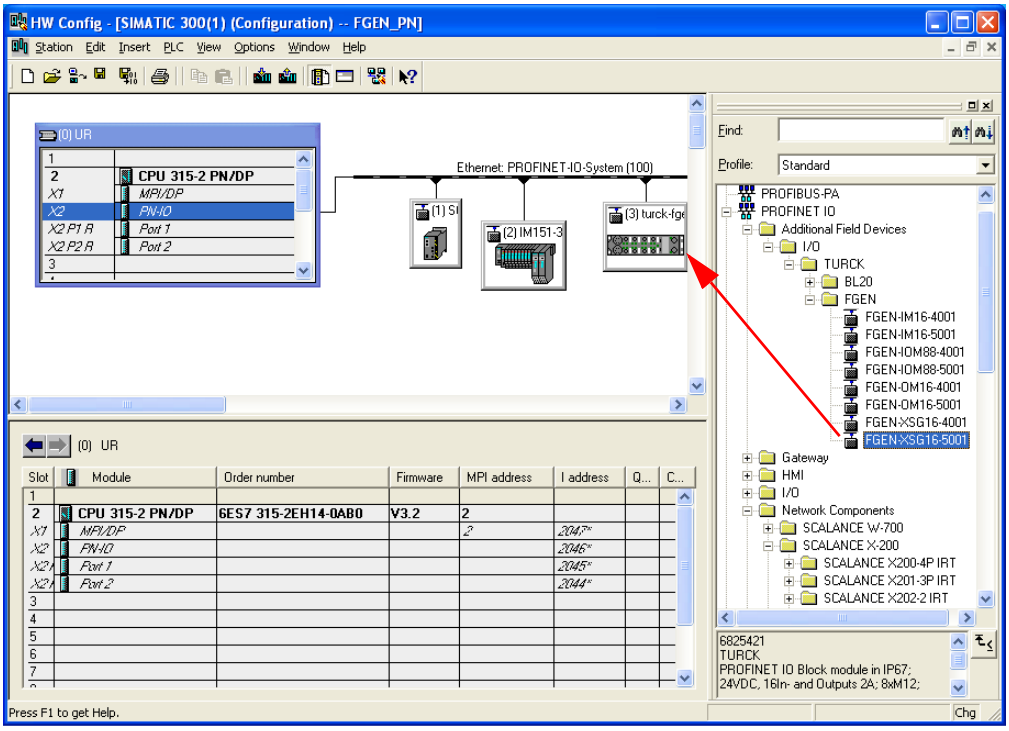
Adding and configuring of FGEN-stations

Now, the FGEN-stations are selected from the Hardware Catalog and added to the configuration.

- FGEN-IOM88-x001
  - Device name: not assigned, yet
  - IP-address: not assigned, yet
- FGEN-XSG16-x001
  - Device name: not assigned, yet
  - IP-address: not assigned, yet

1 Select the station under "PROFINET IO → Additional Field Devices→ I/O TURCK FGEN" and add it to the Ethernet-network.

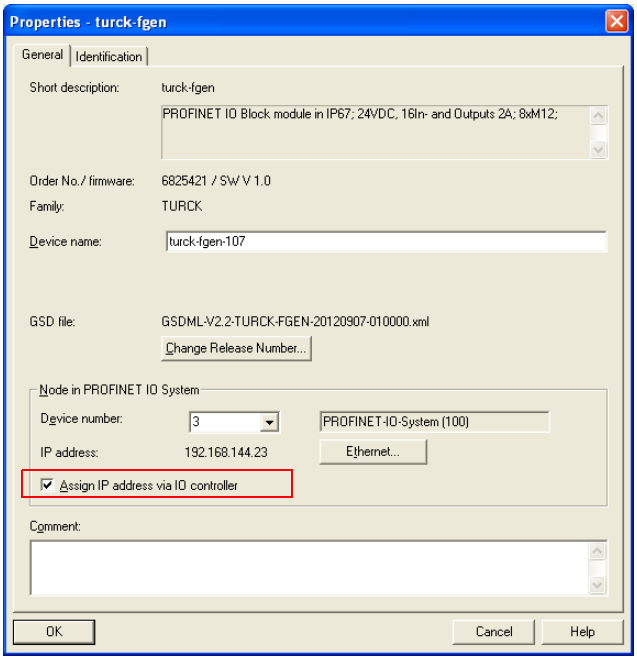
Figure 12-10: Select a FGEN-station



2 A double-click on the station symbol opens the dialog "Properties turck-fgen".

3 Enter the station's device name in this dialog.

Figure 12-11: Dialog: properties turck-fgen



Note

In PROFINET, the connected device is not identified by it's IP address, but recognized and addressed by it's device name.
The selection of a device name for a special IO device can thus be compared to the setting of the PROFIBUS address for a DP slave.

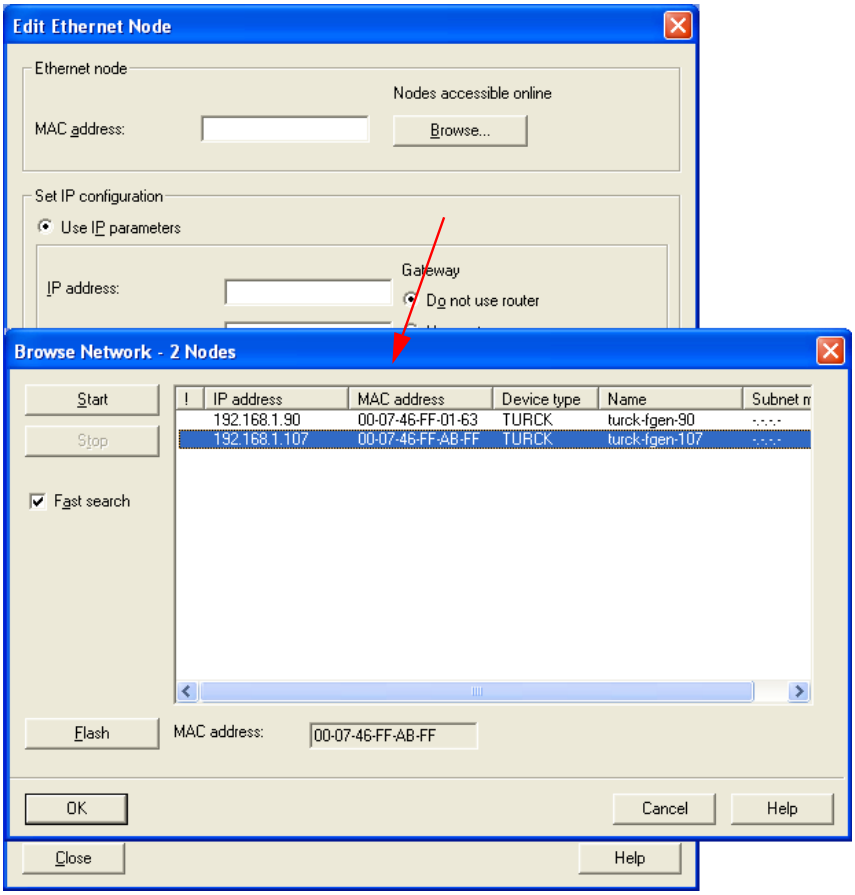
12.1.7 Scanning the network for PROFINET nodes

The Simatic hardware configuration offers the possibility to browse the PROFINET network using a broadcast command in order to find active PROFINET nodes. The active nodes are identified via their MAC address.

1 Open the respective dialog box by using "PLC → Ethernet →Edit Ethernet Node".

2 Browse the network for active network nodes identified by means of their MAC address, by using the button "Browse" in the field "Ethernet node".
All PROFINET nodes found in the network answer the command sending their MAC address and their device name.

