TURCK

Industrial Automation

USER MANUAL

BL67- MULTIPROTOCOL GATEWAY FOR ETHERNET

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

Edition 02/2015

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1 About this manual

1.1 Documentation concept

This manual contains all information about the multiprotocol-gateway of the product line BL67 (BL67-GW-EN).

In addition to a short BL67-system description and the protocol-independent properties of the gateway and if necessary of the I/O-modules (technical properties, diagnostics, parameters, etc.), the following chapters contain two protocol-dependent chapters respectively.

The protocol-dependent chapters contain on the one hand the protocol-specific gateway-properties and on the other hand an application example for the respective Ethernet-protocol, describing the device's connection to automation devices.

- EtherNet/IP
  - chapter 4, Implementation of EtherNet/IP
  - chapter 5, Application example: BL67-GW-EN with EtherNet/IP (Allen Bradley)
- Modbus TCP
  - chapter 6, Implementation of Modbus TCP
  - chapter 7, Application example: BL67-GW-EN with Modbus TCP (CODESYS Win V3)
- PROFINET
  - chapter 8, Implementation of PROFINET
  - chapter 9, Application example: BL67-GW-EN with PROFINET (S7)

Additionally, the manual contain protocol-independent guideline for station configuration, the electrical installation, etc.

1.1.1 Additional documentation

- BL67 I/O-modules (TURCK-documentation no.: German D300572; English D300529).

  The bus-independent I/O-modules of the BL67-system as well as all bus independent information as mounting, labeling etc. are described in a separate manual.

  In addition to that, the manual contains a short description of the I/O-ASSISTANT, the project planning and configuration software tool for TURCK I/O-systems-

1.2 Explanation of symbols used

Warnings

Action-related warnings are placed next to potentially dangerous work steps and are marked by graphic symbols. Each warning is initiated by a warning sign and a signal word that expresses the gravity of the danger. The warnings have absolutely to be observed.

DANGER!

DANGER indicates an immediately dangerous situation, with high risk, the death or severe injury, if not avoided.

WARNING!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.

CAUTION!

WARNING indicates a potentially dangerous situation with medium risk, the death or severe injury, if not avoided.

ATTENTION!

ATTENTION indicates a situation that may lead to property damage, if it is not avoided.

1.2.1 Further notes

NOTE

In NOTES you find tips, recommendations and important information. The notes facilitate work, provide more information on specific actions and help to avoid overtime by not following the correct procedure.

TECHNICAL BASICS

The TECHNICAL BASICS offer technical information, basics and background information. This information lead to a better understanding of the device functions for example. The experienced user can skip this information.

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

➥ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3 General notes

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 BL67-gateways. It has been specially conceived for personnel with the necessary qualifications.

1.3.1 Prescribed use

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

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	Topic	new	changed
3	QuickConnect (QC) and Fast Start-Up (FSU) (page 3-6)	x	
	Ethernet-connection for QC-/FSU-applications (page 3-13)	x	
	Parameters of the I/O-modules (page 3-43)		x
	Diagnostics of the I/O-modules (page 3-44)		x
4	QuickConnect in BL67 (page 4-4)	x	
	Device Level Ring (DLR) (page 4-6)	x	
5	Activating QuickConnect (page 5-15)	x	
8	PROFINET (page 8-2)	x	
	FSU - Fast Start-Up (priorisierter Hochlauf) (page 8-4)	x	
	MRP (Media Redundancy Protokoll) (page 8-5)	x	
9	Fast Start-Up - configuration of fieldbus nodes (page 9-17)	x	

NOTE

The publication of this manual renders all previous editions invalid.

2 BL67 philosophy

2.1 The basic concept

BL67 is a modular I/O system of protection class IP67 for use in industrial automation. It connects the sensors and actuators in the field with the higher-level master.

BL67 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (SSI-, RS232-module,...).

A complete BL67 station counts as **one** station on the bus and therefore occupies **one** fieldbus address in any given fieldbus structure.
A BL67 station consists of a gateway, power distribution modules and I/O modules.

The connection to the relevant fieldbus is made via the bus-specific gateway, which is responsible for the communication between the BL67 station and the other fieldbus stations.

The communication within the BL67 station between the gateway and the individual BL67 modules is regulated via an internal module bus.

NOTE

The gateway is the only fieldbus-dependent module on a BL67 station. All other BL67 modules are not dependent on the fieldbus used.

2.1.1 Flexibility

A BL67 station can contain modules in any combination, which means it is possible to adapt the system to practically all applications in automated industry.

2.1.2 Easy to handle

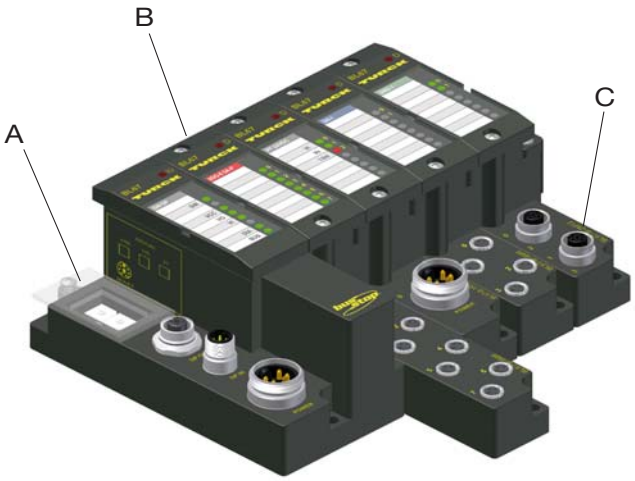
All BL67 modules of the standard line, with the exception of the gateway, consist of a base module and an electronics module.
The gateway and the base modules are either snapped onto a mounting rail or are directly mounted onto the machine frame. The electronic modules are plugged onto the appropriate base modules.

The electronics modules can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

2.2 The BL67 components

Figure 2-1:
BL67 station

A *Gateway*
B *Electronic module*
C *Base module*



2.2.1 Gateways

The gateway connects the fieldbus to the I/O modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the software tool I/O-ASSISTANT.

Figure 2-2:
BL67 gateway

2.2.2 Electronic modules

The standard electronics modules contain the I/O-functions of the BL67 modules (power distribution modules, digital and analog input/output modules, and technology modules).

They are plugged onto the base modules and are not directly connected to the wiring and can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

Figure 2-3: Example of an electronic module

Power feeding modules

Power Feeding modules distribute the required 24 V DC field voltage to the I/O-modules. They are necessary for building groups of modules with different potentials within a BL67 station, or if the rated supply voltage for the outputs cannot be guaranteed.

The adjoining power supply module and modules to the left are potentially isolated.

NOTE

For detailed information about the individual BL67 I/O components, please refer to the chapters 2 to 8 of the manual "BL67- I/O-modules" (TURCK Documentation-No.: German D300572; English: D300529).
The "Appendix" to the manual mentioned above contains (amongst others) a list of all BL67 components and the assignment of electronic modules to base modules.

2.2.3 Base modules

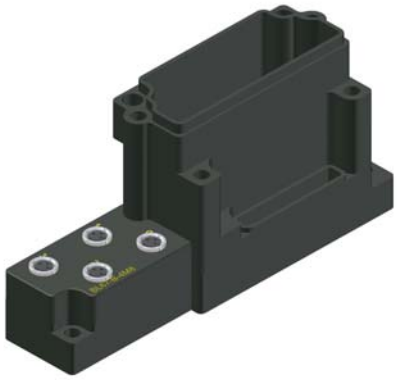
The field wiring is connected to the base modules.

These are available in the following connection variations:

- 1 × M12, 2 × M12, 2 × M12-P, 4 × M12, 4 × M12-P
- 4 × M8, 8 × M8
- 1 × M12-8
- 1 × M23, 1 × M23-19

- 1 × 7/8" (for Power Feeding-modules)

Figure 2-4: Example of a base module



2.2.4 End plate

An end plate on the right-hand side physically completes the BL67 station.

It protects the module bus connections of the last base module in a station and guarantees the protection class IP67.

Figure 2-5: End plate

3 Properties: Gateway

3.1 General technical data

3.1.1 Function

The BL67-GW-EN (> VN 03-00) is used as multiprotocol-interface between the BL67-system and the Ethernet-protocols Modbus TCP, EtherNet/IP and PROFINET.

3.1.2 Version overview

Please observe, that the previous versions of the gateway did not support all protocols.

- Version **< VN 03-00**
  BL67-gateway supports only the Ethernet protocol
  - Modbus TCP
- Version **VN 03-01**
  BL67-gateway supports the Ethernet protocols
  - Modbus TCP
  - EtherNet/IP
- Version **≥ VN 03-02**
  BL67-gateway supports the Ethernet protocols
  - Modbus TCP
  - EtherNet/IP
  - PROFINET

NOTE

´The multi protocol Ethernet gateway replaces all previous versions and is completely compatible.

Only the LED-designation has changed. Please find detailed information under Diagnostic messages via LEDs (page 3-40).

3.2 Supported I/O-modules (protocol dependent)

Table 3-1: List of supported modules

Module	EtherNet/IP	Modbus TCP	PROFINET
Digital input modules			
BL67-4DI-P	✓	✓	✓
BL67-4DI-N	✓	✓	✓
BL67-4DI-PD	✓	✓	✓
BL67-8DI-P	✓	✓	✓
BL67-4DI-N	✓	✓	✓
BL67-8DI-PD	✓	✓	✓
BL67-16DI-P	✓	✓	✓
Analog input modules			
BL67-2AI-I	✓	✓	✓
BL67-2AI-V	✓	✓	✓
BL67-2AI-PT	✓	✓	✓
BL67-2AI-TC	✓	✓	✓
BL67-4AI-TC	✓	✓	✓
BL67-4AI-V/I	✓	✓	✓
Digital output modules			
BL67-4DO-0.5A-P	✓	✓	✓
BL67-4DO-2A-P	✓	✓	✓
BL67-4DO-2A-N	✓	✓	✓
BL67-4DO-4A-P	✓	✓	✓
BL67-8DO-0.5A-P	✓	✓	✓
BL67-8DO-0.5A-N	✓	✓	✓
BL67-16DO-0.1A-P	✓	✓	✓
Analog output modules			
BL67-2AO-I	✓	✓	✓
BL67-2AO-V	✓	✓	✓
BL67-4AO-V	✓	✓	✓
Relay modules			
BL67-8DO-R-NO	✓	✓	✓

Table 3-1: List of supported modules

Module	EtherNet/IP	Modbus TCP	PROFINET
Digital combi modules			
BL67-4DI4DO-PD	✓	✓	✓
BL67-8XSG-P	✓	✓	✓
BL67-8XSG-PD	✓	✓	✓
Analog combi modules			
BL67-2AI2AO-V/I	✓	✓	✓
BL67-4AI4AO-V/I	✓	✓	✓
Technology modules			
BL67-1RS232	✓	✓	✓
BL67-1RS485/422	✓	✓	✓
BL67-1SSI	✓	✓	✓
BL67-1CVI	✓	✓	✓
BL67-1CNT/ENC	✓	✓	✓
BL67-2RFID-A			✓
BL67-2RFID-S	✓	✓	✓
Power distribution modules			
BL67-PF-24VDC	✓	✓	✓

3.3 QuickConnect (QC) and Fast Start-Up (FSU)

The gateway BL67-GW-EN (VN ≥ 03-00) supports QuickConnect- and Fast Start-Up (see also QuickConnect in BL67 (page 4-4) or PROFINET (page 8-2).

The following table shows the BL67 electronic modules, which are ready for QuickConnect or respectively Fast Start-Up.

Table 3-2: Modules ready for QuickConnect or Fast Start-Up BL67 modules

Module	Ready for QC/FSU from VN
BL67-4DI-P	VN 01-03
BL67-4DI-PD	VN 01-07
BL67-8DI-P	VN 01-03
BL67-8DI-PD	VN 01-06
BL67-16DI-P	VN 01-01
BL67-4DO-0.5A-P	VN 01-07
BL67-4DO-2A-P	VN 01-07
BL67-4DO-4A-P	VN 01-01
BL67-8DO-0.5A-P	VN 01-07
BL67-16DO-0.1A-P	VN 01-07
BL67-8XSG-P	VN 01-01
BL67-8XSG-PD	VN 01-06
BL67-4DI4DO-PD	VN 01-06
BL67-PF-24VDC	VN 01-03

NOTE

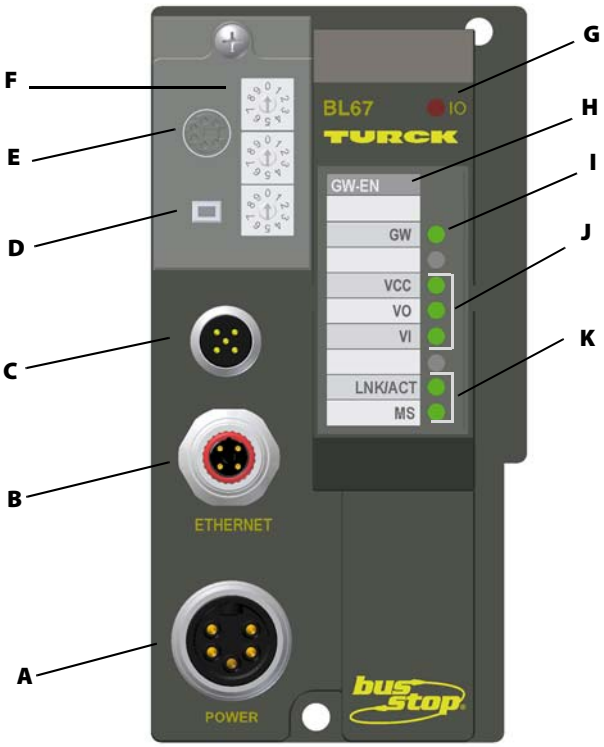
The start up behavior of the complete BL67-station is changed if modules which are **not** ready for QC or FSU are used within a station. The start up time of a station is determined by the slowest module.
In this case, QuickConnect or respectively Fast Start-Up can not be guaranteed.

3.4 Technical data

3.4.1 Top view BL67-GW-EN (VN < 03-00)

Figure 3-1:
Front view

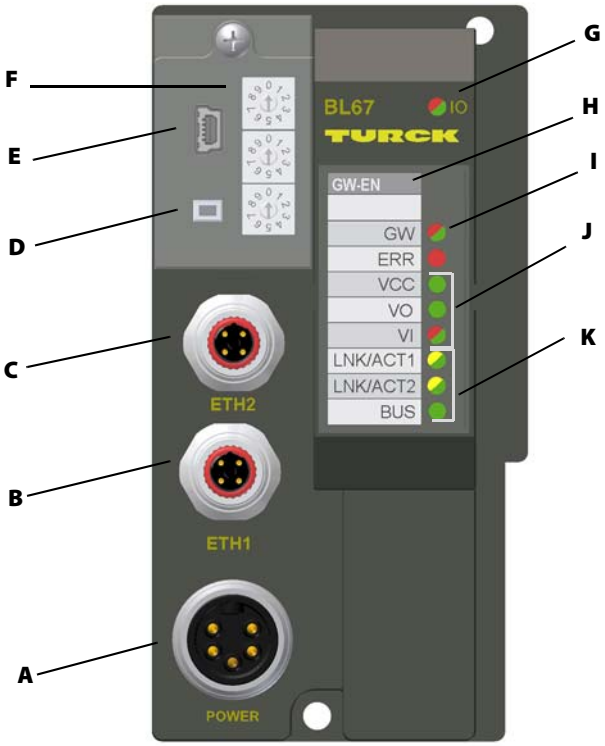
A *Power supply*
B *Ethernet*
C *not used*
D *SET button (s. page 3-39)*
E *Service interface*
F *Rotary coding switches*
G *Module bus LED*
H *Designation*
I *Status LED*
J *LEDs for the Power supply monitoring*
K *Ethernet LEDs*



3.4.2 Top view BL67-GW-EN (VN ≥ 03-00)

Figure 3-2: Top view BL67-GW-EN (VN ≥ 03-00)

A *Power supply*
B *Ethernet 1*
C *Ethernet 2*
D *SET button (s. page 3-39)*
E *Service-interface, no function*
F *Rotary coding switches*
G *Module bus LED*
H *Designation*
I *Status LED*
J *LEDs for the Power supply monitoring*
K *Ethernet LEDs*

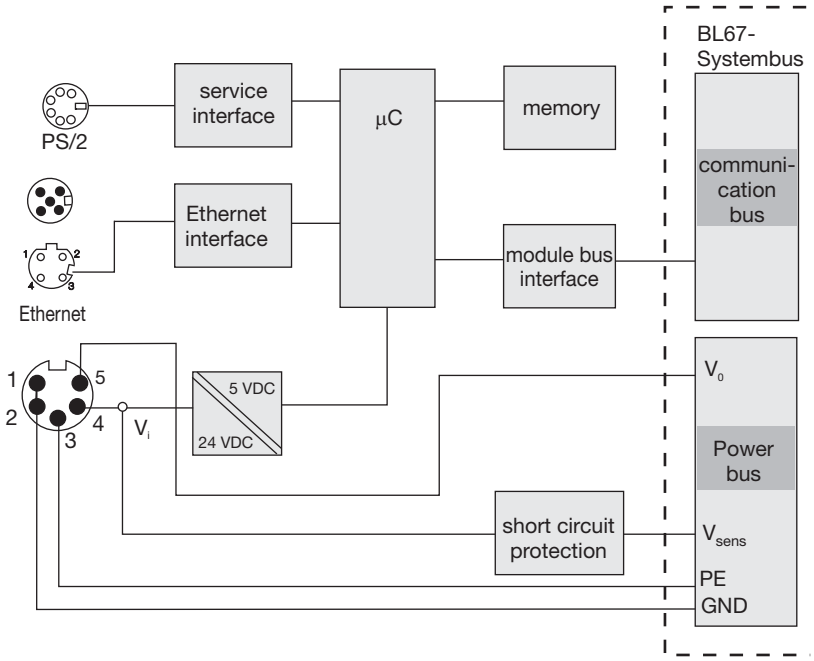


3.4.3 Gateway structure

BL67-GW-EN < VN 03-00

The BL67 gateway has the following structure:

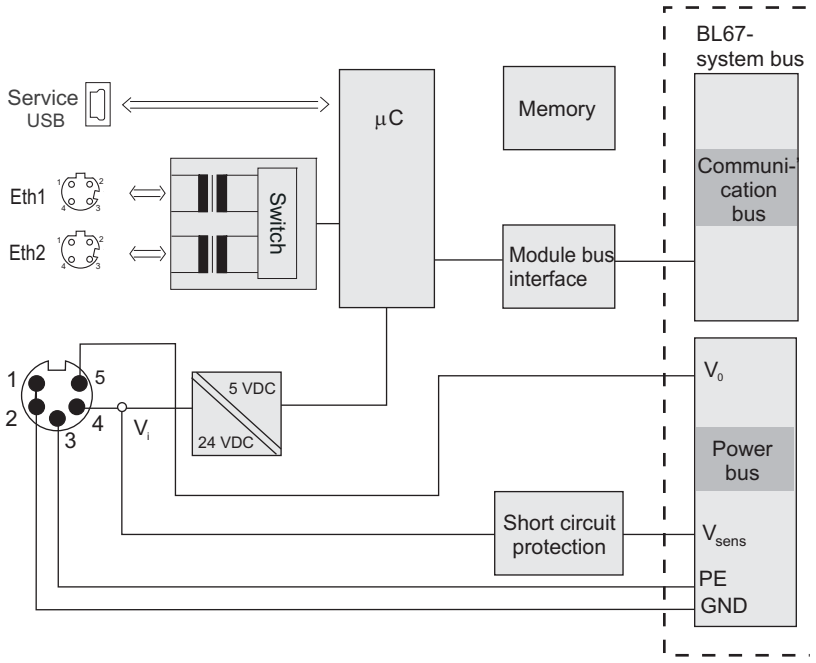
Figure 3-3: Gateway structure < VN 03-00