Figure 12-12: Configure Ethernet node



3 Select a node and close the dialog with "OK".
The features of the selected node are now shown in the in the dialog "Edit Ethernet Node".

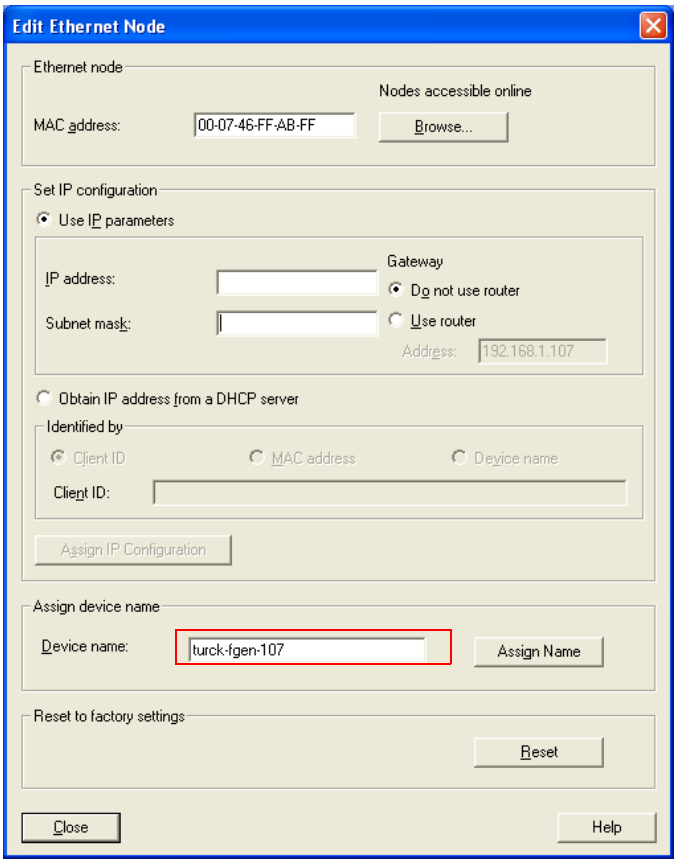
12.1.8 Name assignment for FGEN-stations

Now, the node's IP configuration or device name can be adapted, if necessary for the application.

In this example, the following properties are assigned to the modules:

- FGEN-IOM88-x001
  - Device name: TURCK-FGEN-90
- FGEN-XSG16-x001
  - Device name: TURCK-FGEN-107

Figure 12-13: Adaptation of the Ethernet node configuration



Note

Here, you can also assign an application specific device name to the devices which were found.
Please observe, that the device name assigned here has to be similar to the device name assigned to the node in the properties dialog box (see Figure 12-11: Dialog: properties turck-fgen).

If this is not guaranteed, the PLC will not be able to clearly identify the node!

12.1.9 PROFINET-neighborhood detection (LLDP)

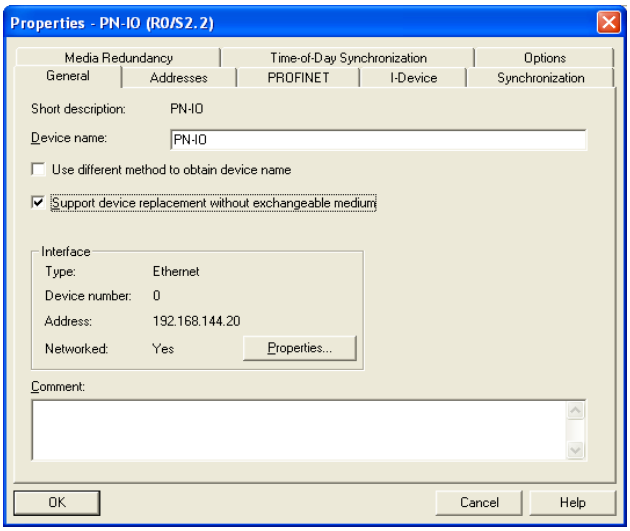
The BL20-gateways support the LLDP protocol (Link Layer Discovery Protocol).

Due to the neighborhood detection, there is no previous PROFINET name assignment (see Name assignment for FGEN-stations (page 12-11) is necessary for a new device of the same type and with an identical process data width in case of a device exchange. The device name and the IP-address will be assigned to the new device by the neighbor-device configured before (see Configuring the neighborhood detection (page 12-13)).

Necessary setting of the PROFINET-controller

The neighborhood detection without using a PC or removable media can only be executed if the function "Support device replacement without exchangeable medium" is activated within the properties of the PROFINET-controller.

Figure 12-14: Settings of the PROFINET-controller



In case of a device exchange, a new device thus not receives the device name from the removable medium or the PG but from the IO-controller.

The device name is assigned by means of the devices' port interconnections configured in the topology definition.

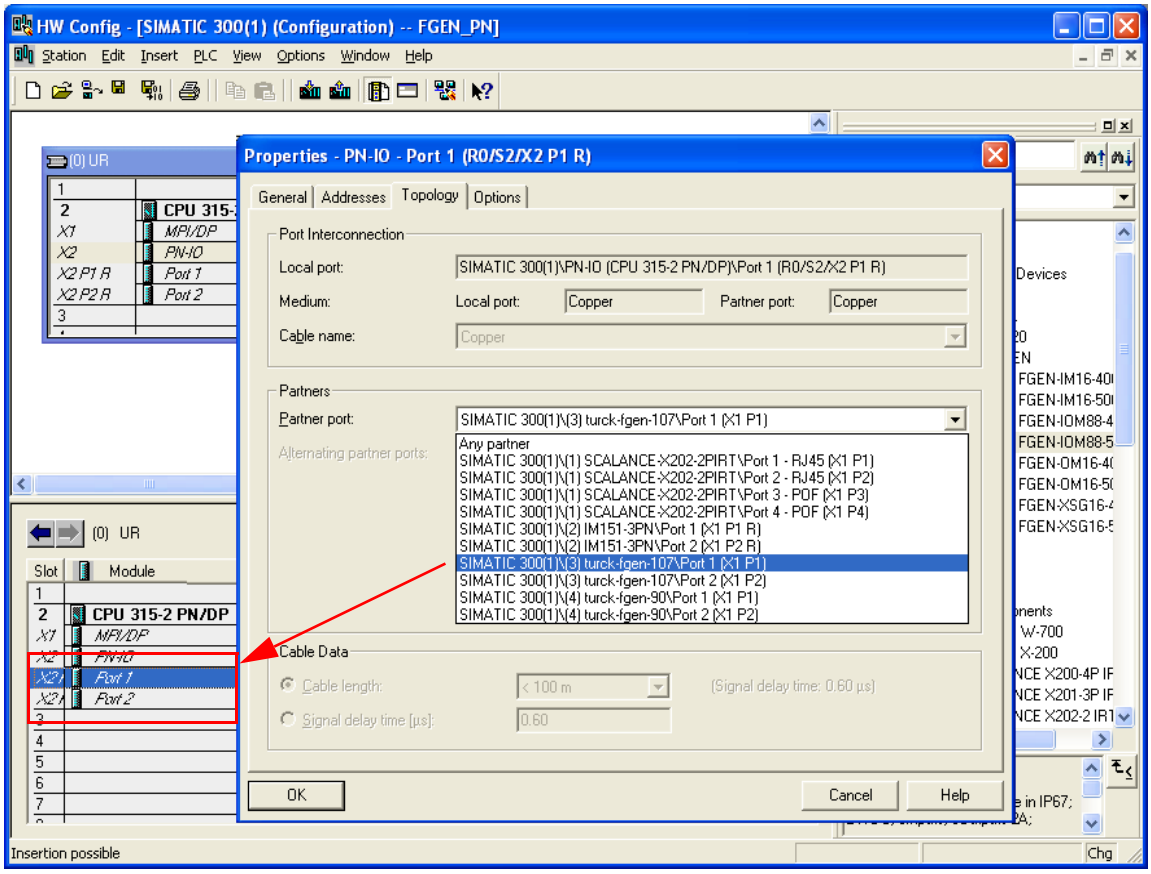
Configuring the neighborhood detection

A neighbor-port can be assigned to each Ethernet-port of a device. In case of a device exchange, this port is then used to assign the IP-address and the device name to the new device.

The definition of the partner-port is done either in the properties of the devices' Ethernet-ports or directly in the PROFINET Topology Editor (seepage 12-14).

- Partner-port definition via port-configuration.
  Selection of the port at the neighboring device to which this port is physically connected.

Figure 12-15: Partner-port definition (Example)



- Neighborhood-assignment using the Topology Editor.
  The assignment of neighboring devices is done either in the tabular or the graphical view.
  The copper ports of the devices are shown in green, the fiber-optic-ports in orange.

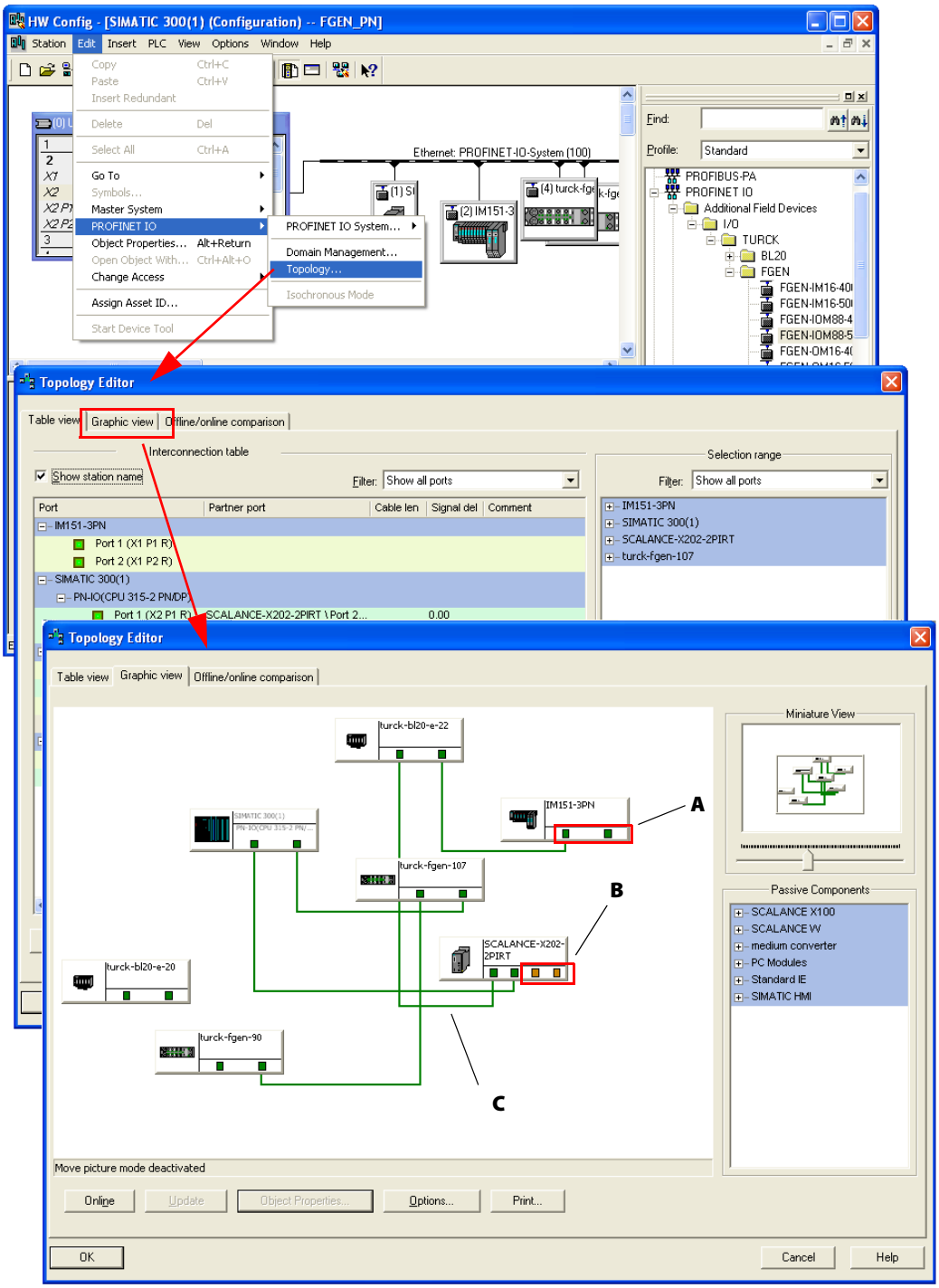


Figure 12-16: PROFINET Topology Editor

A *Example: copper port*
B *fiber optic port*
C *Example: copper-connection*

12.1.10 Online topology detection

The Step 7 software allows an offline/online comparison of the configured and the actually present topology.

1 Start the "Offline/ online comparison" in the Topology Editor using the "Start"-button in the respective tab.

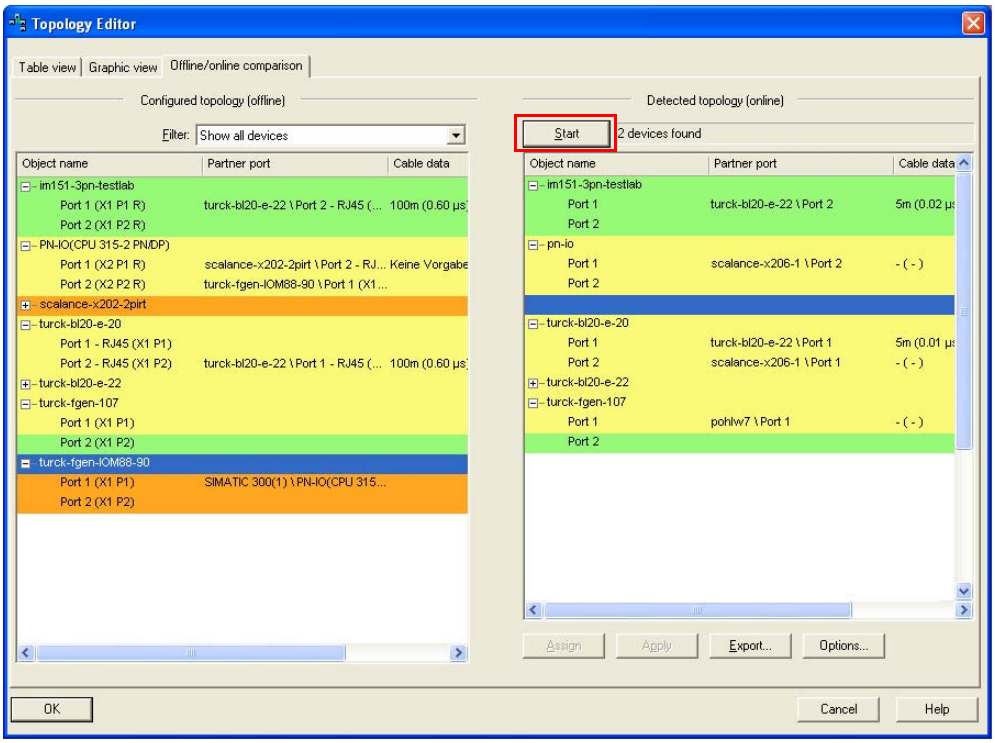


Figure 12-17: PROFINET Topology Editor Offline/ online comparison

12.1.11 Fast Start-Up - configuration of fieldbus nodes

In the following example, the FGEN-stations from the application example will be configured for FSU-operation:

- station 1: turck-fgen-107
- station 2: turck-fgen-90

Prioritized stat-up - activation at PN-IO

FSU is activated at the PN-IO slots of FSU- devices in the hardware configuration (HW Config) in the Simatic software:

In this example, the PN-IO-slots of the two FGEN-stations are configured respectively.