BL67-GW-EN ≥ VN 03-00

The BL67 gateway has the following structure:

Figure 3-4: Gateway structure≥ VN 03-00



3.4.4 Technical data

Table 3-3: Technical data Ethernet gateway

Supply voltage		
Requirements for the power supply according to EN 61131-2		
System supply V_I (U_B)	24 V DC	used to generate the galvanically isolated module bus supply
Permissible range	18 to 30 VDC	
Field supply V_O (U_L)	24 V DC	
Permissible range	18 to 30 VDC	
I_{sys}	600 mA	current consumption CPU + module bus at maximum system extension
I_{MB}	max. 1.3 A	maximum output current of module bus supply
I_{VI}	max. 4 A	short-circuit and overload protection of the sensor supply from gateway or power feeding module

Protocol properties		
Modbus TCP		
Address assignment	Static IP (rotary coding switches), BOOTP, DHCP	
Supported Function Codes	FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16, FC23	
Number of connections	8	
EtherNet/IP		
Address assignment	according to EtherNet/IP standard	
Quick Connect (QC)	< 150 ms	see QuickConnect (QC) and Fast Start-Up (FSU) (page 3-6)
Device Level Ring (DLR)	supported (≥ VN 03-04)	see Device Level Ring (DLR) (page 4-6)
Number of connections	3	
PROFINET		
Address assignment	DCP	
MinCycleTime	1 ms	
Fast Start-Up (FSU)	< 150 ms	see QuickConnect (QC) and Fast Start-Up (FSU) (page 3-6)
Diagnosis	according to PROFINET Alarm Handling	
Topology detection	supported	
Automatic address assignment	supported	
Media Redundancy Protocol (MRP)	supported (^{3}VN 03-04)	see MRP (Media Redundancy Protokoll) (page 8-5)
LLDP	supported	see PROFINET neighborhood detection via LLDP (page 9-13)
Isolation voltages		
U_{RS} (Ethernet/service interface)	500 V AC	
U_{EN} (Ethernet/module bus)	500 V AC	
U_{sys} (V_O/V_I to U_{sys})	1000 V DC	
U_{field}/service interface	1000 V DC	
Ambient conditions		
Ambient temperature		
– $t_{Ambient}$	40 to +70 °C/-40 to 158 °F	
– t_{Store}	40 to +85 °C/-40 to 185 °F	

Relative humidity	5 to 95 % (internal), Level RH-2, no condensation (at 45 °C storage); according to IEC 61131-2
Climatic tests	according to IEC 61131-2
Corrosive gas	according to IEC 60068-2-42/43
– SO_2	10 ppm (rel. humidity < 75 %, no condensation)
– H_2S	1.0 ppm (rel. humidity < 75 %, no condensation)
Vibration resistance	according to IEC 61131-2
– 10 to 57 Hz, constant amplitude 0.075 mm/ 0.003 inch, 1 g	yes
– 57 to 150 Hz, constant acceleration 1 g	yes
– Mode of vibration	Frequency sweeps with a change in speed of 1 Octave/ min
– Period of oscillation	20 frequency sweeps per axis of coordinate
Protection class	according to IEC 60529, IP67
Shock resistance	according to IEC 68-2-27, 18 shocks, semi-sinusoidal 15 g threshold/11 ms, each in ± direction per space coordinate
Repetitive shock resistance	according to IEC 68-2-29, 1000 shocks, semi-sinusoidal 25 g threshold/6 ms, each in ± direction per space coordinate
Drop and topple/ free fall	according to IEC 68-2-31/IEC 68-2-32 1
– Height of fall (weight < 10 kg)	1.0 m
– Height of fall (weight 10 to 40 kg)	0.5 m
– Test runs	7
Emitted interference	
High-frequency, radiated	acc. to EN 55011 class A
Electromagnetic compatibility (EMC)	according to EN 61131-2/EN 50082-2 (industry)
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields	according to IEC 61131-2
Fast transients (Burst)	according to IEC 61131-2
Conducted interferences, induced by HF fields	according to IEC 61000-4-6 10 V Criteria A

A *I/O-line-length≤ 30 m*	High energy transients **A** Power supply	according to IEC 61000-4-5 0,5 kV CM, 12Ω/9 µF 0,5 kV DM, 2Ω/18 µF Criteria B
	Reliability	
	Pull/plug cycles of electronic modules	20
	Housing material	PC-V0 (Lexan)
	Size	
	Width x length x height (mm/inch)	64,5 × 145,0 × 77,5/2,54 × 5,71 × 3,05

WARNING!

This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

3.5 Connection options

3.5.1 Fieldbus connection

Table 3-4: Fieldbus connection

	BL67-GW-EN (VN ≥ 03-00)	BL67-GW-EN (VN < 03-00)
Ethernet connection	2 x M12 (female connector) M12 Ethernet-switch, 4 pole, D-coded acc. to IAONA specification	1 x M12 (female connector) 4 pole, D-coded acc. to IAONA specification

BL67-GW-EN (VN ≥ 03-00)

The switch allows linear topology.

Figure 3-5: M12 female connector

Table 3-5: Pin assignment

Pin-no.		
1	TD+	Transmission Data +
2	RD+	Receive Data +
3	TD-	Transmission Data -
4	RD-	Receive Data -

Ethernet-connection for 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
– ETH1 = connector for **outgoing** Ethernet-line

3.5.2 Voltage supply via 7/8"-connector

The power supply of the BL67 station is realized via a 7/8" male connector on the gateway.

Figure 3-6: male 7/8" connector for power supply

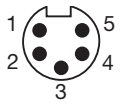


Table 3-6: Pin assignment of the 7/8" connector

Pin-No.	Color	7/8"	Designation
1	Black	GND	
2	blue	GND	
3	green/yellow	PE	Protective earth
4	Brown	V_I (U_B)	Feed-in of nominal voltage for input modules (sensor supply V_{sens})); also used for the generation of the system supply voltage
5	white	V_O (U_L)	Feed-in of nominal voltage for output modules (can be switched off separately).

3.5.3 Service-interface female PS/2 connector (VN < 03-00)

The female PS/2 connector is used to connect the gateway to the project planning and diagnostic software I/O-ASSISTANT.

The service interface is designed as a 6 pole mini-DIN-connection.

Two types of cables can be used to connect the service interface (female PS/2 connector) to a PC for the purpose of using I/O-ASSISTANT (project planning and diagnostic software).

- special I/O-ASSISTANT-connection cable from TURCK (IOASSISTANT-ADAPTERKABEL-BL20/BL67; Ident-no.: 6827133)
- Commercially available PS/2 cable with adapter cable SUB-D/PS/2

Connection with I/O-ASSISTANT-connection cable

The I/O-ASSISTANT-cables have a PS/2 male connector (connection for female connector on gateway) and a SUB-D female connector (connection for male connector on PC).

Figure 3-7: PS/2 male connector on the connection cable to the gateway (top view)

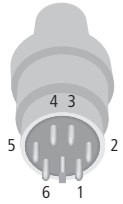
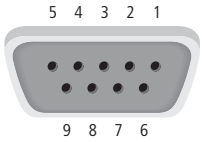


Figure 3-8: 9-pole SUB-D female connector on the cable for connecting to PC (top view)



Connection using commercially available cables

A further possibility to connect PC and BL67 gateway is to use a commercially available connection and adapter cable.

The connection shown in the following figure (PS2-male/PS2-male) is a 6-wire 1:1 connection.

The following two cables are necessary:

- 1 x PS/2 cable (PS/2 male connector/PS/2 male connector) (commercially available keyboard extension cable)
- 1 x adapter cable (PS/2 female connector/SUB-D female connector) (commercially available extension cable for a PC mouse)

Figure 3-9: PS/2 male connector on the connection cable to the gateway (top view)

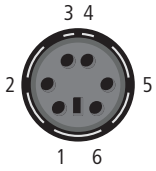
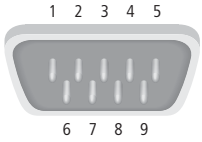


Figure 3-10: PS/2 female connector on the gateway (top view)



Pin assignment

The table below shows the pin assignment when using a PS/2 cable and adapter:

Table 3-7: Pin assignment when using PS/2 cable and adapter

PS/2			9-pole serial interface on PC	
Pin-no.	Standard PS/2 male connector	BL67 gateway: PS/2 female connector	Pin-no.	Male connector
1	CLK	+5 V (from gateway)	4, 6 **A**	DTR, DSR
2	GND	GND	5	GND
3	DATA	not used	–	–
4	n.c. (DATA2)	TxD	2	RxD
5	+5 V	/CtrlMode	7	RTS
6	n.c. (CLK2)	RxD	3	TxD

A *not supported by all adapter cables*

3.5.4 Service interface Mini-USB (VN ≥ 03-00)

The access of the software I/O-ASSISTANT 3 (FDT/DTM) via the service-interface (Mini-USB) is not supported.

For a connection to the gateway via I/O-ASSISTANT 3 (FDT/DTM) is done via Ethernet.

3.6 Address assignment

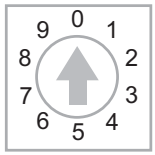
Setting the address mode is done through the 3 rotary coding-switches on the gateway.

NOTE
It is not necessary to address the station's internal module bus.

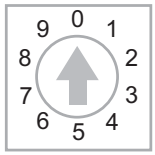
ATTENTION!
Deficient screwing
Protection class IP 67 not guaranteed
➤ Tighten the screws in the base modules correctly.

ATTENTION!
Damaged sealing
Protection class IP 67 not guaranteed
➤ Check the sealing at the left module bus connector of the base modules for correct fit and damage.

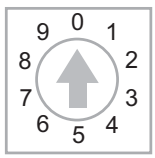
Figure 3-11: Rotary coding switches at the gateway



x 100



x 10



x 1

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

LED behavior

During the start-up, the flashing LED "BUS" (red/green) displays that the station is waiting for address assignment per DHCP/BOOTP/Autonegotiation.

As soon as the address assignment is done, the LED flashes green and the station is ready for communicating in the network.

3.6.1 Default setting of the gateway

The object provides the following control functions:

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.

NOTE

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

Resetting the IP-address, switch position "000"

With this setting the DIP-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 3-18)).

This setting allows for example the I/O-ASSISTANT 3 (FDT/DTM) to communicate with the station, the device's WEB-server can be accessed using the IP-address 192.168.1.254.

NOTE

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

3.6.2 Address setting via rotary coding switch (rotary mode)

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

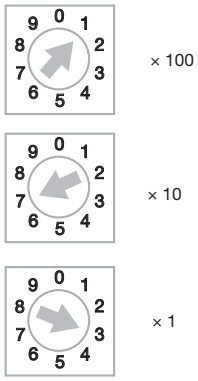
NOTE

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

Addresses from 1 to 254 can be set. The addresses 0 and 255 are used for Broadcast-messages in the subnet.

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

Figure 3-12: Address setting



NOTE

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

NOTE

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

3.6.3 Address setting via BootP-mode (300)

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

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

NOTE

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

If the gateway 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.

3.6.4 Address setting via DHCP-mode (400)

Address setting is carried out by a DHCP-server in the network after the start-up of the gateway (see also Addressing via DHCP (page 12-7).

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

NOTE

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

If the gateway 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.

3.6.5 Address setting via PGM-mode (500)

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

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

NOTE

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

PROFINET

Please assure, that in PROFINET-applications, the address assigned via a I/O-ASSISTANT 3 (FDT/DTM) corresponds to the address, which is assigned in the configuration tool.

3.6.6 Address setting via the mode PGM-DHCP (universal mode, 600)

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

The device sends DHCP-requests until it gets a permanent address.

The DHCP-client in the device is deactivated as soon as the devices gets a permanent address via the I/O-ASSISTANT V3 (FDT/DTM), the Web-server or the PROFINET-controller.

If the IP-address assignment is done via BOOTP/DHCP-server, the device usually gets a new IP-address after every start-up (see also Addressing via DHCP (page 12-7)).

Permanent IP-address assignment using the Rockwell BOOTP/DHCP-server

The Rockwell BOOTP/DHCP-server can also be used to assign a permanent IP-address.

For that purpose, deactivate the DHCP-client in the respective device using "Disable BOOTP/DHCP" in the BOOTP/DHCP-server The device stores the set IP-address even after start-up.

PROFINET

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

3.6.7 F_Reset (reset to factory settings, 900)

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

NOTE

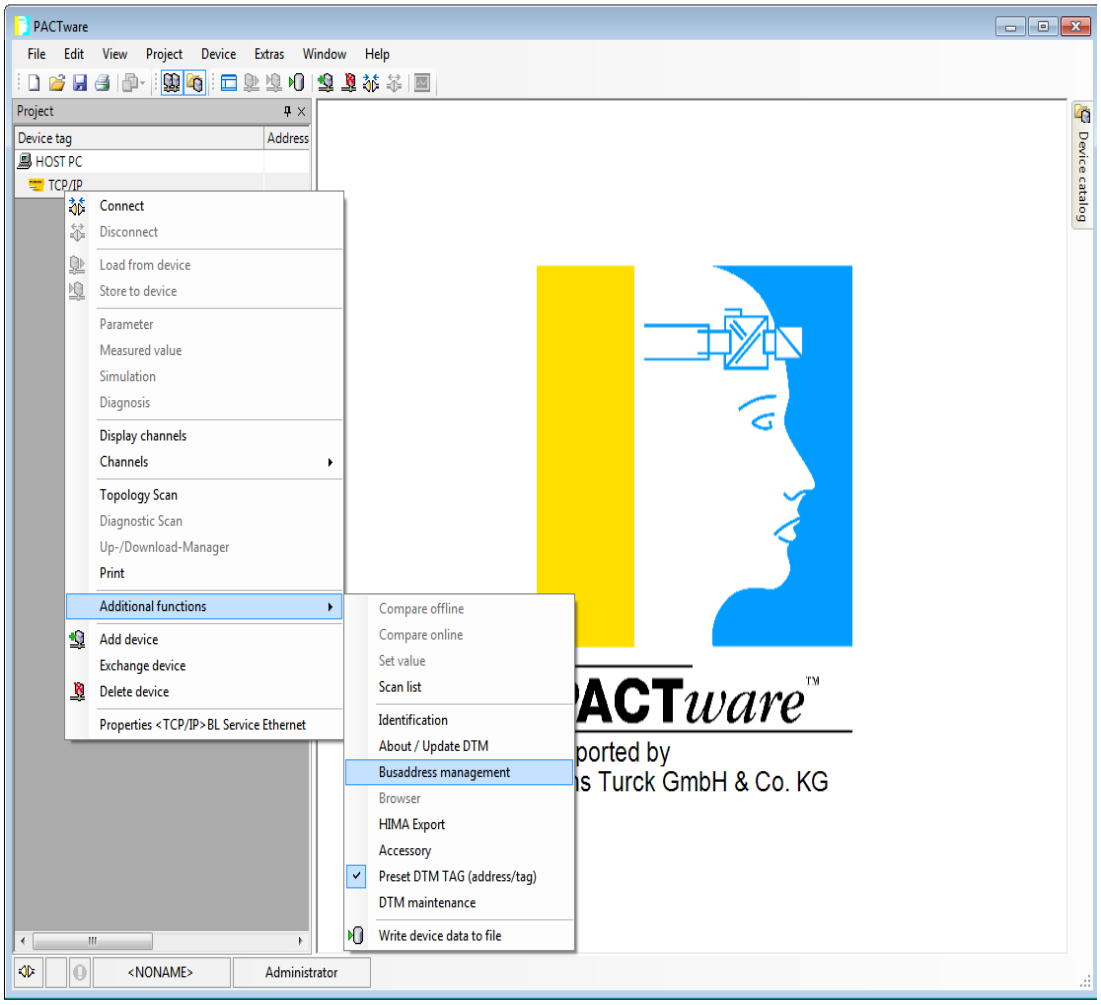
This setting is no operation mode! Please set the device to another mode after having reset the IP address to the default values.

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

The software-tool I/O-ASSISTANT 3 (FDT/DTM) 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 3 (FDT/DTM).