The following figure shows the activation of the prioritized start-up using the example of the node turck-fgen-107:

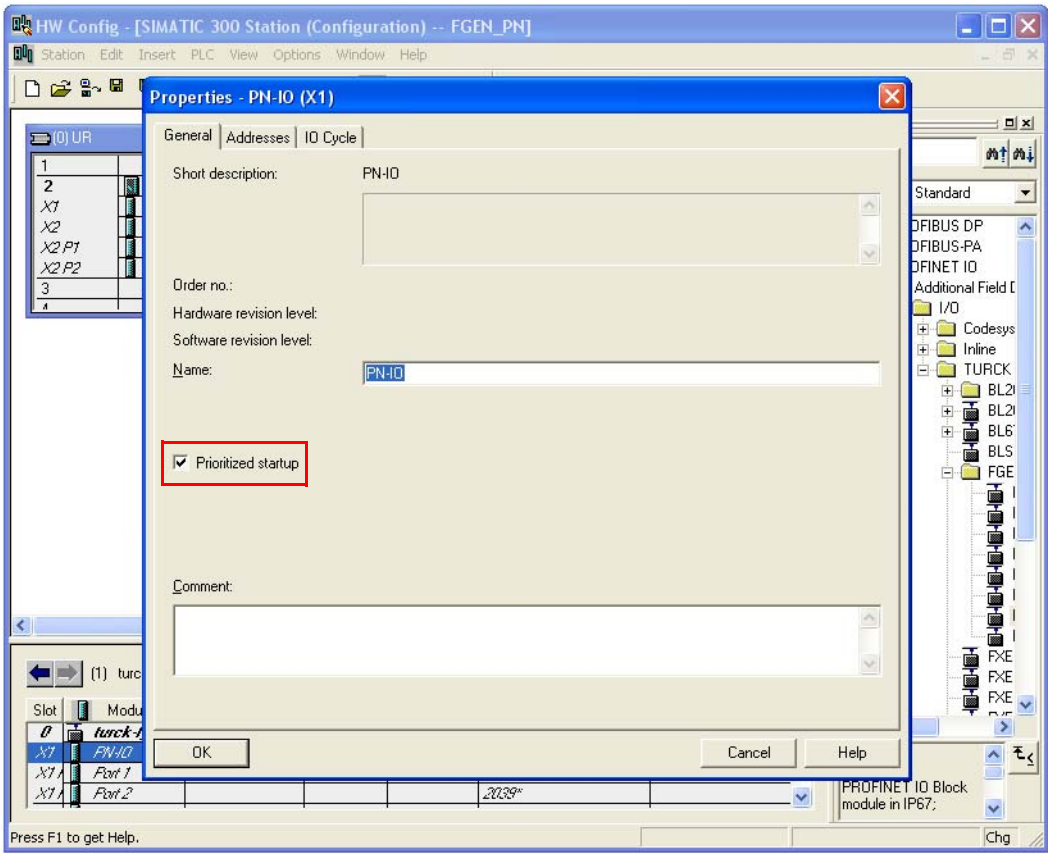


Figure 12-18: Prioritized start-up, settings at the PN-IO-slot

Note

This configuration has to be set for node turck-fgen-90 as well.

Setting the Ethernet-Ports (Port 1 and Port 2)

In order to enable a faster startup of devices, the Ethernet ports of the respective devices have to be configured as follows:

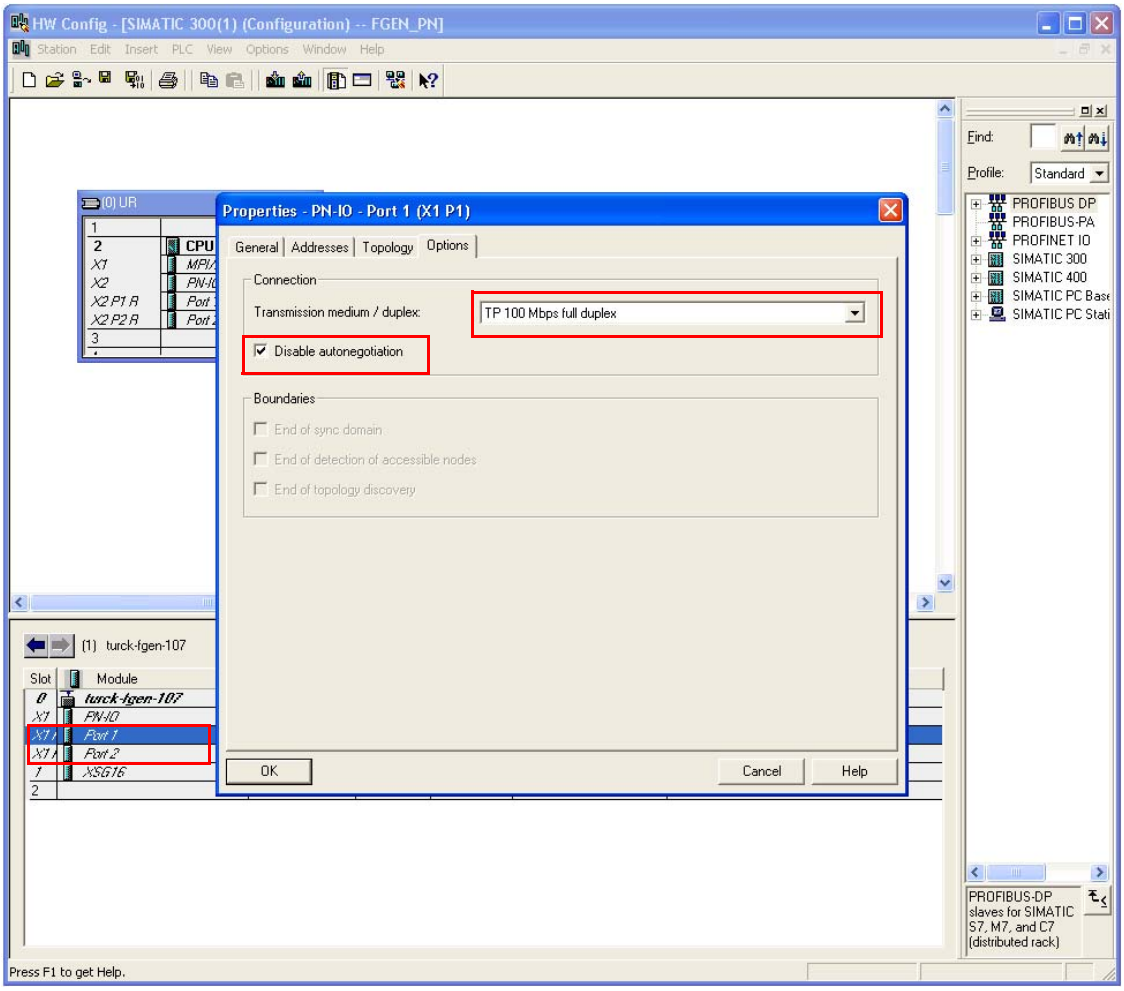
- Autonegotiation: disable
- Transmission medium / duplex: set to a fixed value

Note

Please observe, during configuration, that the settings for the ports of neighboring devices are identical.

Here also, the port configuration is shown using the example of port 1 at station turck-fgen-107.