Figure 3-13: Busaddress management



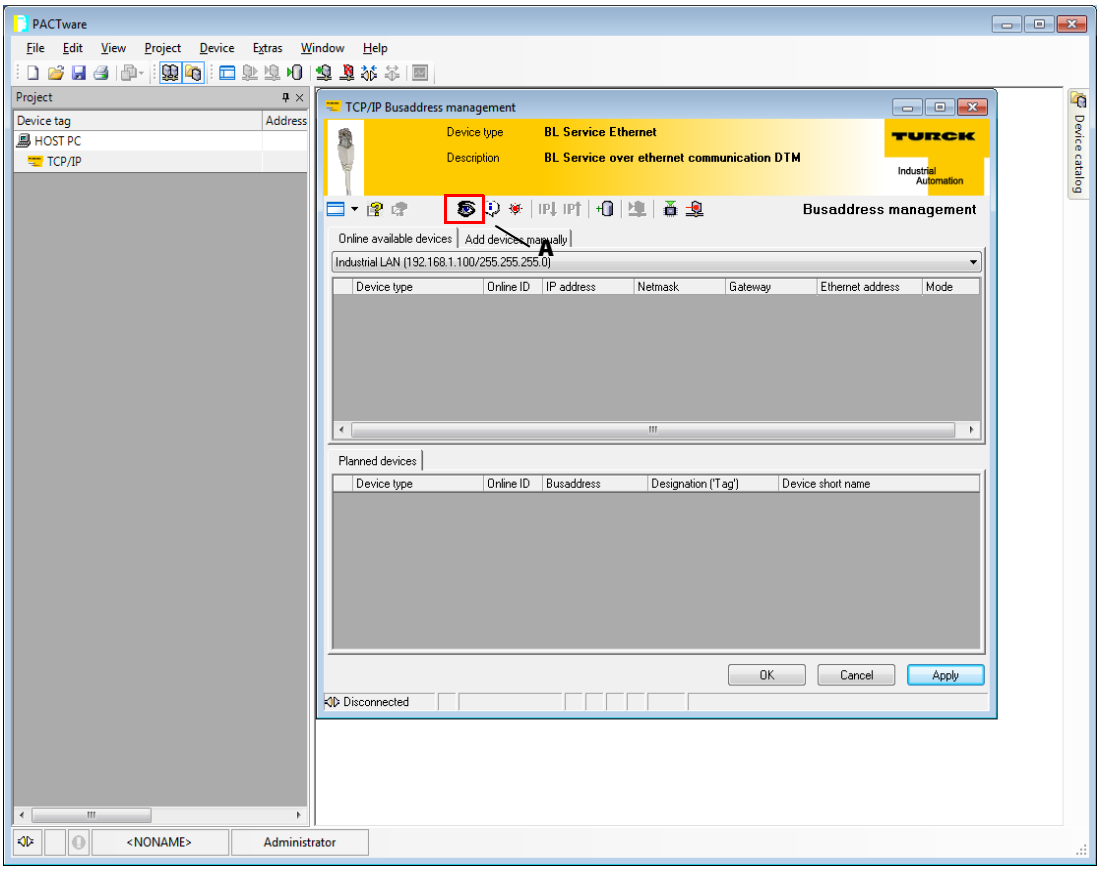


Figure 3-14: Searching network-Nodes in the Busaddress management

A *Search function in the Busaddress management*

NOTE

The access of the II/O-ASSISTANT 3 (FDT/DTM) to the station is only possible, if the station already has an IP-address (see Address assignment (page 3-17))

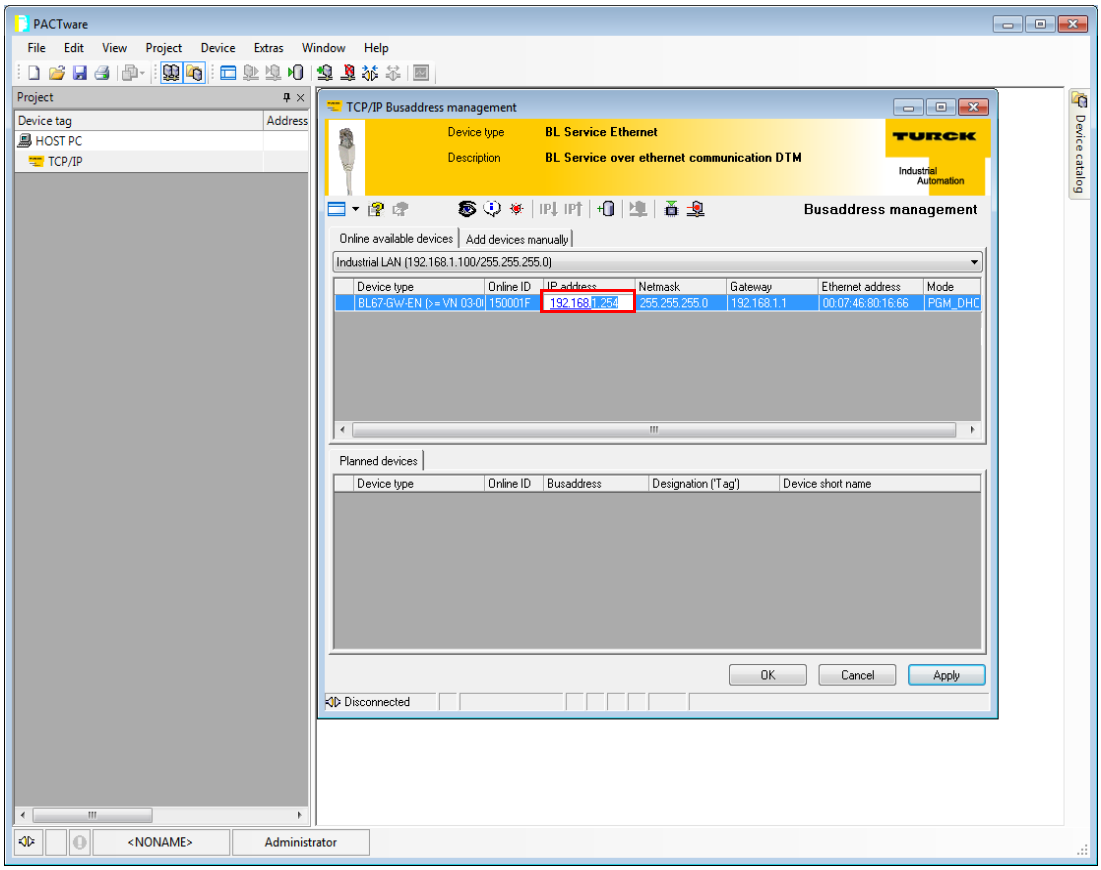
and if it is operated in switch position PGM or PGM-DHCP-mode.

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 3-15:
IP address
Change IP address



3.6.9 Address assignment via Web server (only VN ≥ 03-00)

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 (only VN ≥ 03–00) (page 3 28).

NOTE

The access of the web server to the station is only possible, if the station already has an IP address, Address assignment (page 3-17).

and if it is operated in switch position PGM or PGM-DHCP-mode.

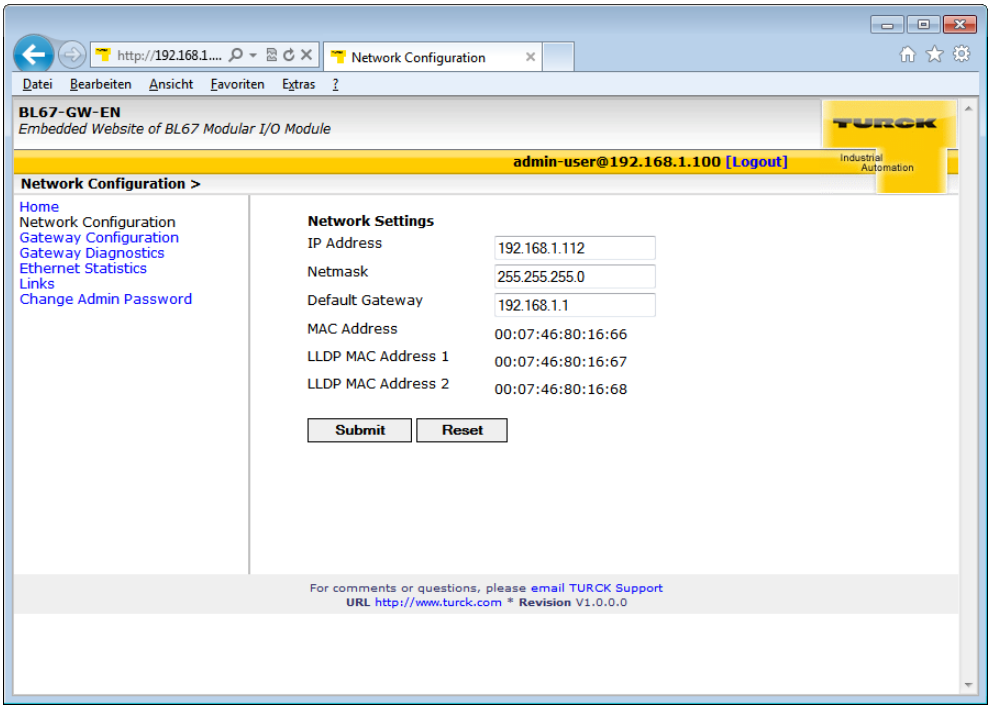


Figure 3-16: Web server with network Configuration

3.7 Reset to factory settings

Besides the hardware rest using the rotary coding switches (seeF_Reset (reset to factory settings, 900) (page 3-22)), the TURCK IP Address Tool as well as the web server (see Reset to Factory Defaults (page 3-34)) offer the possibility to reset the devices to the factory settings.

Figure 3-17: IP Address Tool, reset to factory settings

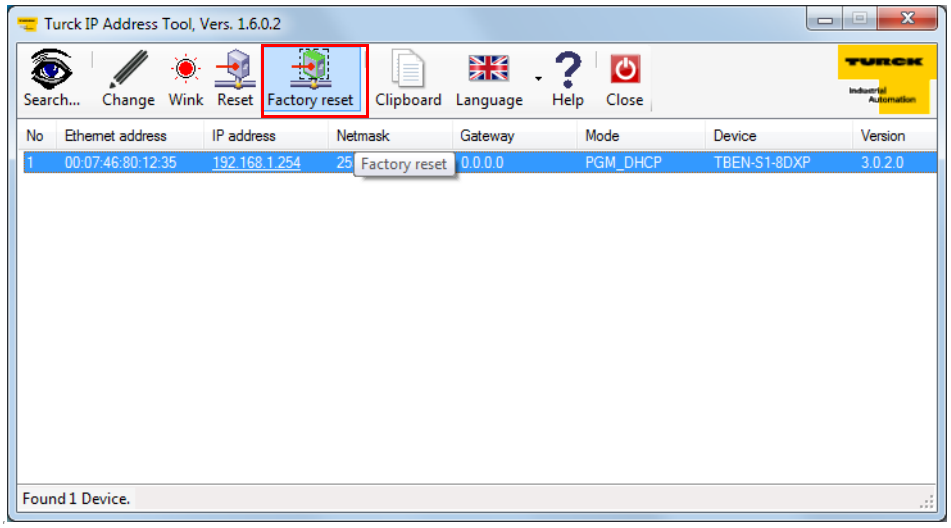
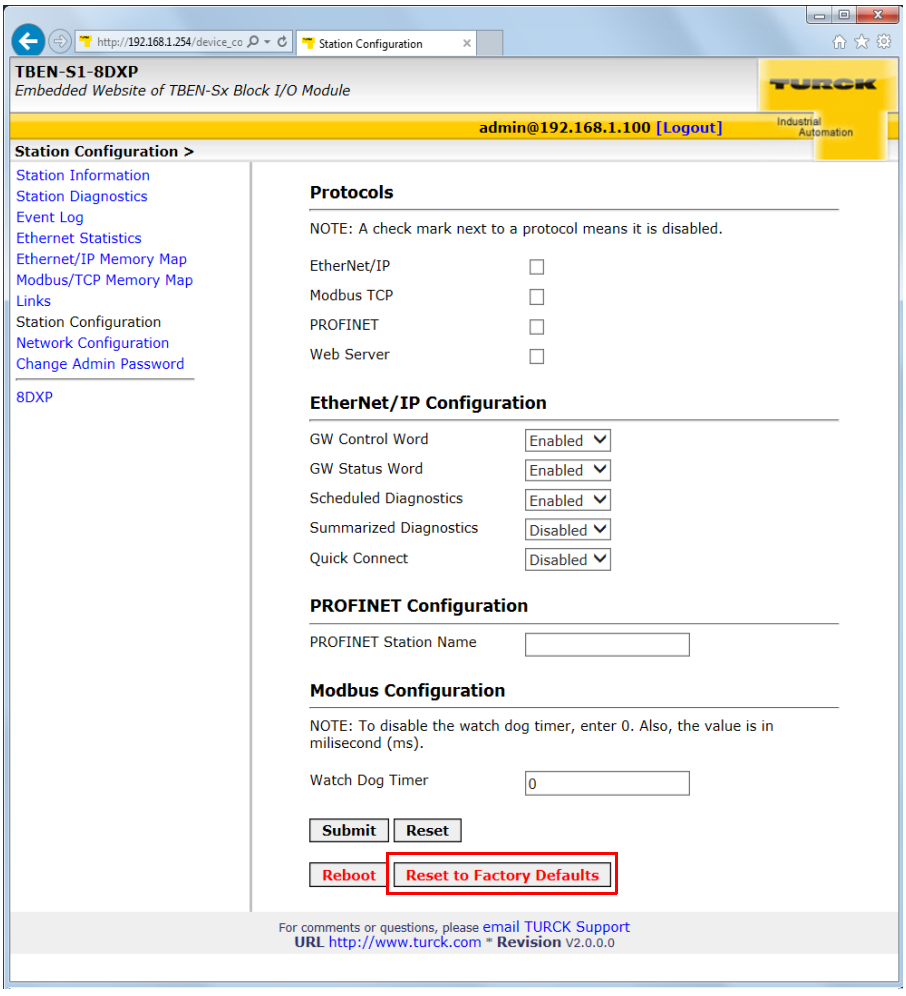


Figure 3-18: Web server reset to factory settings



3.8 Web server - remote access/configuration (only VN ≥ 03-00)

3.8.1 Safety in the web server

In the web server, a default-password is assigned in the BL67-devices for the administrator access.

We strongly recommend to use an individual password, in order to avoid possible misuse by a third party!

This should be done in the context of the network security concept for the complete facility in which the modules are placed.

3.8.2 IP address

In the delivery status, neither an address nor a PROFINET name is stored into the devices.

In order to be able to access the device per web server, the web server can be opened using the IP address 192.168.1.254.

If the PC used for the configuration is situated in the same IP network, page

http://192.168.1.254

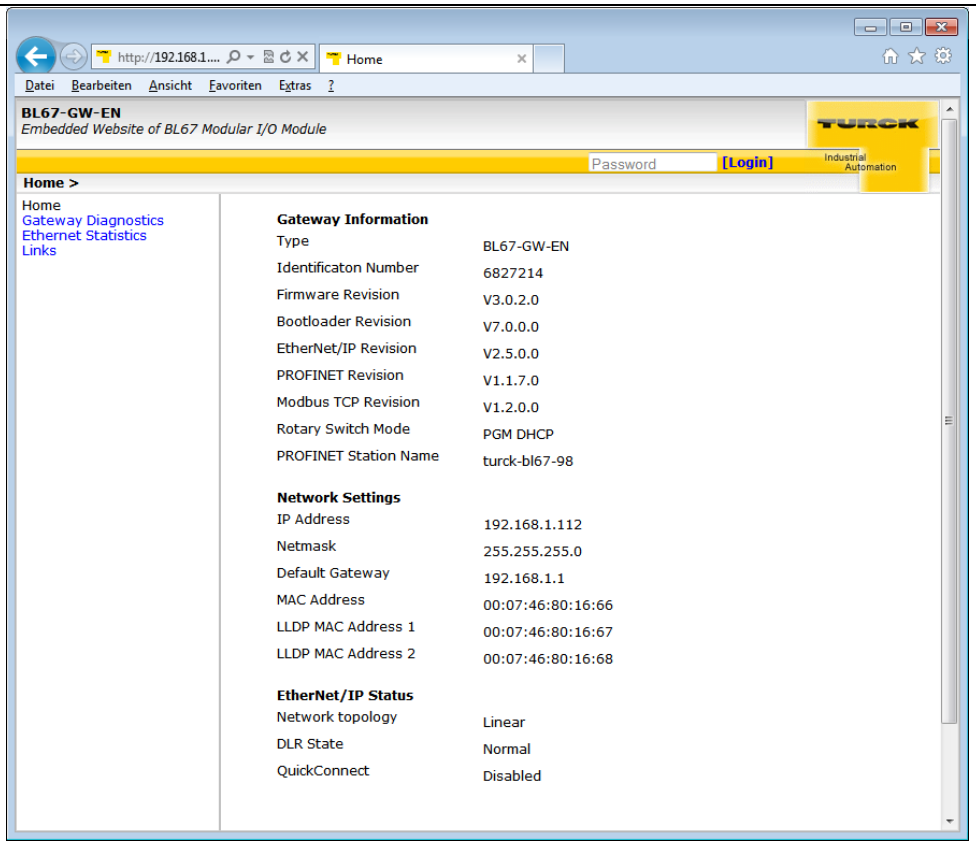
can be opened in order to initially change some settings.

3.8.3 Home

The web server's start page shows general device information, network settings, etc.

The menu items "Station Diagnostics", "Ethernet Statistics" and "Links" can also be accessed read-only without an administrator access.

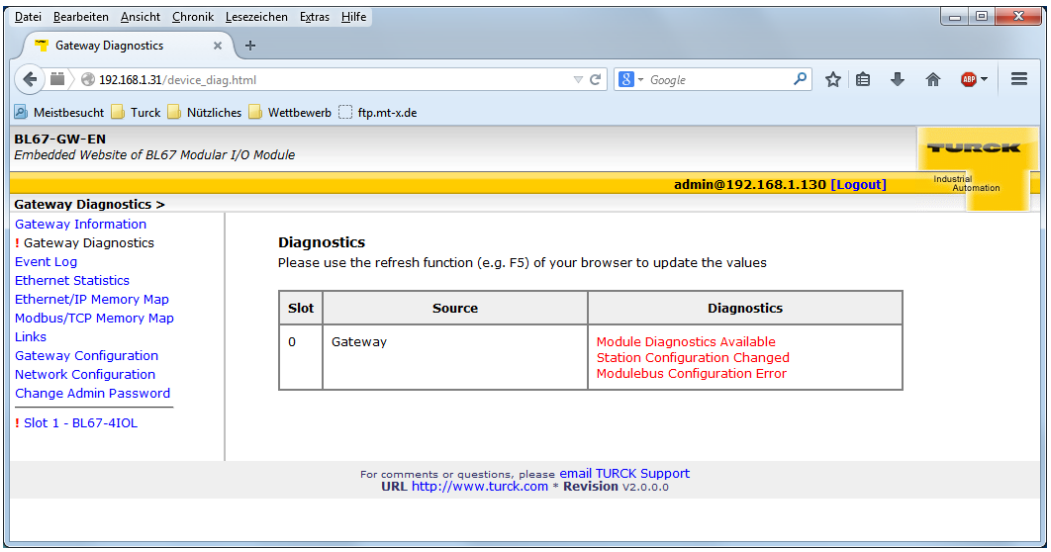
Figure 3-19: "Home" page of the web server of the BL67-gateway



3.8.4 Gateway Diagnostics

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

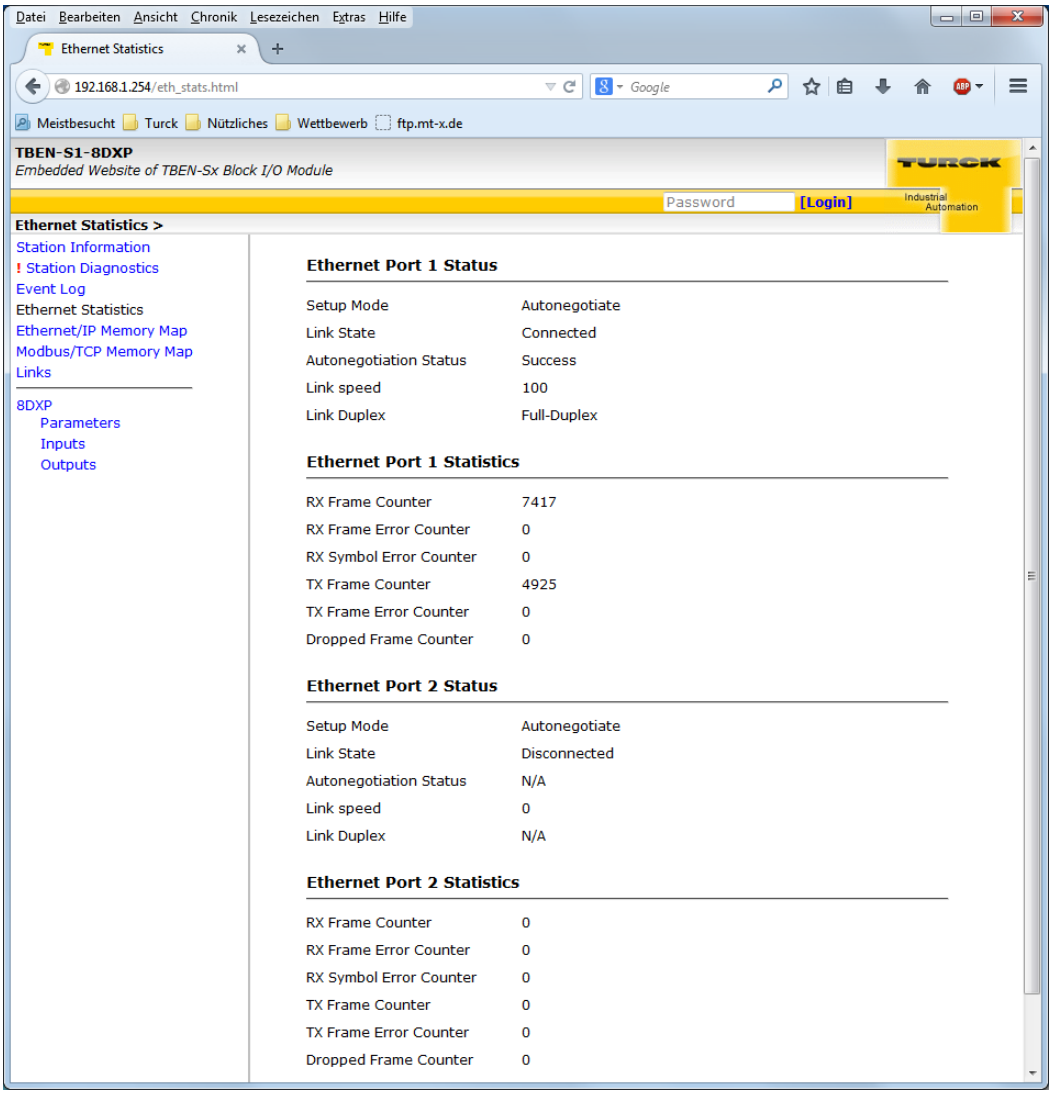
Figure 3-20: Diagnostics in the web server



3.8.5 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.

Figure 3-21: Ethernet Statistics



3.8.6 Links

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

3.8.7 Login/password

In order to obtain administrator rights and thus full access to the extended functions of the web server (Network Configuration, Station Configuration, etc.), you have to log-on to the web server as administrator.

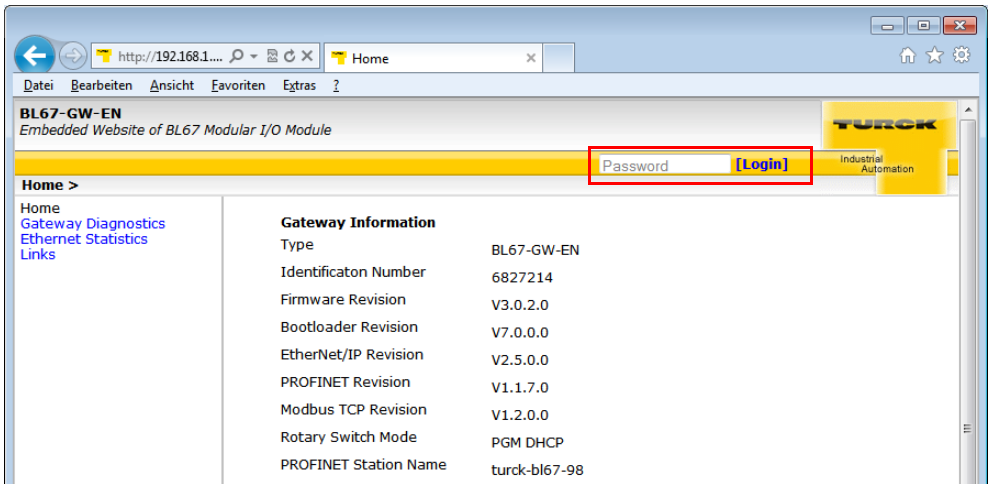
For the first login use the default password "password".

The default-password should be changed by the administrator. To do so, please follow the instructions under Change Admin Password (page 3-32).

NOTE

Executing the "Reset to Factory Defaults" also resets the password to "password".

Figure 3-22: Webserver "home" page



3.8.8 Change Admin Password

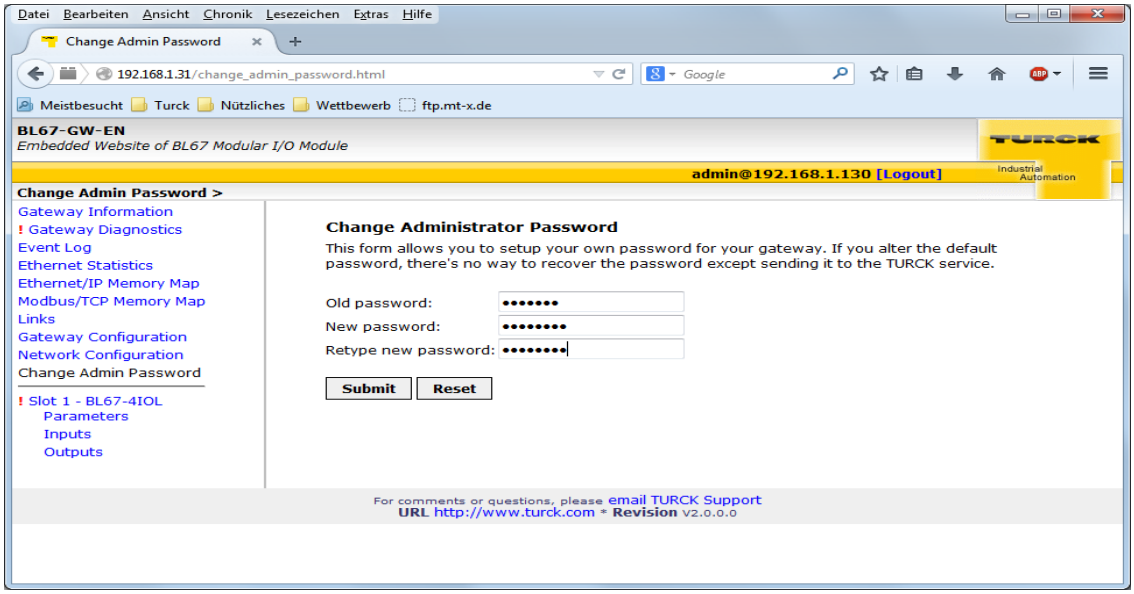
Please define an individual password for administrator rights.

default password "password"

NOTE

A device reset via "Reset to Factory Defaults" (see also Reset to Factory Defaults (page 3-34)) also resets the password to "password".

Figure 3-23: Change Admin Password



Change password

➤ Change the password for the module in the web server mask.

➤ Write the changes into the device via "Submit".

➤ Execute a device restart (by a power supply reset or by pressing the set button).

➥ The device has accepted the new settings, the settings are active

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

3.8.9 Network Configuration

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

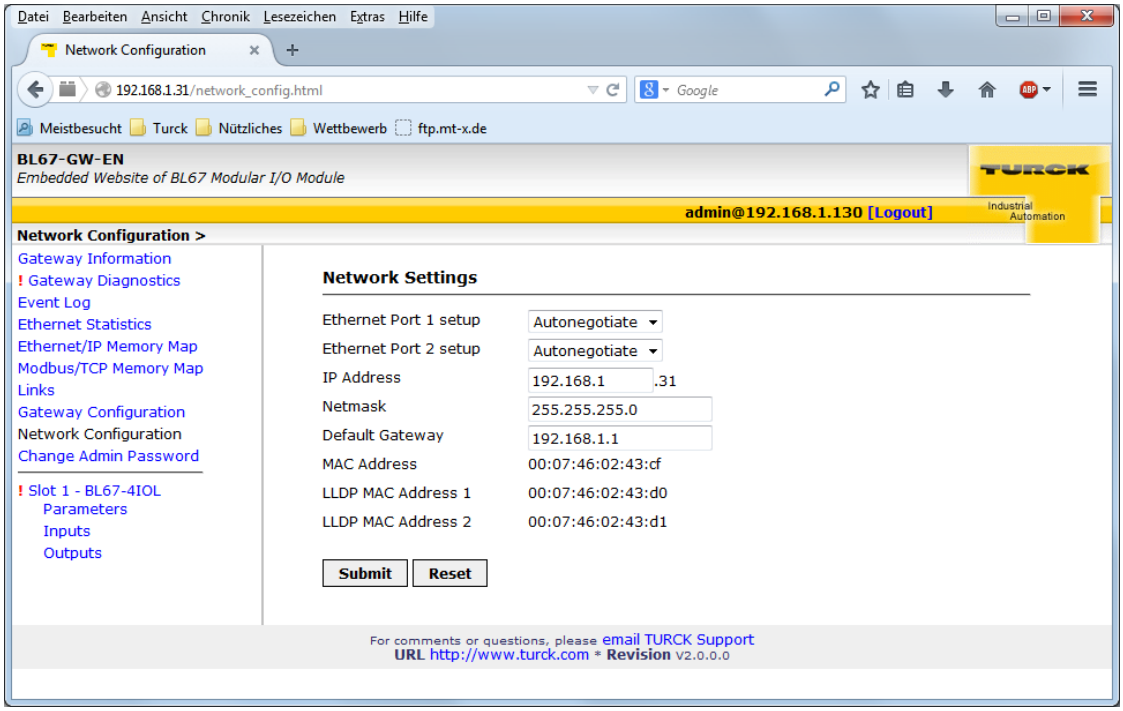
Change network parameters (port settings, IP address, etc.)

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

NOTE

The access of the web server to the station is only possible, if the station already has an IP address, Address assignment (page 3-17).

Figure 3-24: Web server with network Configuration



Change network parameters

➤ Change the network parameters in the web server mask

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings are active

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

3.8.10 Gateway Configuration

Configuration of the field bus interface

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

- Deactivating an Ethernet protocol or the web server
- Changing the EtherNet/IP configuration
- Assigning a PROFINET device name
- Activating the watchdog for MODBUS TCP

Reboot

"Reboot" executes a power-cycle at the device.

Reset to Factory Defaults

Resets the device to the default settings (factory settings).

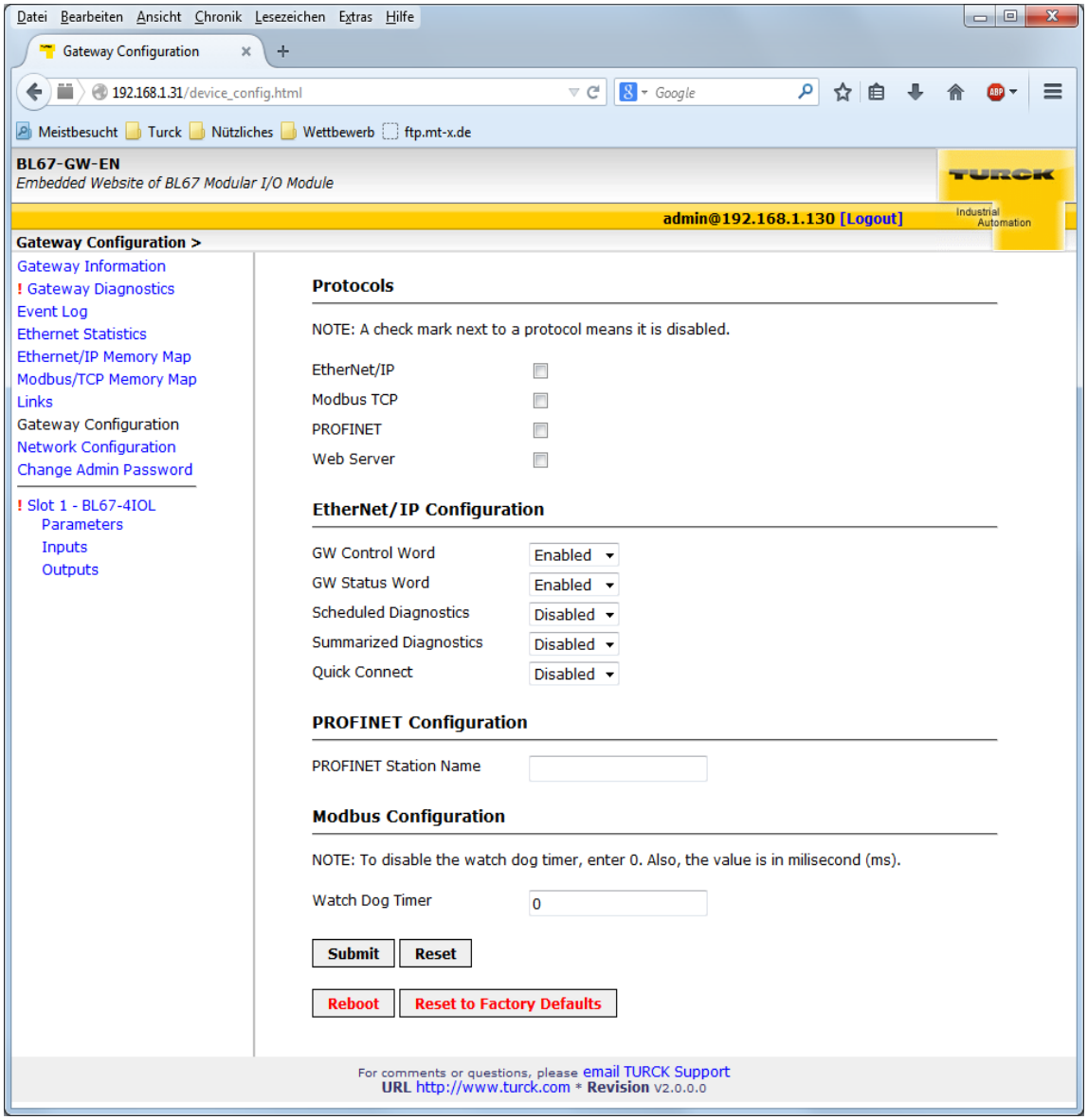


Figure 3-25: Web server "Gateway Configuration"

Gateway Configuration

➤ Change the configuration in the web server mask

➤ Write the changes into the device via "Submit".

➥ The device has accepted the new settings, the settings are active

NOTE

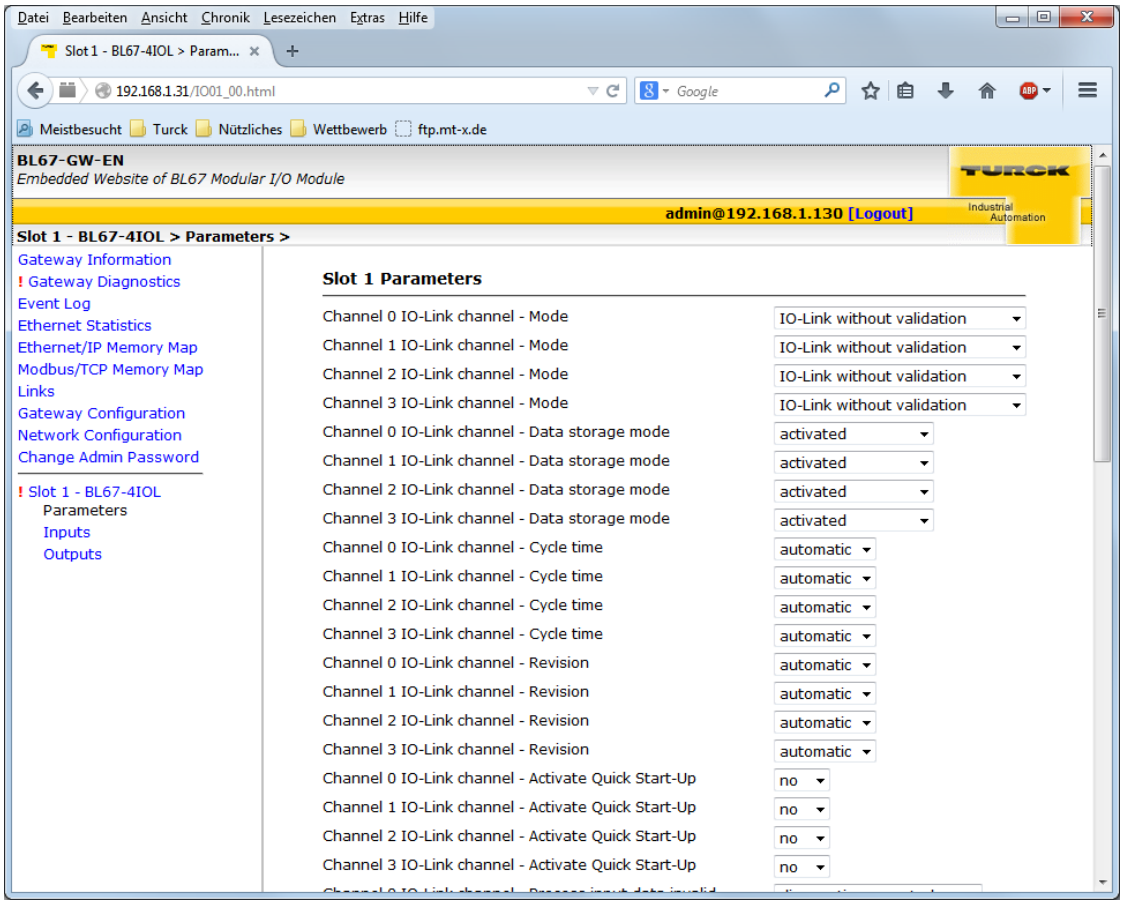
"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

3.8.11 Slot Parameters

Parameterization of the in-/outputs

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

Figure 3-26: Web server "Parameters"



Change parameters

➤ Change the parameters for the module in the web server mask.

➤ Write the changes into the device via "Submit".

➤ Execute a device restart (by a power supply reset or by pressing the set button).

➥ The device has accepted the new settings, the settings are active

NOTE

"Reset" only resets the changes done in the web server mask back to the original values. The function does not influence the device itself.

3.8.12 Usage of mobile devices

The internal web server has a responsive design. This means, the web functions can also be executed using a mobile device, e.g. a smartphone.

The web content is automatically adapted to the smaller display in order to assure an optimized web server representation.

The BL67-gateway and the mobile device have to be nodes of the same network. Please assure therefore that the IP addresses of both devices are part of the same subnet (e.g. 255.255.255.0).

In addition to that, a WLAN access has to be available for the mobile device.

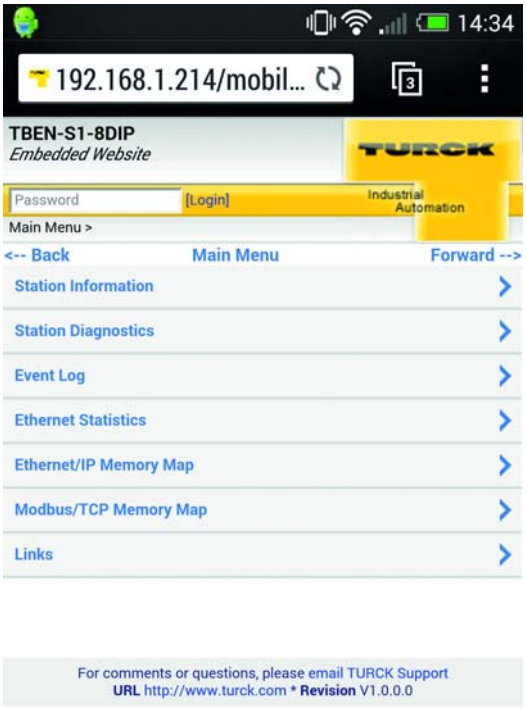


Figure 3-27: Access to the web server via smartphone

3.8.13 Web server logout

In order to disconnect a logged in user/PC with administrator rights from the web server, a logout is necessary.

If only the web browser is closed, the last active access is reactivated when opening the web server again from the same PC, which means, possibly with all administrator rights.

3.8.14 Deactivating the web server

NOTE

If, for safety reasons, the web server has to be deactivated completely, this can be done via the protocol specific mechanisms (Modbus TCP: parameter registers, seepage 6-8/EtherNet/IP: Class Instance Attribute, see page 4-26/PROFINET: GSDML configuration, see page 8-15) as well as via the web server itself (see page 3-34).
If the web server is deactivated using the web server itself, further access to it is only possible following a device reset to the factory settings (see page 3-22).