Figure 12-19: Configuring one Ethernet-port



Note

This configuration has to be set for the neighbor-port of the neighboring node turck-fgen-90 as well.

12.1.12 Diagnostics with Step 7

Diagnostic messages in the hardware configuration

The FGEN-stations for PROFINET show gateway diagnostics and channel-specific module diagnostics in the hardware configuration of the Step 7-software.

Furthermore a special help text, which clearly specifies the error, is given for each diagnostic message:

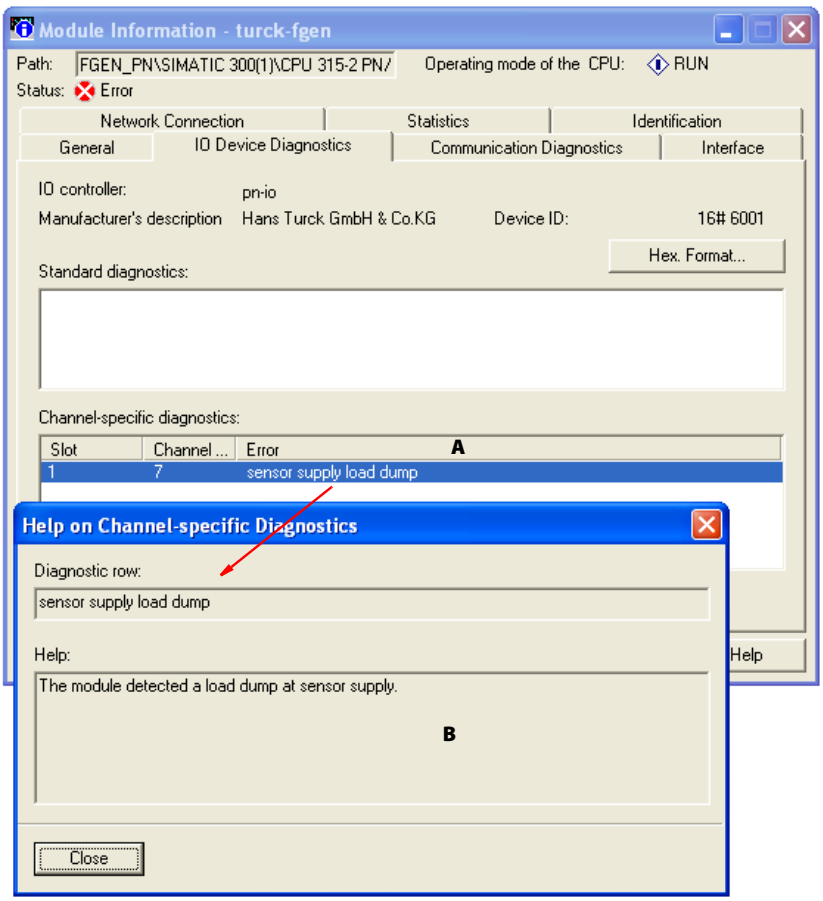


Figure 12-20: Diagnostics

A *channel specific station diagnostics*

B *manufacturer specific help texts*

13 Guidelines for Electrical Installation

13.1 General notes

13.1.1 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.).

13.1.2 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.

13.1.3 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.

13.1.4 Transmission media

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

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

Note

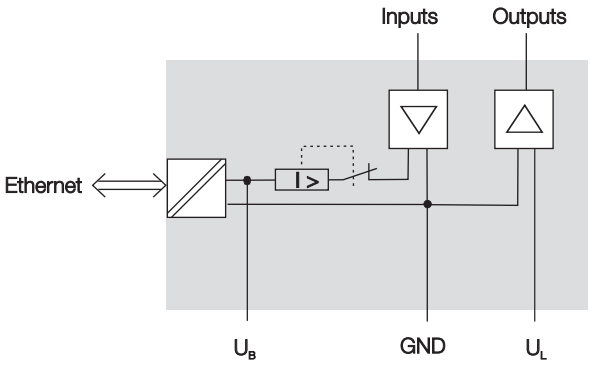
TURCK offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors.

The ordering information on the available cable types can be taken from the BL20-catalog.

13.2 Potential relationships

The potential relationships of an Ethernet system realized with FGEN-stations is characterized as shown in the following figure:

Figure 13-1: Block diagram of a FGEN-station



13.3 Electromagnetic compatibility(EMC

The TURCK products comply in full with the requirements pertaining to EMC regulations. Nevertheless, an EMC plan should be made before installation.

Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

13.3.1 Ensuring electromagnetic compatibility

The EMC of the stations 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.

13.3.2 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.

13.3.3 PE connection

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

13.4 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.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is used in stationary 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 or resistor can be connected parallel to the capacitor, to prevent disruptive discharges 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.

13.5 Potential compensation

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

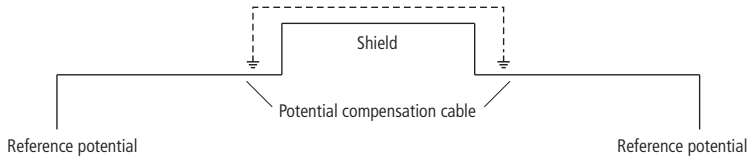
- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

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

Warning

Never use the shield as a potential compensation.

Figure 13-2: 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.

13.5.1 Switching inductive loads

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

13.5.2 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.

14 Appendix

14.1 Changing the IP address of a PC/ network interface card

14.1.1 Changing the IP address in Windows

The IP address is changed in the Control Panel:

- in Windows 2000/Windows XP under "Network Connections",
- in Windows 7 under "Network and Sharing Center".