3.9 Status and Control Word of the BL67-stations

For EtherNet/IP and Modbus TCP, 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, 64h), and GW Status Register (page 4-25)).
- Modbus TCP → see Register 100Ch: Gateway status (page 6-14)
- PROFINET → see Diagnose bei PROFINET (page 8-8)

3.9.1 Status Word

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	0	V_O low	V_O high	I_i Overc.	-	I/O Cfg Warn.	-	-	Diag Warn
	1	-	FCE	-	MB Wdg	I/O CFG	I/O COM	V_I low	V_I high

Meaning of the status bits

Table 3-8: Meaning of the status bits

Name	Meaning
Diag Warn	Group diagnostics of the device. At least one I/O-module sends active diagnosis.
I/O Cfg Warn.	The station configuration has changed.
V_O high	Load voltage too high (> 30 V DC).
V_O low	Load voltage too low (< 18 V DC).
V_I high	System supply voltage too high (> 30 V DC).
V_I low	System supply voltage too low (< 18 V DC).
I/O COM	I/O Communication Lost error No Communication on the module bus.
I/O CFG	I/O CfgModified Error The I/O-configuration has be changed and is no longer compatible.
MB Wdg	Modbus Watchdogs Error A timeout occurred in the Modbus-communication. (only for Modbus TCP)
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.

3.10 SET button

The SET-button at the gateway serves to take-over the Current Configuration of the BL67-station as Required Configuration to the gateway's non-volatile memory.

Please press the button for approx. 10 seconds in order to store the Current Configuration as Required Configuration (reference configuration).

NOTE

Storing the Current Configuration via SET-Taster is necessary in EtherNet/IP as well as for Modbus TCP. In PROFINET, the Required Configuration is defined by the master.

3.11 Status indicators/diagnostic messages gateway

The gateway sends out the following diagnostic information:

- undervoltage monitoring for system and field supply
- monitoring of the BL67-station
- monitoring of the internal communication via the module bus
- monitoring of the Ethernet communication
- monitoring of the gateway status

Diagnostics messages are indicated in two different ways:

- via the LEDs
- via the respective configuration software

3.11.1 Diagnostic messages via LEDs

Every BL67-gateway for Ethernet displays the following statuses via LEDs:

- 2 LEDs for the module bus communication (module bus-LEDs):
  GW and **IOs**
- 1 LED for diagnostics
- **VN <03-00:**
  1 LED for the field bus communication: **MS**
  VN ≥ 03-00:
  2 LEDs for the field bus communication: **ERR** and **BUS**
- 2 LEDs at each Ethernet-connector for the Ethernet-communication **LINK/ACT1** and **LINK/ACT2**
- 3 LEDs for monitoring the voltage supply (system: $\mathbf{V_{CC}}$/inputs: $\mathbf{V_I}$/outputs: $\mathbf{V_o}$).

Table 3-9: LED displays

LED	Status	Meaning	Remedy
GW	off	No power supply of the CPU.	Check the system power supply at the gateway.
	green	Firmware active, gateway ready	-
	green flashing, 1 Hz	Station is in the Force Mode of the I/O-ASSISTANT.	
		If LED "**IOs**" red, then	Firmware download necessary
	green flashing, 4 Hz	Firmware running, hardware error.	Replace the gateway.
	red	Hardware error	

Table 3-9: LED displays

LED	Status	Meaning	Remedy
GW	Red	CPU not ready, VCC too low → possible causes: – too many modules at the gateway – short-circuit in connected module – gateway hardware error.	– Check the system power supply at the gateway and the cabling. – Unmount excessively mounted modules. – Replace the gateway, if necessary.
	red flashing, 1 Hz	Wink-command received	
ERR	off	Station running	–
	Red	A diagnostic message from gateway or I/O-modules is pending.	– Check the diagnostic messages.
IO	off	No power supply of the CPU.	Check the system power supply at the gateway.
	green	The modules configured correspond to the modules in the station, communication running.	-
	green flashing, 1 Hz	Station is in the Force Mode of the I/O-ASSISTANT.	Deactivate the Force Mode of the I/O-ASSISTANT.
	Red	CPU not ready, V_{CC} too low → possible causes: – too many modules at the gateway – short-circuit in connected module – gateway hardware error.	– Check the system power supply at the gateway and the cabling. – Unmount excessively mounted modules. – Replace the gateway, if necessary.
	Red flashing, 1 Hz	Non adaptable changes in the configuration of the module bus nodes.	– Compare the configured BL67-station and the current configuration. – Check the physical BL67-station for defective or incorrectly plugged electronic modules.
	Red flashing, 4 Hz	No communication via the module bus.	– At least one module has to be plugged and has to be able to communicate with the gateway.
IO	red/green flashing, 1 Hz	– The current and configured module list do not match but the data exchange proceeds as normal. – SET button is pushed and V_O is missing.	– Check the physical BL67-station for pulled or new but not planned modules. – Check the system power supply at the gateway.

Table 3-9: LED displays

LED	Status	Meaning	Remedy
V_{cc}	green	Module bus and CPU OK	-
	off	No supply of CPU or short-circuit of the module bus supply.	– Check the voltage supply at the gateway.
V_o	green	Supply of outputs OK	–
	green, flashing, 1 Hz	Undervoltage V_O; system running.	– Check the system power supply at the gateway.
	green, flashing, 4 Hz	Overvoltage V_O; system running.	
	off	Voltage supply missing	
V_I	green	V_I OK	–
	red	Short circuit or over-load at sensor supply V_{sens} → sensor supply is switched off.	– Automatic restart when debugging.
	green, flashing, 1 Hz	Undervoltage V_I; system running.	– Check the system power supply at the gateway.
	green, flashing, 4 Hz	Overvoltage VI; system running.	
	off	Voltage supply missing	
LINK/ACTx	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.
BUS (MS)	green	Displays the logical connection to a Master	
	green, flashing	Gateway ready for operation	
	red	Gateway error: – IP address conflict – gateway in RESTORE-mode – F_Reset activated	– Check the IP-addresses in the network – Check the position of the DIP-switches
	red/green	– Auto-negotiation and/or – Autonegotiation and/or waiting for DHCP-/BootP-address assignment.	The gateway waits for IP-address assignment. Wait for the address assignment to be finished.

3.12 Parameters of the I/O-modules

NOTE

The description of the parameters for the BL67 I/O modules is part of the user manual "BL67 I/O module" (D300529www.turck.de.

3.13 Diagnostics of the I/O-modules

NOTE

The description of the diagnostics for the BL67 I/O modules is part of the user manual "BL67 I/O module" (D300529www.turck.de.

4 Implementation of EtherNet/IP

4.1 The EtherNet/IP Communications Profile

TECHNICAL BASICS

EtherNet/IP is based on a connection-oriented communication model. This means that it is only possible to exchange data via specified connections assigned to the devices. Communication between the nodes in the EtherNet/IP network can be carried out either via I/O Messages or Explicit Messages.

I/O Messages

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

Explicit Messages

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

– 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.

4.1.1 Communications Profile for BL67

BL67 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

TECHNICAL BASICS

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.

4.2 QC - QuickConnect

4.2.1 General

QuickConnect enables a PLC to build up connections to EtherNet/IP devices 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

Please read Ethernet-connection for QC-/FSU-applications (page 3-13) for information about the correct Ethernet-cabling in QC-applications with BL67,

4.2.2 QuickConnect in BL67

The TURCK BL67-gateway BL67-GW-EN (VN ≥ 03-00) supports 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 5.5, Activating QuickConnect (page 5-15))

or

- via Class Instance Attribute in
  TCP/IP Interface Object 245 (0×F5), instance 1, attribute 12 (0×C0)

NOTE

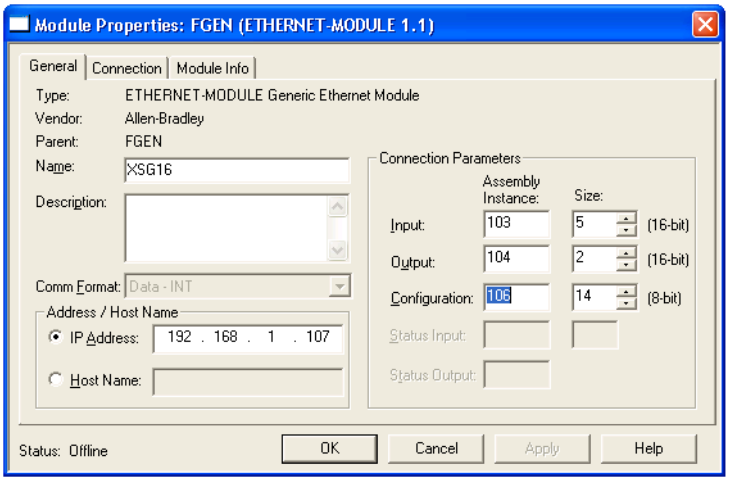
Activating QuickConnect also activated the automatic setting of all necessary port-properties:

Auto-negotiation	= 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 4-1: Configuration Assembly



NOTE

Further information about the configuration of BL67-stations in the Rockwell software RS Logix can be found in chapter 5, Application example: BL67-GW-EN with EtherNet/IP (Allen Bradley).

Quick Connect via Class Instance Attribute

Activate QuickConnect via Class Instance Attribute using the following setting:

Class	Instance	Attribute	Value
245 (0×F5)	1 (0×F6)	12 (0×0C)	0: disabled (default) **1: enabled**

QuickConnect via web server

QuickConnect can also be activated or deactivated using the device's web server, see also chapter 3.8.10, Gateway Configuration (page 3-34)

4.3 Device Level Ring (DLR)

The BL67-GW-EN (≥ VN 03-04) supports DLR.

TECHNICAL BASICS

The Device Level Ring (DLR)-redundancy protocol is used to increase the stability of EtherNet/IP networks.

DLR-capable products provide an integrated switch and can thus be integrated into a ring topology.
The DLR-protocol is used to recognize a ring fault. In case of an interruption of the data line, data are sent through an alternative network section, so that the network can be reconfigured as soon as possible.
DLR-capable network nodes are provided with extended diagnostic functions which enable the devices to localize errors and thus decrease the time for error search and maintenance.

4.4 Diagnostic messages via the process data

Besides the evaluation of diagnostic data via Explicit Messages, BL67 with EtherNet/IP offers the possibility of mapping diagnostic data into the process data (see also the process data mappings (page 4-13 ff.).

2 different forms of diagnostic data handling are provided:

- Summarized diagnostics
- Scheduled Diagnostics

4.4.1 Summarized Diagnostics

The summarized diagnostic data mode will send back 1 bit for each slice within the station.

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

The diagnostic bits are placed at the end of the input data. The diagnostic data start WORD aligned (see page 4-13).

Bit "I/O Diag Warn"

0 = OK, no diagnostics present

1 = at least one module sends diagnostics (acc. to VSC 100, Gateway Class, Attr. 116, page 4-24)

4.4.2 Scheduled Diagnostics

If scheduled diagnostics is activated (Process Data Class (VSC102, 66h) (page 4-27)), the manufacturer specific diagnostic bits are mapped into the station's process data(page 4-7 ff.).

The scheduled diagnostic data is placed at the end of the input data and after the summarized diagnostic data (see page 4-13).

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

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

The data length for the scheduled diagnostics is set according to properties of the modules attached to the gateway.

Word	Byte	Data
0	0	Slot-no. of the module which sends an emergency-frame.
	1	Status of diagnostic message: bit 5 = 1: diagnostic active bit 6 = 1: wrong module bit 7 = 1 Module pulled (acc. to VSC 100, Gateway Class, Attr. 116, page 4-24)
n		Module diagnostics from the module actually referenced by the round-robin mechanism.

4.5 Classes and Instances of the EtherNet/IP stations

4.5.1 EtherNet/IP Standard Classes

The BL67-stations support the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Table 4-1: EtherNet/IP Standard Classes

Class Code	Object name
01 (0×01)	Identity Object (0×01)
04 (0×04)	Assembly Object (0×04)
245 (0×F5)	TCP/IP Interface Object (0×F5)
246 (0×F6)	Ethernet Link Object (0×F6)
71 (0×47)	DLR Object (0×47)
72 (0×48)	QOS Object (0×48)

4.5.2 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 BL67.

Class attributes

Table 4-2: 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

Object instance 1 - instance attribute

Table 4-3: Instance attribute, object instance 1

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_{dec} = 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. 0×01 0×06
5 (0×05)	DEVICE STATUS	G	WORD	see Table 4-4: 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]	

Device Status

Table 4-4: 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 4-5: Common services

Service code	Class	Instance	Service name
01 (0×01)	yes	yes	Get_Attribute_All Returns a predefined list of the object's attributes.
05 (0×05)	no	yes	Reset Starts the reset service for the device.
14 (0×0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.

4.5.3 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 BL67.

Class attributes

Table 4-6: 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 attribute

Table 4-7: Instance Attribute

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 4-8: Common services

Service code	Class	Instance	Service name
14 (0×0E)	no	yes	Get_Attribute_Single

Process data instances

Instance 101

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

2 Bytes status information (see page 3-38)

+ 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 and 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 0×04) and can be from 2 to 496 bytes large.

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 4-5)).

Mapping of process data

The process data image of the BL67-gateways is depicted in WORD-format (16 bit).

The process data of successive modules of the same type, with process data of less than 1 word, are grouped together until 16 bits of process data is reached.

The process data is written in a new word when:

- 16-bit input data is reached and further input modules follow
- 16-bit output data is reached and further output modules follow
- An input module, whose process data length cannot be completely incorporated in the preceding word, follows on from another input module
- An output module, whose process data length cannot be completely incorporated in the preceding word, follows on from another output module 16-bit input data is reached and further input modules follow

Table 4-9: Data mapping for BL67-GW-EN

Produced Data (word no.)	**Eingangsdaten**
0	Status Word of the gateway Mapping can be disabled using attr. 138 in VSC100, object instance 2, page 4-24)
1 to n	Input data of modules An example mapping can be found in chapter 5.3, I/O data mapping (page 5-10).
n + x	Summarized diagnostic data (page 4-7) of individual length (1 bit per module which sends diagnostics). Can be enabled/disabled using VSC102, Object instance 3, attr. 104, page 4-27 ff. (x = the no. of following bytes depending on the no. of slices within the station)
n + y	Scheduled diagnostic data (page 4-7). Can be enabled/disabled using VSC102, Object instance 3, attr. 105, page 4-27 ff. (y = data length for the scheduled diagnostics set according to the properties of the modules attached to the gateway)
Consumed Data (word no.)	**Ausgangsdaten**
0	Control word of the gateway. The mapping can be disabled using attribute 139 "GW CONTROL REGISTER" in the Gateway Class (VSC 100), object instance 2 (see page 4-26).
1- n	Output data of modules An example mapping can be found in chapter 5, I/O data mapping (page 5-10).

Note

The data mapping can be structured individually. All parts except for the in- and out-put data of the station can be enabled/disabled independently from each other.

4.5.4 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 BL67.

Class attributes

Table 4-10: 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

Object instance 1: Instance attribute

Table 4-11: Instance attribute, object instance 1

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0×01)	STATUS	G	DWORD	Interface status (see page 4-15, Table 4-13: Interface Status)
2 (0×02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag (see page 4-15, Table 4-14: Configuration Capability)
3 (0×03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag (see page 4-16, Table 4-15: Configuration Control)
4 (0×04)	PHYSICAL LINK OBJECT	G	STRUCT	
	Path size		UINT	Number of 16 bit 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 4-16)
	IP address	G	UDINT	Actual IP address
	NETWORK MASK	G	UDINT	Current network mask
	GATEWAY ADDR.	G	UDINT	Actual default gateway
	NAME SERVER	G	UDINT	0 = no name server address configured
	NAME SERVER 2	G	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 4-16)

Table 4-11: Instance attribute, object instance 1

Attr. No.	Attribute name	Get/ Set	Type	Description
10 (0×0A)	ACD Enable	S	BOOL	Activates ACD (Address Conflict Detection) 0 = deactivated 1 = activated If ACD is activated, attribute 11 (0×0B) contains the return value.
11 (0×0B)	Last Conflict detected	G/S	STRUCT of:	Contains information about the last detected conflict, ACD diagnostics parameter
12 (0×0C)	Quick Connect	G/S	BOOL	0 = deactivate 1 = activate

Common Services

Table 4-12: Common services

Service code	Class	Instance	Service name
14 (0×0E)	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 4-2: 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 4-13: 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 4-14: 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 4-15: 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 0×09) 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.

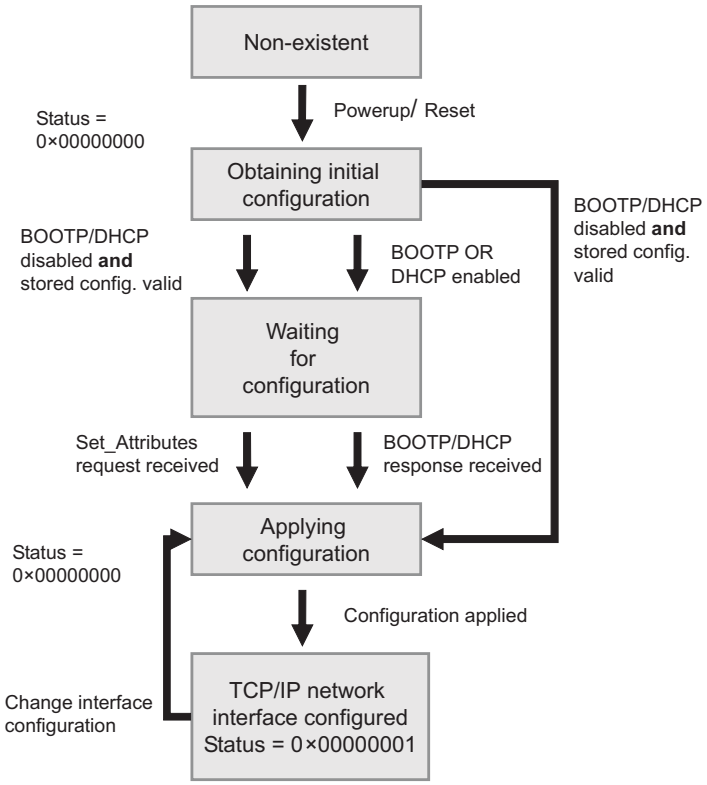


Figure 4-2: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)

4.5.5 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 BL67.

Class attributes

Table 4-16: 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

Instance attributes (instance 1 = port 1/instance 2 = port 2)

Table 4-17: Instance attribute

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 4-18: 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	S	STRUCT OF:	Allows port-wise changes of the Ethernet-settings
	Control Bits		WORD	Table 4-19: Interface control - control bits
	Forced Interface Speed		UINT	Table 4-19: Interface control - control bits
7 (0×07)	INTERFACE TYPE			
10 (0×0A)	INTERFACE LABEL			

Table 4-18: 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 4-18: Interface flags

Bits	Name	Definition	Default value
2 to 4	Negotiation Status	Indicates the status of the automatic duplex detection (Autonegotiation) 0 = Autonegotiation in progress 1 = Autonegotiation and speed detection failed. Using default values for speed and duplex (10 Mbps/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

Table 4-19: Interface control - control bits

Bits	Name	Definition	Default value
0	Auto-negotiate	0 = Autonegotiation deactivated 1 = Autonegotiation activated	
1	Forced Duplex Mode	If bit "Auto-negotiate" is 0, bit "Forced Duplex Mode" shows if the interface should work in Full or Half Duplex-mode. 0 = Half Duplex 1 = Full Duplex Interfaces which do not support the selected duplex-mode, send an error code 0×09 (Invalid Attribute Value). If auto-negotiation is enabled, attempting to set the Forced Duplex Mode bits shall result in a error code 0×0C (Object State Conflict).	Depends on application
2-15	reserved		

Forced Interface Speed

If the Auto-negotiate bit is 0, the "Forced Interface Speed" bits indicate the speed at which the interface shall operate. Speed is specified in megabits per second (e.g., for 10 Mbps Ethernet, the Interface Speed shall be 10).