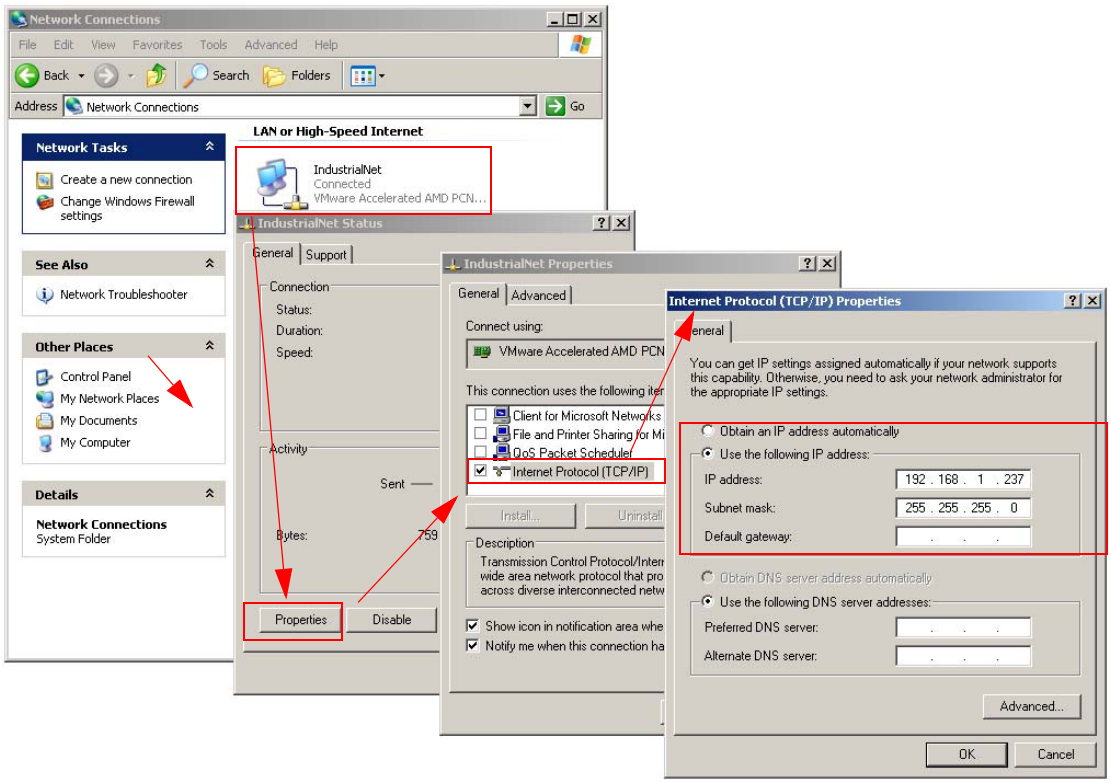
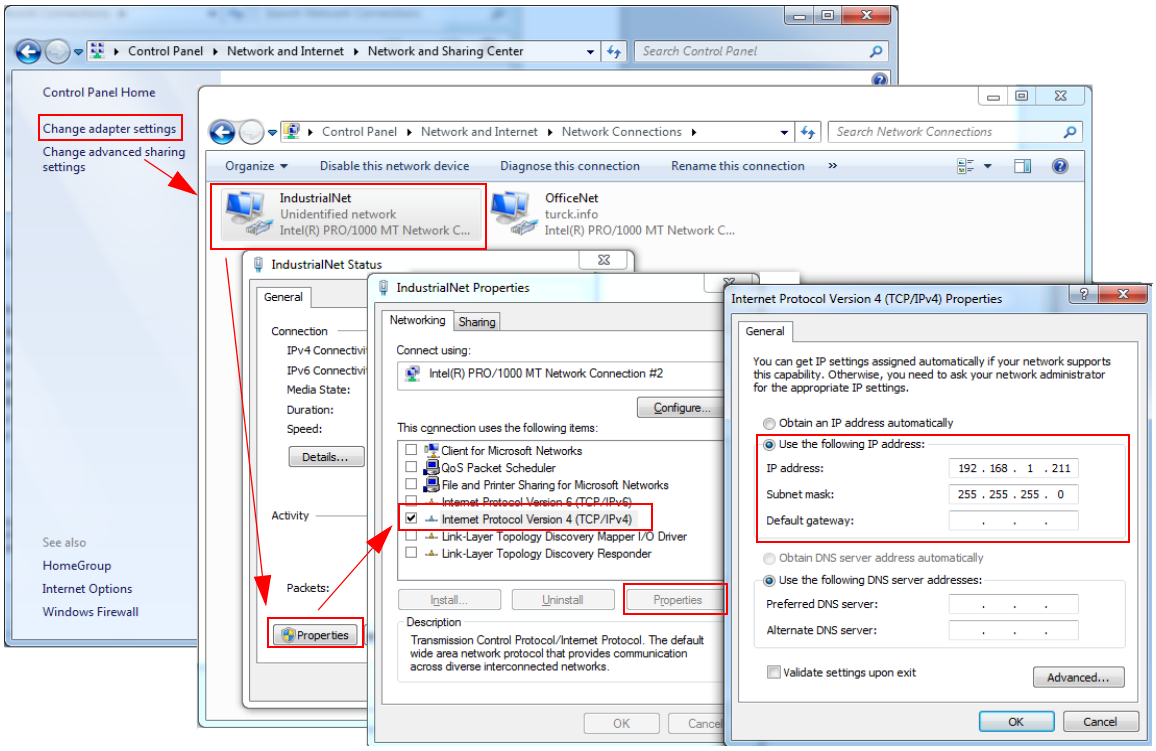


Figure 14-1: Changing the IP address in Windows 2000/ XP

Figure 14-2: Changing the IP address in Windows 7

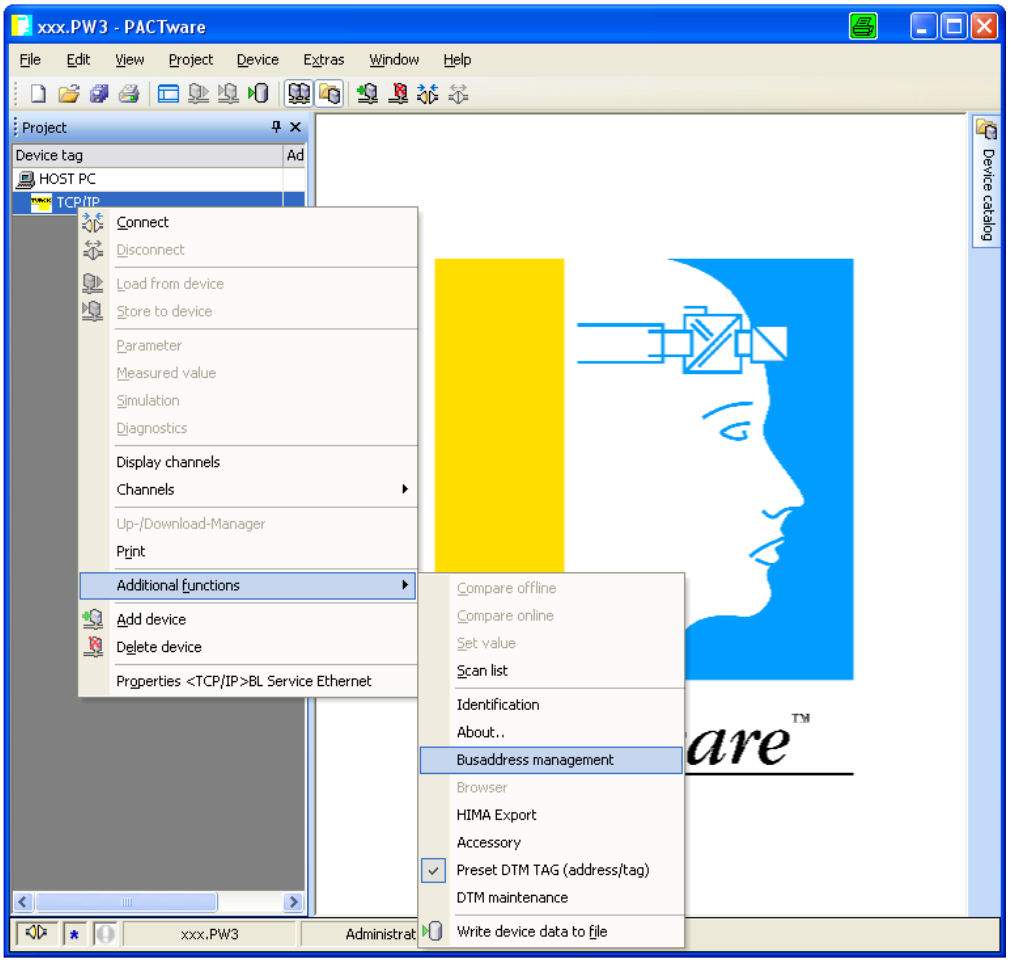


14.1.2 Changing the IP address via I/O-ASSISTANT V3

The Busaddress Management DTM in the software I/O-ASSISTANT (access via: "Additional functions → Busaddress Management") 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.

For further information concerning this issue, please read Addressing via I/O-ASSISTANT 3 (FDT/DTM) (page 3-12)).

Figure 14-3: Busaddress Management



14.2 Deactivating/ adapting the firewall in Windows

When using the Windows Firewall, problems may occur while changing IP addresses via the I/O-ASSISTANT. In this case, you can deactivate the system integrated Windows firewall completely or adapt it to your application.