Interfaces not supporting the requested speed should return a error code 0×09 (Invalid Attribute Value).

If auto-negotiation is enabled, attempting to set the Forced Interface Speed bits shall result in a error code 0×0C (Object State Conflict).

Common Services

Table 4-20: Common Services

Service code	Class	Instance	Service name
14 (0×0E)	yes	yes	Get_Attribute_Single
16 (0×10)	no	yes	Set_Attribute_Single

4.5.6 DLR Object (0×47)

The object DLR contains the configuration and status interface of the DLR protocol. The DLR protocol enables the use of an Ethernet ring topology.

Class attributes

Table 4-21: Class attributes

Attr. No.	Attribute name	Get/ Set	Type	Value
1 (0×01)	REVISION	G	UINT	1

Instance attribute

Table 4-22: Instance attribute

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0×01)	NETWORK TOPOLOGY	G	USINT	Current network topology mode 0 = linear 1 = ring topology
2 (0×02)	NETWORK STATUS	G	USINT	status of the gateway network 0 = normal 1 = ring error 2 = unexpected loop detected
10 (0×0A)	ACTIVE SUPERVISOR ADDR.	G	STRUCT of:	IP and/or MAC address of the active ring supervisor
12 (0×0C)	CAPABILITY FLAGS	G	DWORD	Describes the DLR capabilities of the device 0 = Announce-based Ring Node

Common Services

Table 4-23: Common Services

Service code	Class	Instance	Service name
14 (0×0E)	yes	yes	Get_Attribute_Single

4.5.7 QOS Object (0×48)

Quality of Service (QoS) is used for prioritizing or parameterizing of the data transmission of a device. Each change is only accepted after a power-cycle of the device.

The DSCP-value is part of the EtherNet/IP data telegram and is used to define data priorities in data handling.

Instance attribute

Table 4-24: Instance attribute

Attr. No.	Attribute name	Get/ Set	Type	Description
4 (0×04)	DSCP Urgent	S	USINT	DSCP value for CIP transport class 0/1 Urgent priority messages
5 (0×05)	DSCP Scheduled	S	USINT	DSCP value for CIP transport class 0/1 Scheduled priority messages
6 (0×06)	DSCP High	S	USINT	DSCP value for CIP transport class 0/1 High priority messages
07 (0×07)	DSCP Low	S	USINT	DSCP value for CIP transport class 0/1 Low priority messages
08 (0×08)	DSCP Explicit	S	USINT	DSCP value for CIP explicit messages (transport class 2/3 and UCMM)

Common Services

Table 4-25: Common Services

Service code	Class	Instance	Service name
14 (0×0E)	yes	yes	Get_Attribute_Single
16 (0×10)	no	yes	Set_Attribute_Single

4.6 VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the BL67-stations support the vendor specific classes described in the following.

Table 4-26: VSC-Vendor Specific Classes

Class Code dec. (hex.)	Name	Description
100 (64h)	Gateway Class, page 4-24	Contains data and settings concerning the fieldbus-specific part of the BL67-stations.
102 (66h)	Process Data Class, page 4-27	Contains process data
126 (1Ah)	Miscellaneous Parameters Class, page 4-29	Describes the EtherNet/IP-Port properties

4.6.1 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 4-27: 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.

4.6.2 Gateway Class (VSC 100, 64h)

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 4-23) for the description of the class instance for the VSC.

Object Instance 1

Table 4-28: Object Instance 1 Boot instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	MAX INSTANCE 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 firmware revision 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 4-29: 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 (V_I) too low (< 18 VDC). – Bit 08: "U_{sys} too high" System voltage (V_I) too high (< 30 VDC). – Bit 07: "U_L too low" Load voltage (V_O) too low (< 18 VDC). – Bit 06: reserved – Bit 05: reserved – Bit 04: reserved **Warnings** – Bit 03: "I/O Cfg Modified Warning" The station configuration has changed. – 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. 0 = deactivated 1 = activated (default)

Table 4-29: Object instance 2, gateway instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
139 (0×8B)	GW Control Register	Get/ Set	DWORD	Allows to enable/disable the control register which is part of the output data. 0 = deactivated 1 = activated (default)
140 (0×8C)	Disable Protocols	Get/ Set	UINT	Deactivate the other Ethernet-protocols, if necessary: 0 = EtherNet/IP (can not be disabled via EtherNet/IP-interface) Bit 1 = Modbus/TCP Bit 2 = PROFINET Bit 15 = web server

4.6.3 Process Data Class (VSC102, 66h)

This class contains the process-relevant information.

Class instance

NOTE

Please refer to paragraph Class instance of the VSC, page 4-23 for the description of the class instance for the VSC.

Object instance 1, standard output process data (compressed)

Table 4-30: Object instance 1, standard input process data (compressed)

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	MAX INSTANCE 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 4-31: Object instance 2, standard output process data (compressed)

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**Type**	**Description**
100 (64h)	MAX INSTANCE 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 4-32: 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 = yes 1 bit of diagnosis mapped at the end of the input data image (page 4-7). Changes become valid after a start-up!
105 (69h)	GW manufacturer specific diagnostics (scheduled diagnostics)	G/S	BOOL	0 = disabled 1 = yes The channel-specific diagnostic bits are mapped into the process input data (see page 4-7). Changes become valid after a start-up!
106 (6Ah)	reserved			-

Object Instance 4, COS/CYCLIC instance

Table 4-33: Object Instance 4, COS/CYCLIC instance

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

4.6.4 Miscellaneous Parameters Class (VSC 126)

Instance 1 (port 1)/Instance 2 (port 2)

Table 4-34: Object instance

Attr. No. dec. (hex.)	**Attribute name**	**G**et/ **S**et	**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 = 100BaseT, 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.

A *default setting*

5 Application example: BL67-GW-EN with EtherNet/IP (Allen Bradley)

5.1 General notes

The following example shows detailed information about the connection of a BL67-station for EtherNet/IP to an Allen Bradley PLC.

5.1.1 Used hard-/ software

Hardware

Hardware used in this example:

- Allen Bradley Controller 1756-L30 Logix5572
- Allen Bradley EtherNet/IP Bridge 1756 EN2TR
- BL67-GW-EN (> VN 03-00, IP: 192.168.1.112)
  - Slot 1: BL67-8XSG-PD
  - Slot 2: BL67-8DI-PD
  - Slot 3: BL67-2AO-I
  - Slot 4: BL67-8DO-0.5A-P
  - Slot 5: BL67-4AI-V/I
  - Slot 6: BL67-4DO-2A-P

Software

Software used in this example:

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

5.2 Network configuration

BL67-stations are delivered in the address-mode "PGM-DHCP" and can be reached using IP-address **192.168.1.254.**

NOTE

In order to build up the communication between the BL67-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 gateway's IP address via BootP, DHCP etc. for integrating it into your own network (for detailed information about the different possibilities for address setting, please read chapter 3.6, Address assignment (page 3-17),.

  or

- to change the IP address of the used PC or network interface card (for detailed information, please read Changing the IP address of a PC/ network interface card (page 12-2).

5.2.1 Configuration of the network in "RS Logix 5000"

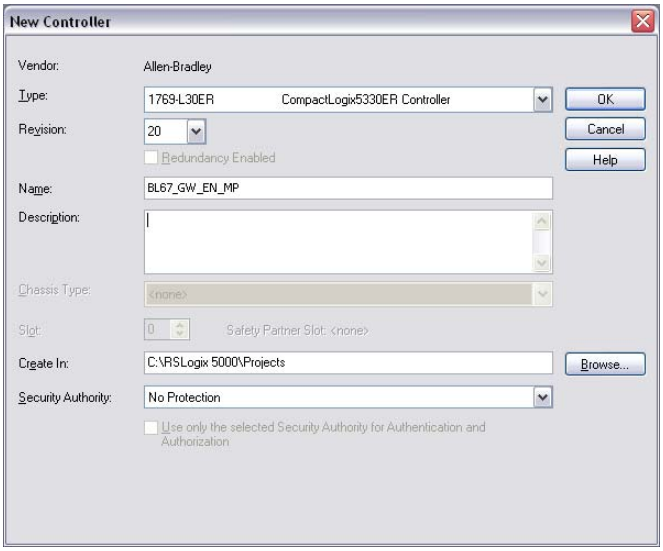
The EtherNet/IP hosts (PLC, EtherNet/IP interface, I/O stations) have to be configured using the software "RSLogix 5000" (in this example version 15) from Rockwell Automation.

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

Configuration of the controller

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

Figure 5-1: Configuration of the controller



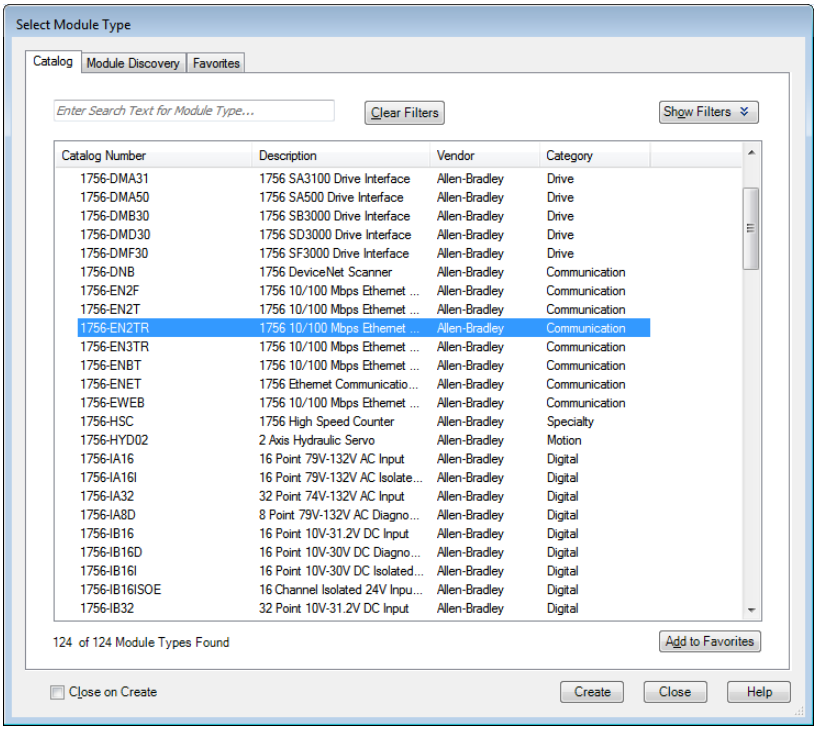
2 Your project will be opened offline.

Configuration of the EtherNet/IP Bridge

1 Open the context menu by right-clicking "Backplane, 1756-A10" and select "New Module" in order to add the Bridge to the network.

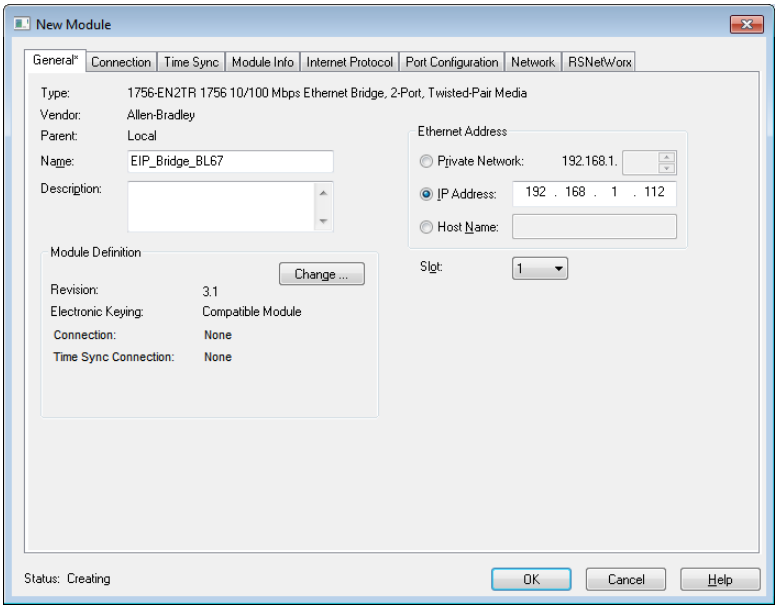
2 Select the appropriate EtherNet/IP Bridge, in this example "1756-EN2TR" and so add an EtherNet/IP interface to the controller.

Figure 5-2: Add EtherNet/IP Bridge



3 Enter the necessary device properties (name, IP-address etc.) in the dialog box which is opened.

Figure 5-3: EtherNet/IP Bridge properties

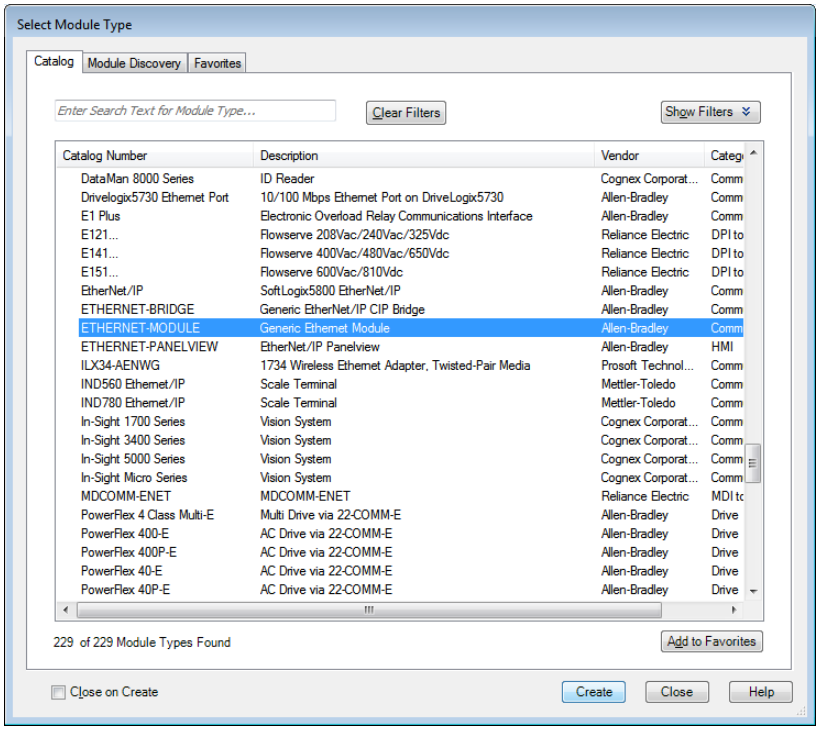


Configuring the BL67-station

4 Open the context menu by right-clicking "Ethernet" and select "New Module" in order to add the BL67-station to the network.

5 Open the entry "Generic Ethernet Module" to configure the station.

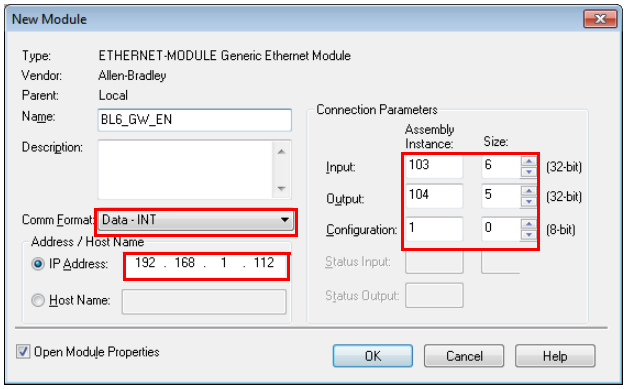
Figure 5-4: Add Generic Ethernet module



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

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

Figure 5-5: Configuring the BL67-station



NOTE

If the variable Assembly Instances 103 and 104 (see page 4-11) are used, the Connection Parameters have to be set according to the actual station configuration.
This means:
The in- and output sizes have to match the sizes definitely required by the station.
This required in- and output size can be determined as follows:

Create a station report for the station using the TURCK DTMs for BLxx (see also Figure 5-6: Eth-erNet/IP report (PLC configuration) (page 5-6))

OR

Read out the correct size of in- and output data via Assembly Class (0×04), Instance 0×67, Attr. 0×04 and Assembly Class (0×04), Instance 0×68, Attr. 0×04.

Figure 5-6: EtherNet/IP report (PLC configuration)

A *Data to enter into assembly instances in RS Logix*

1. EtherNet/IP report

1.1. Station description

Station address: 192.168.1.7

Adr./Slot	Name	TAG	Descr.	Data Size In	Data Size Out
Slot 0*	BL67-GW-EN (>= VN 03-00)	192.168.1.7/BL67-GW-EN (>= VN 03-00)	Term0A	16 bit	16 bit
Slot 1	BL67-8XSG-PD	01/BL67-8XSG-PD	Term0B	8 bit	8 bit
Slot 2	BL67-8DI-PD	02/BL67-8DI-PD	Term0C	8 bit	0 bit
Slot 3	BL67-2AO-I	03/BL67-2AO-I	Term0D	0 bit	32 bit
Slot 4	BL67-8DO-0.5A-P	04/BL67-8DO-0.5A-P	Term0E	0 bit	8 bit
Slot 5	BL67-4AI-V/I	05/BL67-4AI-V/I	Term0F	64 bit	0 bit
Slot 6	BL67-4DO-2A-P	06/BL67-4DO-2A-P	Term0G	0 bit	4 bit
	Local I/O data incl. status/control			6 Words	5 Words
Total size for in/out data rounded on full words				**6 Words**	**5 Words**

In the PLC Configuration software, the in - and output size entries for the assembly instances may be depicted in words (DATA -INT) or even in double-words (DATA - DINT).
The I/O-PROFIBUS mapping results have thus to be converted into the respective data format.

PLC-configuration:
Values for Assembly Instance 103 (input data): 6 Words
Values for Assembly Instance 104 (output data): 5 Words

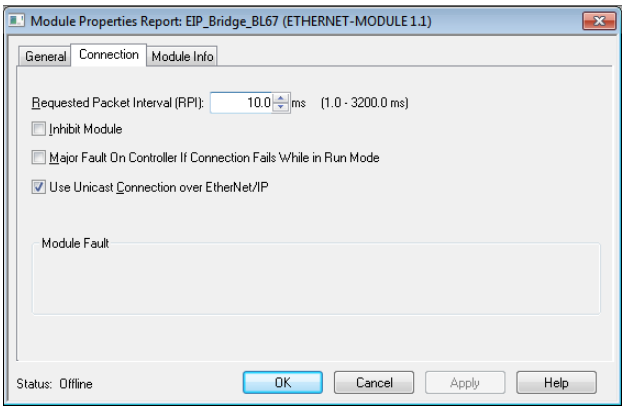
A

Note:
If a module with a firmware < 1.9 is used, the variable Assembly Instances 103 and 104 are not supported. In this case, the Assembly Instances 101 and 102 have to be used. The defined data width for each of these Instances is 128 words.

*For detailed information about the status word, please see online help. The control word is mapped into the process data, but has no function for the standard EtherNet/IP gateways.
It can only be used in the EtherNet/IP gateways with DeviceNet™-master (see online help).