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

Figure 14-4: Deactivating the Firewall in Windows 2000/ XP

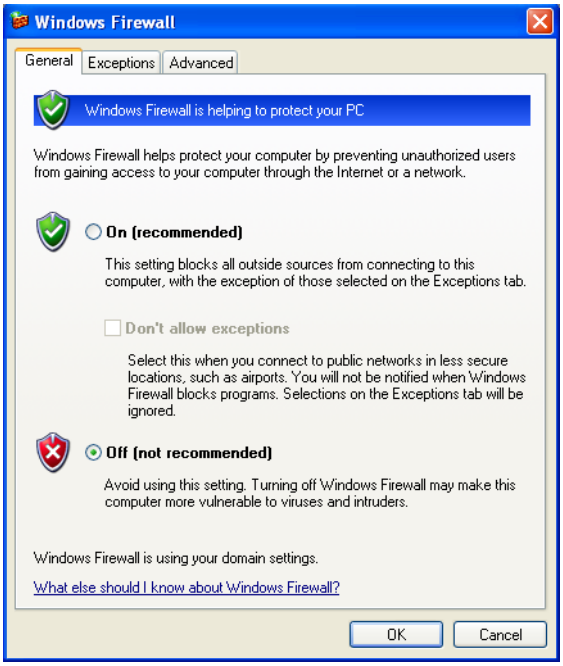
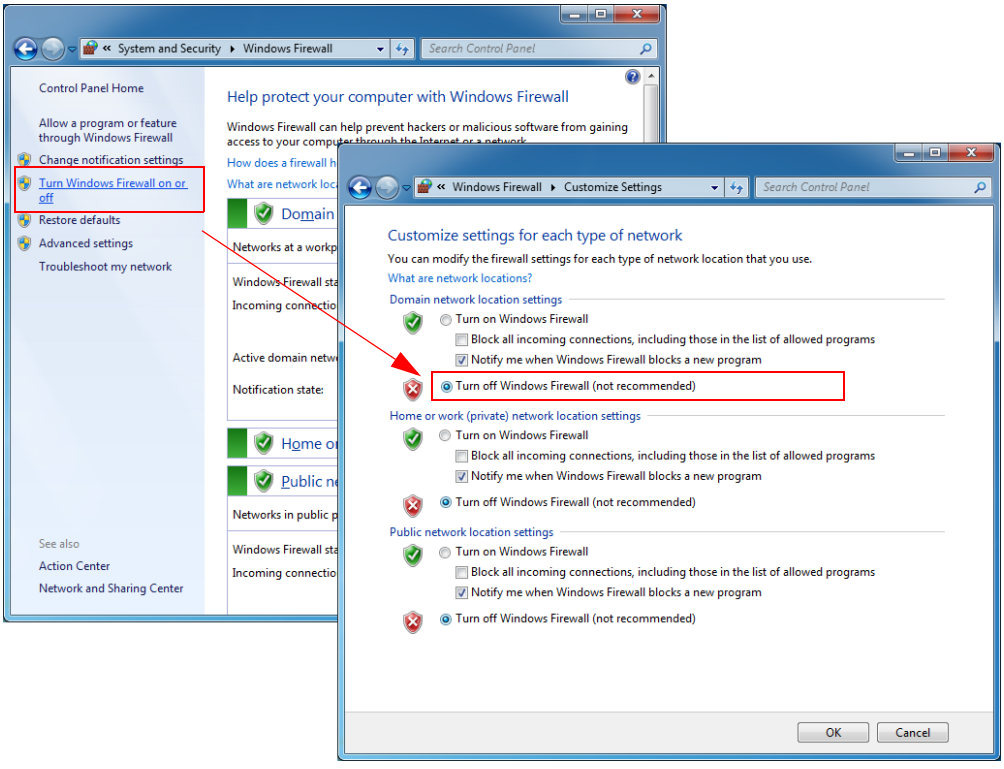


Figure 14-5: Deactivating the Firewall in Windows 7



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

Figure 14-6: Adapting the Firewall in Windows 2000/ XP

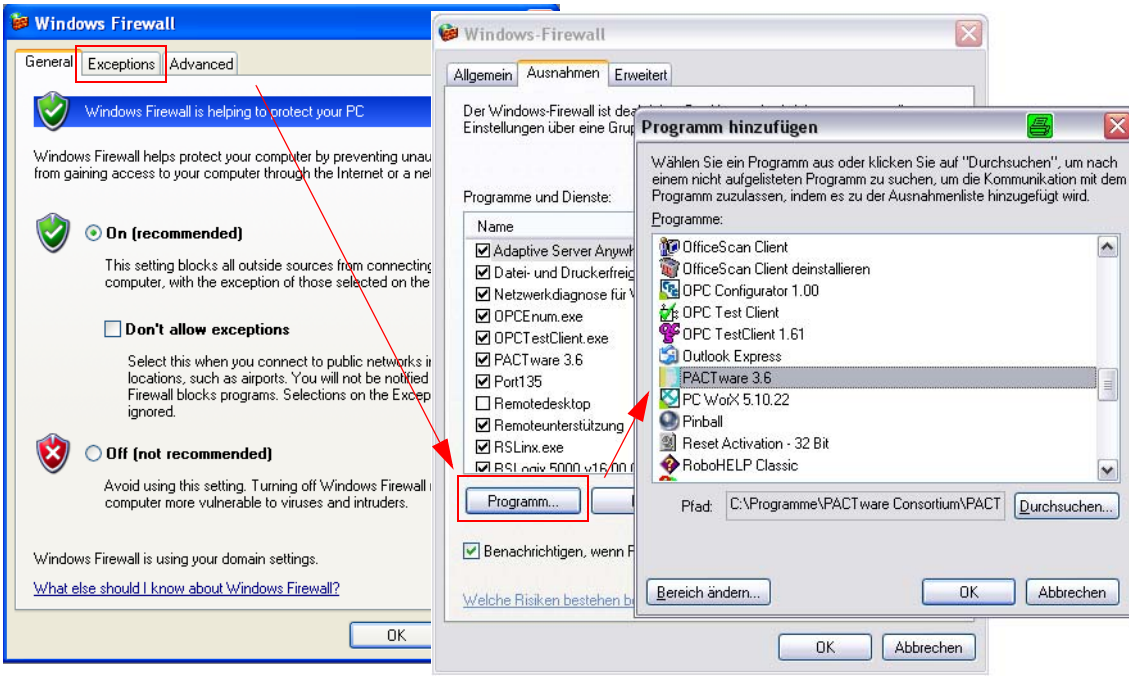
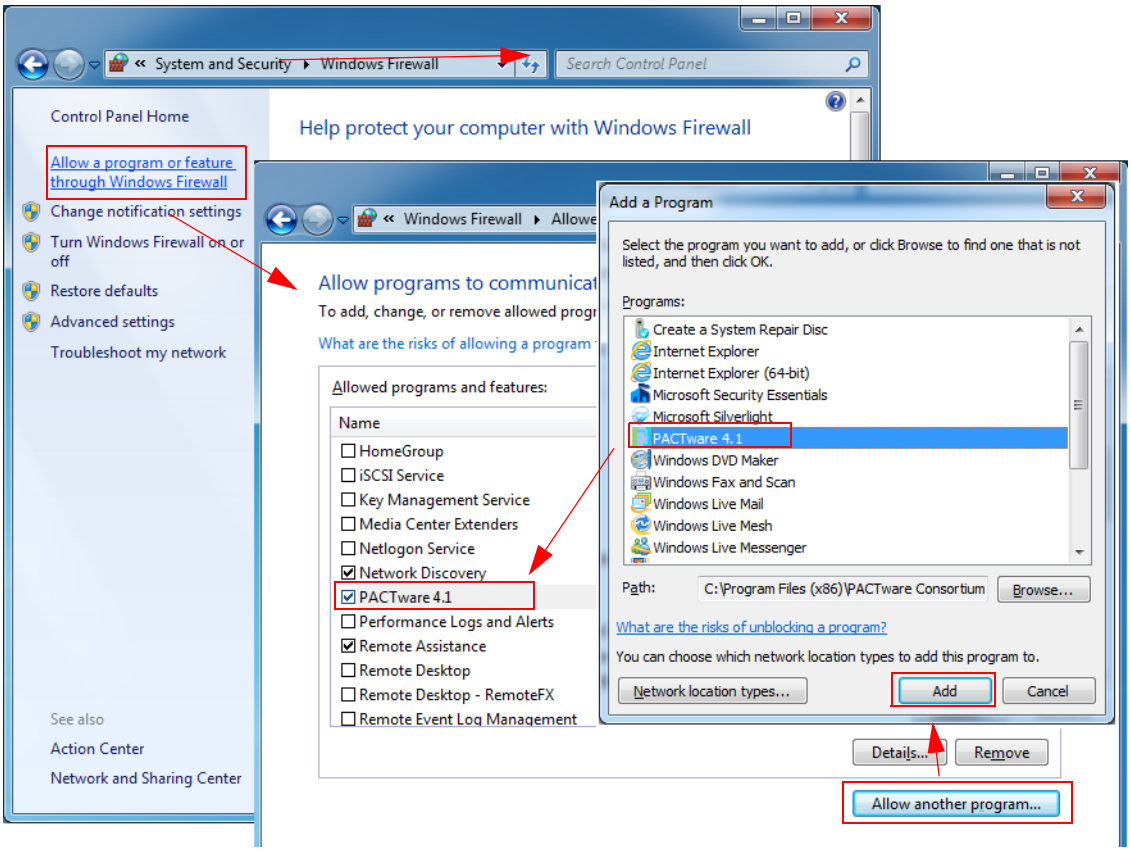


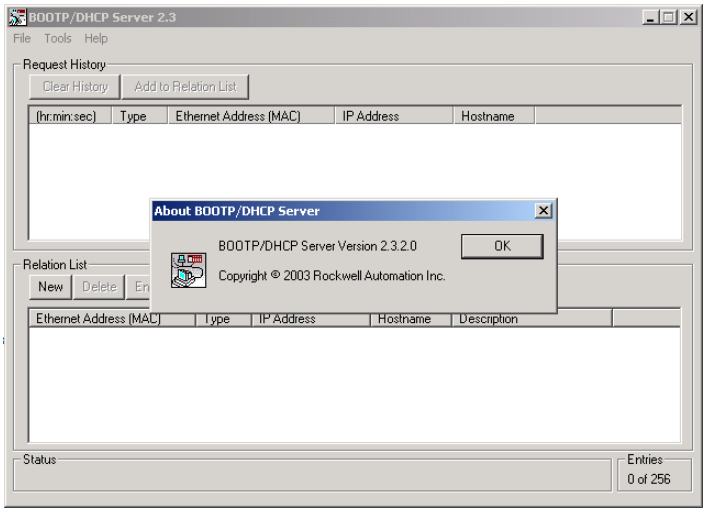
Figure 14-7: Adapting the Firewall in Windows 7



14.2.1 Addressing via DHCP

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 14-8: BootP-Server from Rockwell Automation Automation



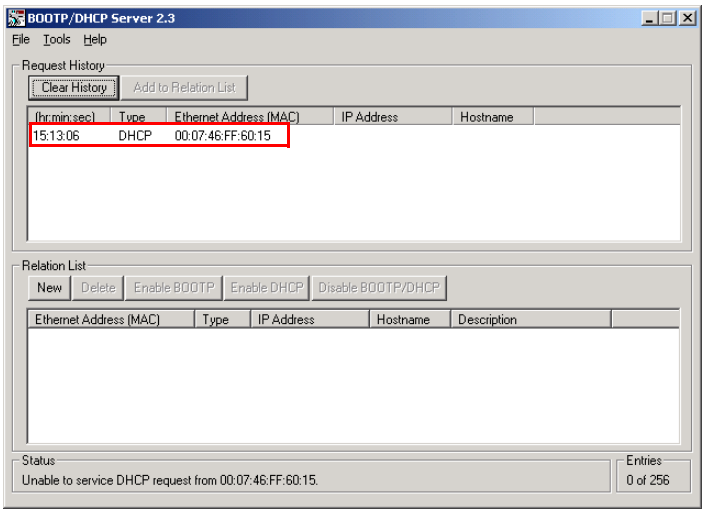
Addresses in the range from 1 to 254 can be allocated. The addresses 0 and 255 are reserved for broadcast messages in the subnet.

Note

The rotary coding switches on the gateway must be set to "300" = BootP, "400" = DHCP or "600" = PGM-DHCP in order to enable the BootP/DHCP-Mode.
(see also chapter 3, section Adressierung (page 3-9)).

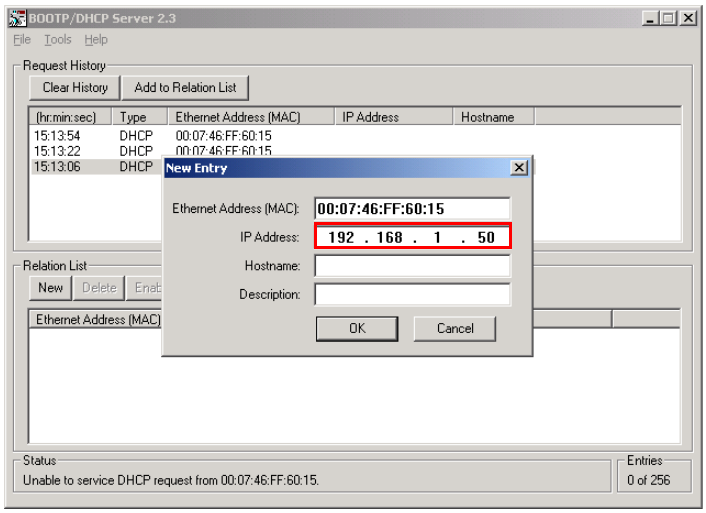
After having been connected to the network, the BL20 sends DHCP requests to the server using its MAC-ID.

Figure 14-9: DHCP-request of the device



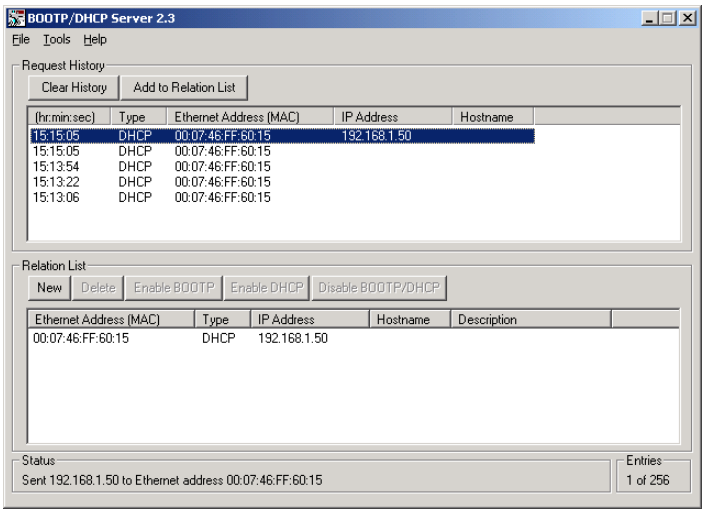
A double click on the request-entry opens the "New Entry" dialog box in which an IP address can be assigned to the MAC-ID.

Figure 14-10: Setting the IP address via DHCP



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

Figure 14-11: Set IP address



Attention

If the device is operated in switch position "300" = BootP or "400" = DHCP, the device loses the IP address in case of a voltage reset as soon as the Bootp/DHCP-server is shut down.
In switch position "600"' = PGM-DHCP, the IP address is stored permanently.

15 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.

BootP

Short for Bootstrap-protocol. The Bootstrap-protocol is used to set the network address of network nodes by means of a boot server .

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.

16 Index

U

V

W

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