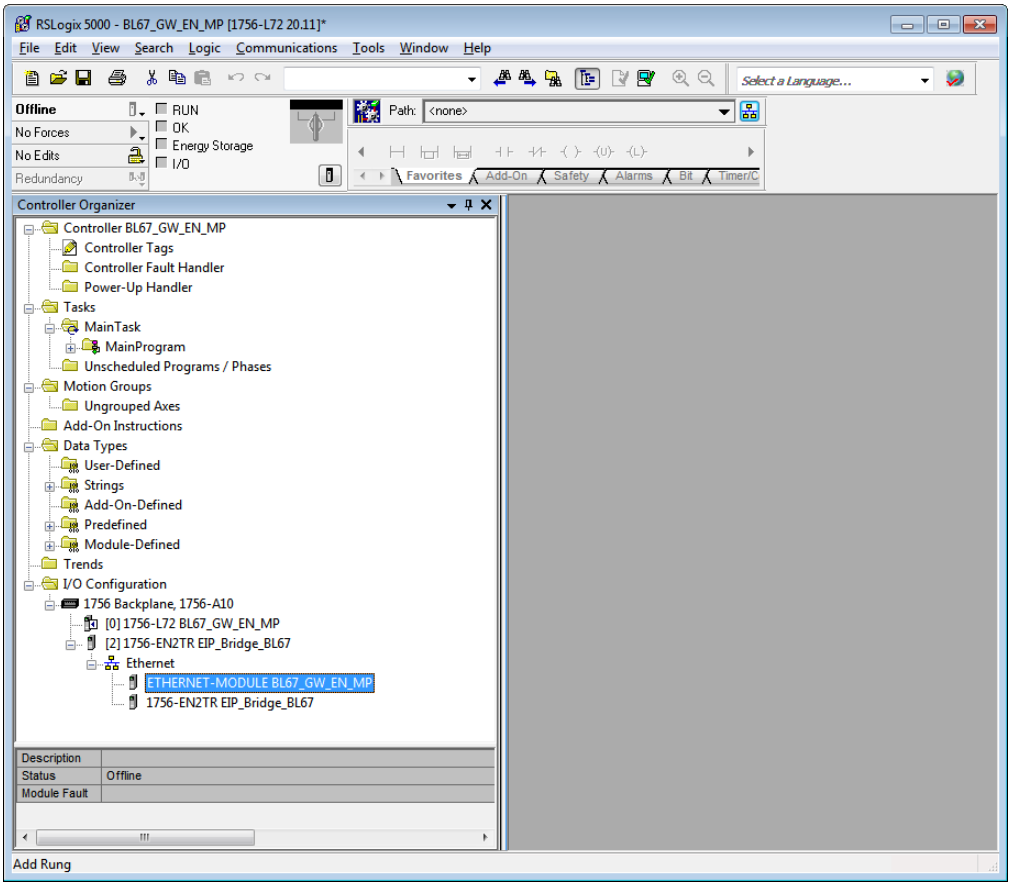
8 In the "Connection" tab set the "Requested Packet Interval" (RPI) to 10 ms, which normally should be the default setting. For BL67, the RPI should be set to 5 ms or higher.

Figure 5-7: Set connection options for the gateway



9 The station is now added to the project tree.

Figure 5-8: Project tree with stations

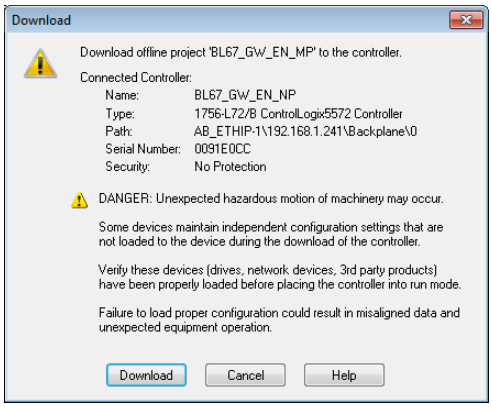


5.2.2 Downloading the I/O configuration

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 5-9: 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 5-10:), select your controller and press "Set Project Path" (see Figure 5-11:).

Figure 5-10: Communication path

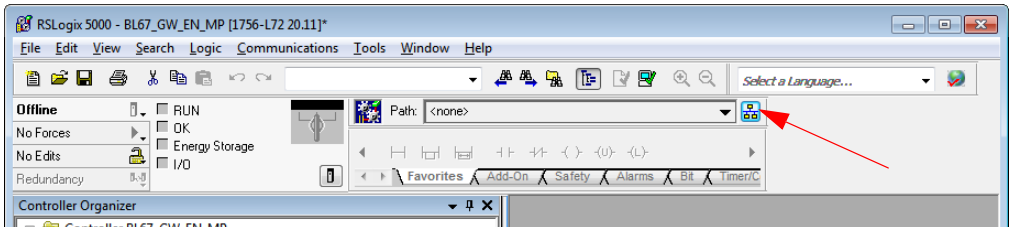
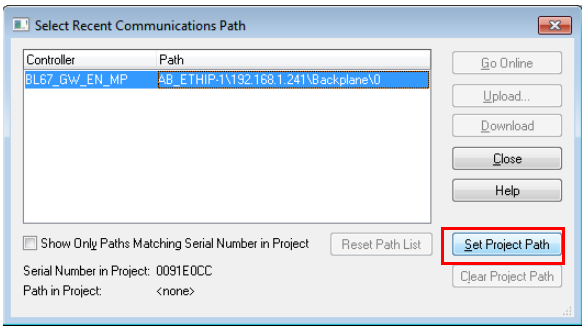


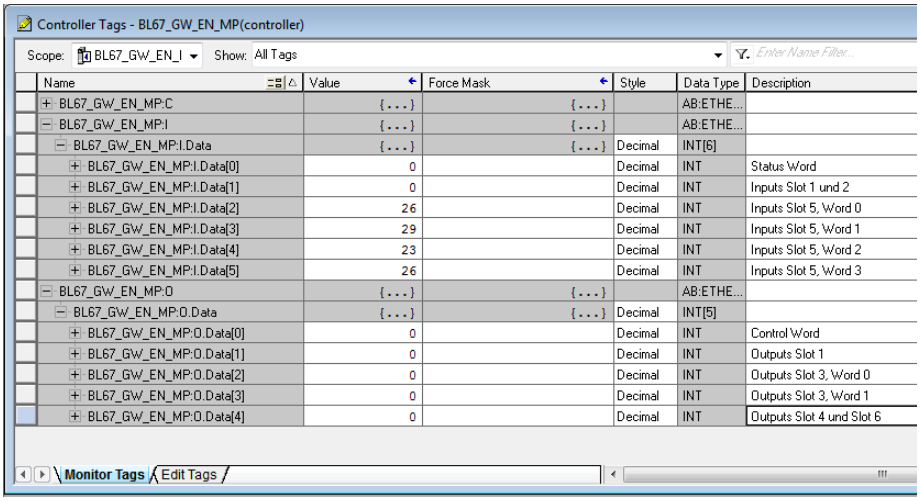
Figure 5-11: Communication path



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

5 Once the I/O configuration is downloaded and the controller is in "Run" or "Remote Run" mode, the I/O-data mapping of the BL67-stations is shown in the "Controller Tags":

Figure 5-12: Controller Tags



Name	Value	Force Mask	Style	Data Type	Description
BL67_GW_EN_MP:C	{...}	{...}		AB:ETHE...	
BL67_GW_EN_MP:I	{...}	{...}		AB:ETHE...	
BL67_GW_EN_MP:I.Data	{...}	{...}	Decimal	INT[6]	
BL67_GW_EN_MP:I.Data[0]	0		Decimal	INT	Status Word
BL67_GW_EN_MP:I.Data[1]	0		Decimal	INT	Inputs Slot 1 und 2
BL67_GW_EN_MP:I.Data[2]	26		Decimal	INT	Inputs Slot 5, Word 0
BL67_GW_EN_MP:I.Data[3]	29		Decimal	INT	Inputs Slot 5, Word 1
BL67_GW_EN_MP:I.Data[4]	23		Decimal	INT	Inputs Slot 5, Word 2
BL67_GW_EN_MP:I.Data[5]	26		Decimal	INT	Inputs Slot 5, Word 3
BL67_GW_EN_MP:O	{...}	{...}		AB:ETHE...	
BL67_GW_EN_MP:O.Data	{...}	{...}	Decimal	INT[5]	
BL67_GW_EN_MP:O.Data[0]	0		Decimal	INT	Control Word
BL67_GW_EN_MP:O.Data[1]	0		Decimal	INT	Outputs Slot 1
BL67_GW_EN_MP:O.Data[2]	0		Decimal	INT	Outputs Slot 3, Word 0
BL67_GW_EN_MP:O.Data[3]	0		Decimal	INT	Outputs Slot 3, Word 1
BL67_GW_EN_MP:O.Data[4]	0		Decimal	INT	Outputs Slot 4 und Slot 6

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

5.3 I/O data mapping

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

The data mapping depends on process data mappings of the configured BL67-modules (see chapter 4, Assembly Object (0×04), Mapping of process data (page 4-13) ff.).

The detailed station data mapping can be found in the EtherNet/IP-report, generated using the BL××-PACTware-DTM.

Figure 5-13: EtherNet/IP-report with data mapping

1. EtherNet/IP report

1.1. Station description

Station address: 192.168.1.7

Adr./Slot	Name	TAG	Descr.	Data Size In	Data Size Out
Slot 0*	BL67-GW-EN (>= VN 03-00)	192.168.1.7/BL67-GW-EN (>= VN 03-00)	Term0A	16 bit	16 bit
Slot 1	BL67-8XSG-PD	01/BL67-8XSG-PD	Term0B	8 bit	8 bit
Slot 2	BL67-8DI-PD	02/BL67-8DI-PD	Term0C	8 bit	0 bit
Slot 3	BL67-2AO-I	03/BL67-2AO-I	Term0D	0 bit	32 bit
Slot 4	BL67-8DO-0.5A-P	04/BL67-8DO-0.5A-P	Term0E	0 bit	8 bit
Slot 5	BL67-4AI-V/I	05/BL67-4AI-V/I	Term0F	64 bit	0 bit
Slot 6	BL67-4DO-2A-P	06/BL67-4DO-2A-P	Term0G	0 bit	4 bit
	Local I/O data incl. status/control			6 Words	5 Words
Total size for in/out data rounded on full words				**6 Words**	**5 Words**

In the PLC Configuration software, the in - and output size entries for the assembly instances may be depicted in words (DATA -INT) or even in double-words (DATA - DINT).
The I/O-PROFIBUS mapping results have thus to be converted into the respective data format.

PLC-configuration:
Values for Assembly Instance 103 (input data): 6 Words
Values for Assembly Instance 104 (output data): 5 Words

Note:
If a module with a firmware < 1.9 is used, the variable Assembly Instances 103 and 104 are not supported. In this case, the Assembly Instances 101 and 102 have to be used. The defined data width for each of these Instances is 128 words.

*For detailed information about the status word, please see online help. The control word is mapped into the process data, but has no function for the standard EtherNet/IP gateways.
It can only be used in the EtherNet/IP gateways with DeviceNet™-master (see online help).

1.2. I/O map for input data

	Byte n+1								Byte n							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word0*	0A.15	0A.14	0A.13	0A.12	0A.11	0A.10	0A.9	0A.8	0A.7	0A.6	0A.5	0A.4	0A.3	0A.2	0A.1	0A.0
Word1	0C.7	0C.6	0C.5	0C.4	0C.3	0C.2	0C.1	0C.0	0B.7	0B.6	0B.5	0B.4	0B.3	0B.2	0B.1	0B.0
Word2	0F.15	0F.14	0F.13	0F.12	0F.11	0F.10	0F.9	0F.8	0F.7	0F.6	0F.5	0F.4	0F.3	0F.2	0F.1	0F.0
Word3	0F.31	0F.30	0F.29	0F.28	0F.27	0F.26	0F.25	0F.24	0F.23	0F.22	0F.21	0F.20	0F.19	0F.18	0F.17	0F.16
Word4	0F.47	0F.46	0F.45	0F.44	0F.43	0F.42	0F.41	0F.40	0F.39	0F.38	0F.37	0F.36	0F.35	0F.34	0F.33	0F.32
Word5	0F.63	0F.62	0F.61	0F.60	0F.59	0F.58	0F.57	0F.56	0F.55	0F.54	0F.53	0F.52	0F.51	0F.50	0F.49	0F.48

*For detailed information about the status word, please see online help. The control word is mapped into the process data, but has no function for the standard EtherNet/IP gateways.
It can only be used in the EtherNet/IP gateways with DeviceNet™-master (see online help).

Process input data: 6 Words

1.3. I/O map for output data

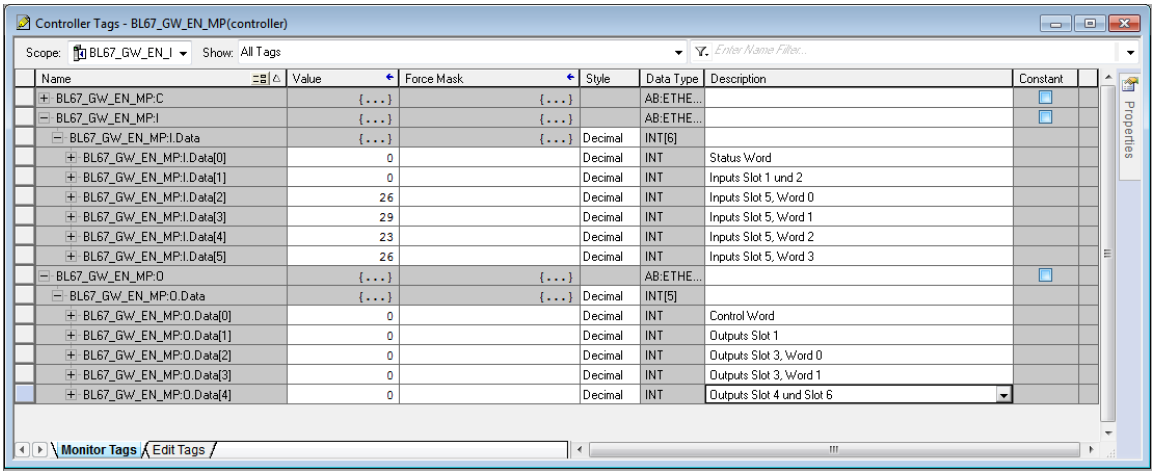
	Byte n+1								Byte n							
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word0*	0A.15	0A.14	0A.13	0A.12	0A.11	0A.10	0A.9	0A.8	0A.7	0A.6	0A.5	0A.4	0A.3	0A.2	0A.1	0A.0
Word1	-	-	-	-	-	-	-	-	0B.7	0B.6	0B.5	0B.4	0B.3	0B.2	0B.1	0B.0
Word2	0D.15	0D.14	0D.13	0D.12	0D.11	0D.10	0D.9	0D.8	0D.7	0D.6	0D.5	0D.4	0D.3	0D.2	0D.1	0D.0
Word3	0D.31	0D.30	0D.29	0D.28	0D.27	0D.26	0D.25	0D.24	0D.23	0D.22	0D.21	0D.20	0D.19	0D.18	0D.17	0D.16
Word4	-	-	-	-	0G.3	0G.2	0G.1	0G.0	0E.7	0E.6	0E.5	0E.4	0E.3	0E.2	0E.1	0E.0

*For detailed information about the status word, please see online help. The control word is mapped into the process data, but has no function for the standard EtherNet/IP gateways.
It can only be used in the EtherNet/IP gateways with DeviceNet™-master (see online help).

Process output data: 5 Words

For the example station, the mapping in RS Logix looks as follows:

Figure 5-14: Mapping of the BL67 station



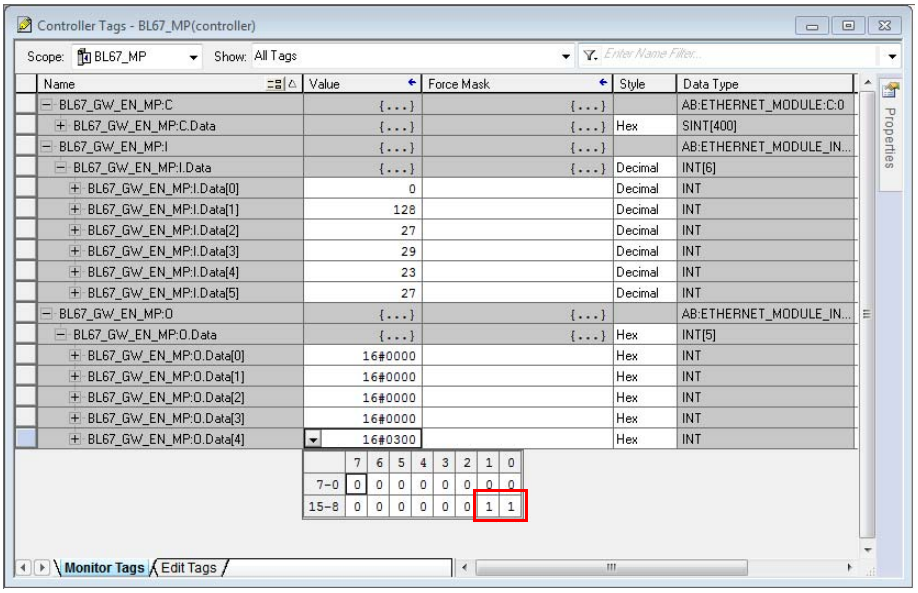
5.4 Process data access

5.4.1 Setting outputs

Example:

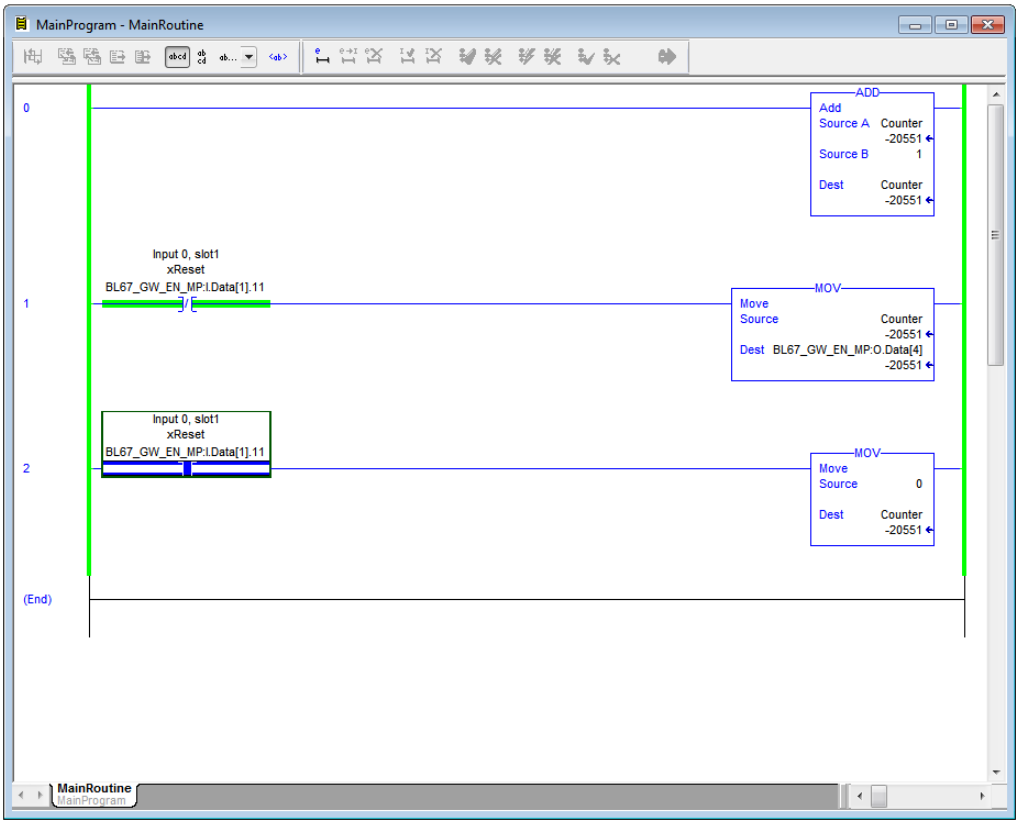
In order to set outputs "0" and "1" at slot 6 of the station (BL67-4DO-2A-P, see example station), bit 0 and bit 1 in data word 4 (BL67_GW_EN:I.Data [4]) have to be set (see above Figure 5-11:I/O data mapping (page 5-10)).

Figure 5-15: Setting outputs at BL67-4DO-2A-P



5.4.2 Example program

Figure 5-16: Example program

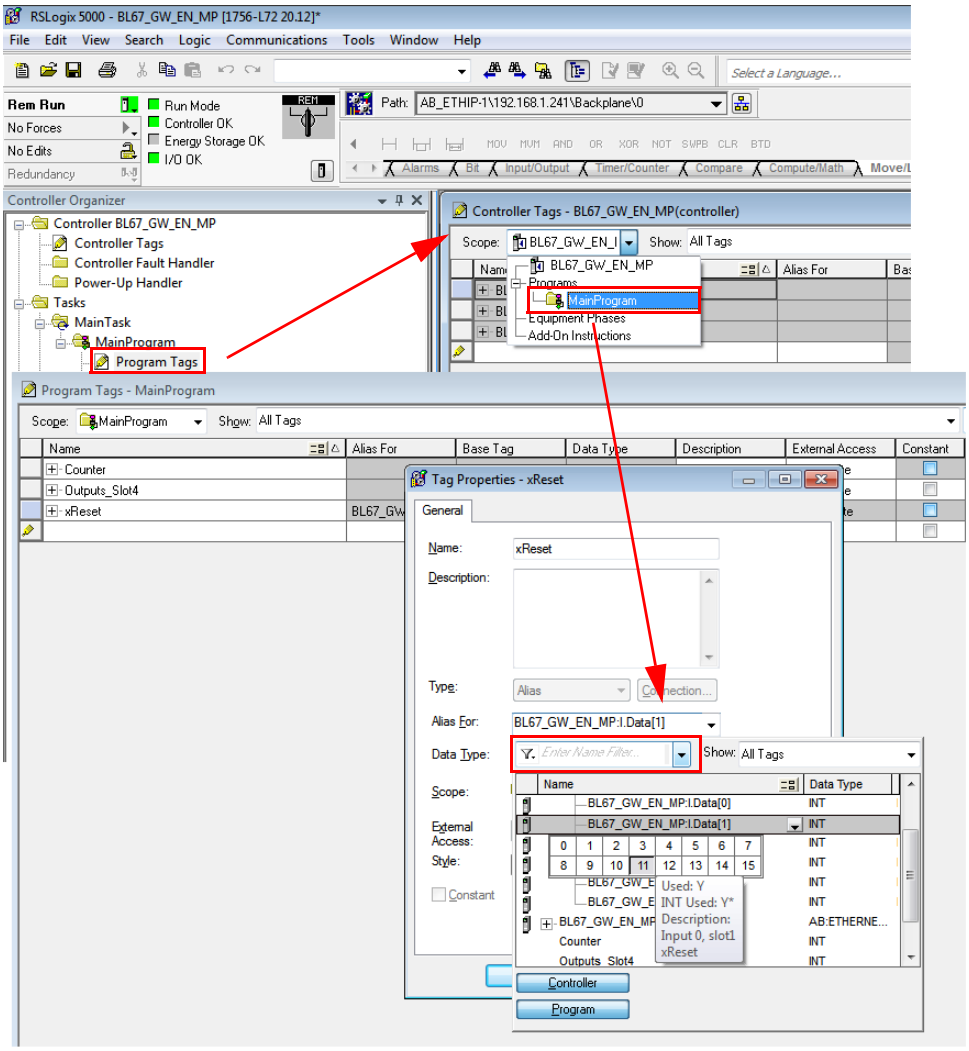


1 The counter counts up.

2 The counter value is mapped to the outputs of the two digital output modules in the station (slot 4 and slot 6).

3 The counter is set to "0" by setting the variable "xReset" (BOOL) to "1".
"xReset" has been defined and mapped to Bit BL67_E_GW_EN:I.Data[1].11 by building an Alias in the Main Program.

Figure 5-17: Definition and mapping of xReset

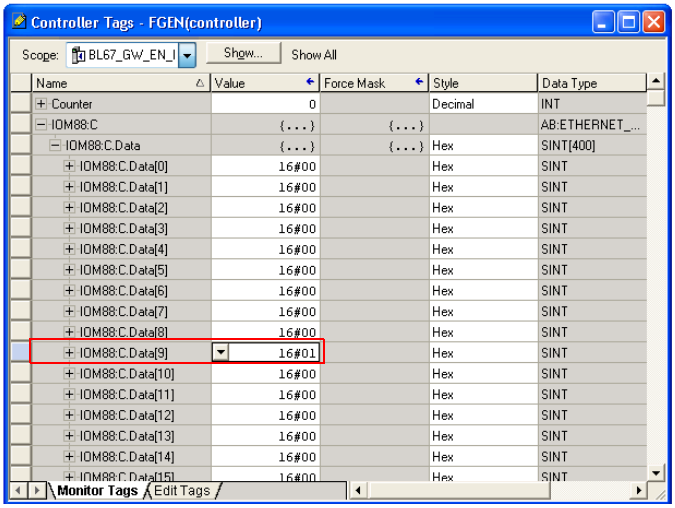


5.5 Activating QuickConnect

The QuickConnect-function of the BL67-stations is activated via:

- Configuration Assembly,
  byte 9, bit 1.

Figure 5-18: Activating the QuickConnect-function



NOTE

Further information about QuickConnect can also be found in chapter 4, QuickConnect in BL67 (page 4-4).

6 Implementation of Modbus TCP

6.1 Common Modbus description

NOTE

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

TECHNICAL BASICS

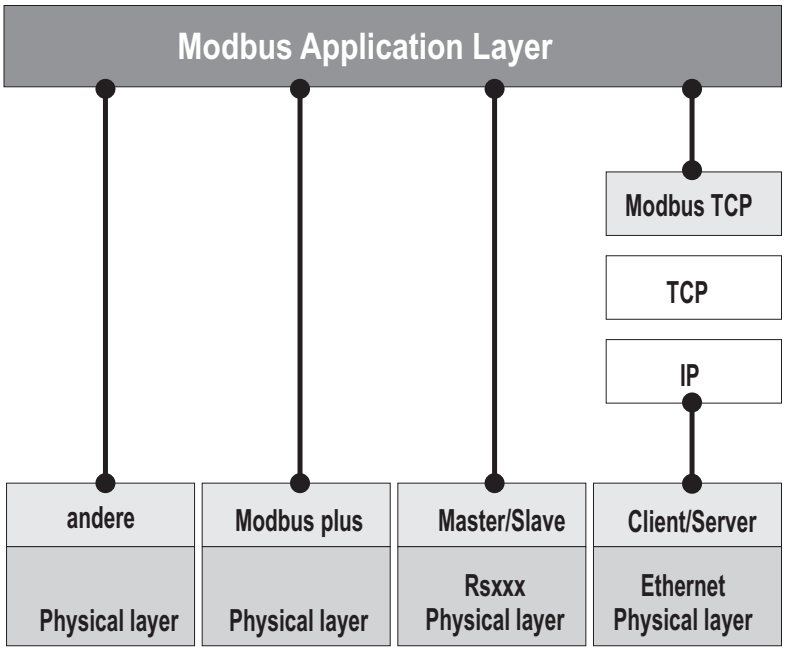
Modbus is an application layer messaging protocol, positioned at level 7 of the OSI model, that provides client/server communication between devices connected on different types of buses or networks.

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 TBEN-L 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.

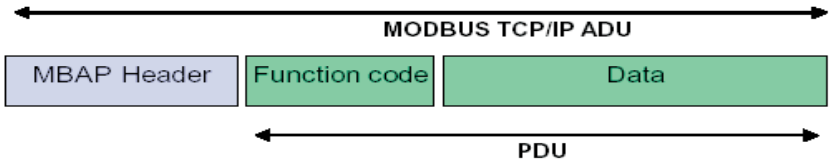
Schematic representation of the Modbus Communication Stack (according to Modbus Application Protocol Specification V1.1 of Modbus-IDA):



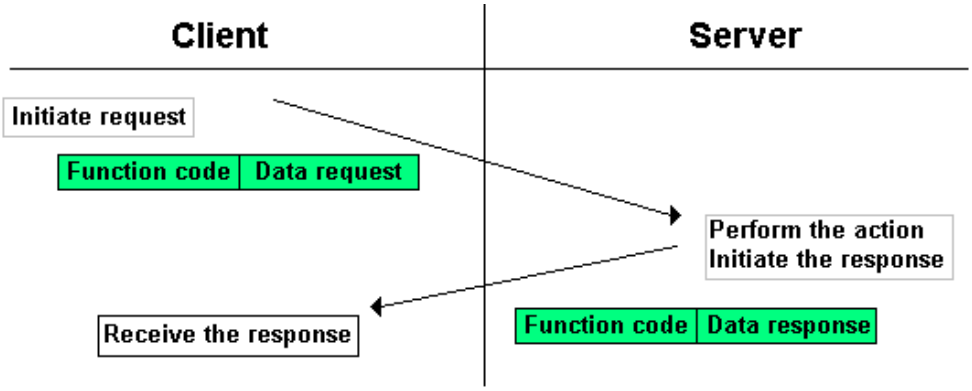
Protocol description

TECHNICAL BASICS

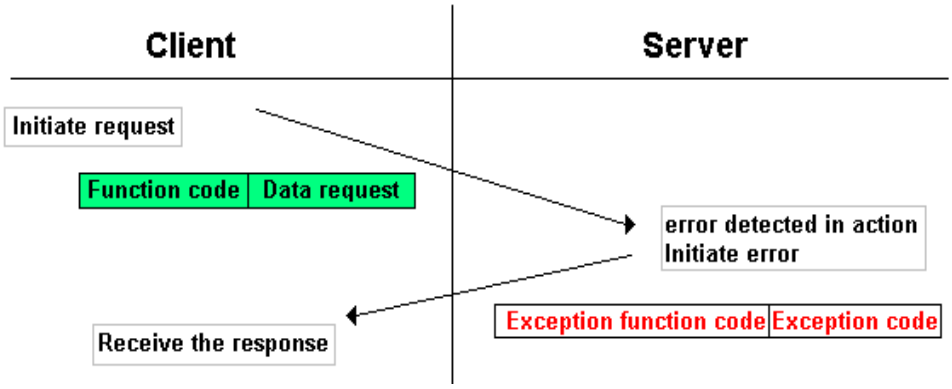
The Modbus protocol defines a simple protocol data unit (PDU) independent of the underlying communication layers.
The mapping of Modbus protocol on specific buses or network can introduce some additional fields on the application data unit (ADU).
The Modbus application data unit is built by the client 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.



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.



Data model

The data model distinguishes four basic data types:

Table 6-1: 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.

TECHNICAL BASICS

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 6-7)).

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

BL67 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.

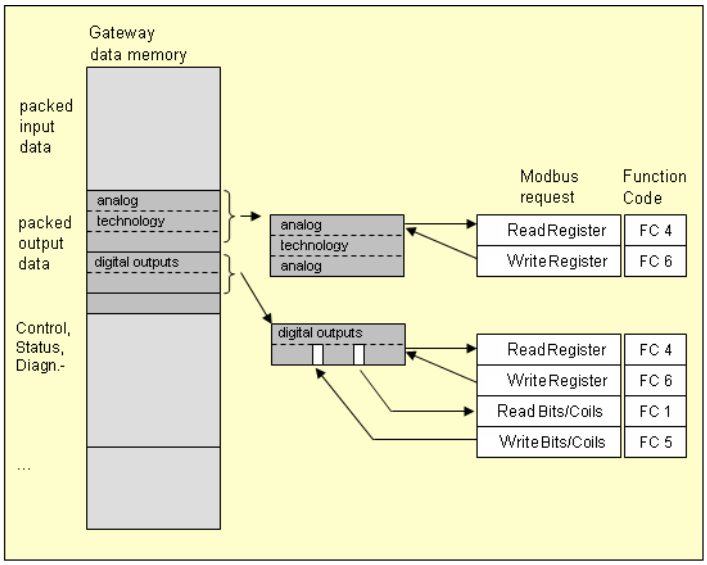


Figure 6-1: Picture of the data memory of the BL67 modules

6.2 Implemented Modbus functions

The BL67-gateways for Modbus TCP support the following functions for accessing process data, parameters, diagnostics and other services.

Table 6-2: 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

6.3 Modbus registers

NOTE

The following table page 6-9 shows the register mapping for the different Modbus addressing methods.

Table 6-3: Modbus registers of the module

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

Address (hex.)	Access A	Description
0×0000 - 0×01FF	ro	Packed process data of inputs (process data length of modules → siehe Table 6-5: Data width of the I/O-modules)
0×0800 - 0×09FF	rw	Packed process data of output (process data length of modules → siehe Table 6-5: Data width of the I/O-modules)
0×1000 - 0×1006	ro	Gateway identifier
0×100C	ro	Gateway status (see Table 6-6:, Register 100Ch: Gateway status (page 6-14))
0×1010	ro	Process image length in bit for the intelligent output modules
0×1011	ro	Process image length in bit for the intelligent input modules
0×1012	ro	Process image length in bit for the digital output modules
0×1013	ro	Process image length in bit for the digital input modules
0×1017	ro	Register-mapping revision (always 1, if not, mapping is incompatible with this description)
0×1018 - 0×101A	ro	Group diagnostics of I/O-modules 0 to 32 (1 bit per I/O module)
0×1020	ro	Watchdog, actual time [ms]
0×1120	rw	Watchdog predefined time [ms] (default: 0), see also Output module behavior in case of an error (page 6-19))
0×1121	rw	Watchdog reset register
0×1130	rw	Modbus connection mode register, page 6-15
0×1131	rw	Modbus connection timeout in sec. (Def.: 0 = never), page 6-15
0×113C - 0×113D	rw	Modbus parameter restore (reset of parameters to default values), page 6-15
0×113E - 0×113F	rw	Modbus parameter save (permanent storing of parameters), page 6-15

Table 6-3: Modbus registers of the module

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

Address (hex.)	Access A	Description
0×1140	rw	Deactivate protocol Deactivates explicitly the selected Ethernet-protocol: 0 = EtherNet/IP 1 = Modbus TCP 2 = PROFINET 15 = web server
0×1141	ro	Active protocol 0 = EtherNet/IP 1 = Modbus TCP 2 = PROFINET 15 = web server
0×2000 - 0×207F	rw	Service object, request area page 6-16
0×2080 - 0×20FF	ro	Service object, response area page 6-16
0×2400	ro	System voltage U_{SYS} [mV]
0×2401	ro	Load voltage U_L [mV]
0×2405	ro	Load current I_L [mA]
0×27FE	ro	No. of entries in actual module list
0×27FF	rw	No. of entries in reference module list
0×2800 - 0×2840	rw	Reference-module-list (max. 32 modules per station × 2 registers for module-ID)
0×2A00 - 0×2A40	ro	Actual module-list (max. 32 modules per station × 2 registers for module-ID)
0×8000 - 0×8400	ro	Process data inputs (max. 32 modules per station × 32 registers for module-ID)
0×9000 - 0×9400	rw	Process data outputs (max. 32 modules per station × 32 registers for module-ID)
0×A000 - 0×A400	ro	Diagnostics (max. 32 modules per station × 32 registers for module-ID)
0×B000 - 0×B400	rw	Parameters (max. 32 modules per station × 32 registers for module-ID)

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

Table 6-4: Mapping of BL67-GW-EN Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
Packed input data	0×0000 - 0×01FF	0 - 511	40001 - 40512	400001 - 400512
Packed output data	0×0800 - 0×09FF	2048 - 2549	42049 - 42560	402049 - 402560
Gateway identifier	0×1000 - 0×1006	4096 - 4102	44097 - 44103	404097 - 404103
Gateway status	0×100C	4108	44109	404109
Process image length in bit for the intelligent output modules	0×1010	4112	44113	404113
Process image length in bit for the intelligent input modules	0×1011	4113	44114	404114
Process image length in bit for the digital output modules	0×1012	4114	44115	404115
Process image length in bit for the digital input modules	0×1013	4115	44116	404116
Register mapping revision	0×1017	4119	44120	404120
Group diagnostics of I/O-modules 0 to 32 (1 bit per I/O-module)	0×1018 - 0×101B	4120 - 4122	44121 - 44123	404121 - 404123
Watchdog, actual time	0×1020	4128	44129	404129
Watchdog, predefined time	0×1120	4384	44385	404385
Watchdog reset register	0×1121	4385	44386	404386
Modbus connection mode register	0×1130	4400	44401	404401
Modbus Connection Timeout in seconds	0×1131	4401	44402	404402
Modbus parameter restore	0×113C - 0×113D	4412 - 4413	44413 - 44414	404413 - 404414
Modbus parameter save	0×113E - 0×113F	4414 - 4415	44415 - 44416	404415 - 404416
Deactivate protocol	0×1140	4416	44417	404417
Active protocol	0×1141	4417	44418	404418
Service object, request area	0×2000 - 0×207F	8192 - 8319	48193 - 48320	408193 - 408320
Service object, response area	0×2080 - 0×20FF	8320 - 8447	48321 - 48448	408321 - 408448

Table 6-4: Mapping of BL67-GW-EN Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
System voltage U_{SYS} [mV]	0×2400	9216	49217	409217
Load voltage U_L [mV]	0×2401	9217	49218	409218
Load current I_L [mA]	0×2405	9221	49222	409222
No. of entries in actual module list	0×27FE	10238	-	410239
No. of entries in reference module list	0×27FF	10239	-	410240
Reference-module-list (max. 32 modules per station × 2 registers for module-ID)	0×2800 - 0×2840	10240 - 10304	-	410241 - 410305
Actual module list (max. 32 modules per station × 2 registers for module-ID)	0×2A00 - 0×2A20	10752 - 10784	-	410753 - 410785
Slot related address assignment				
Process data inputs (max. 32 modules per station × 32 registers for module-ID)	0×8000 - 0×8400			
Slot 1	0×8000	32768	-	432769
Slot 2	0×8020	32800	-	432801
Slot 3	0×8040	32832	-	432833
...				
Slot 32	0×83E0	33760		433761
Process data outputs (max. 32 modules per station × 32 registers for module-ID)	0×9000 - 0×9400			
Slot 1	0×9000	32768	-	432769
Slot 2	0×9020	32800	-	432801
Slot 3	0×9040	32832	-	432833
...				
Slot 32	0×93E0	33760		433761
Diagnostics (max. 32 modules per station × 32 registers for module-ID)	0×A000 - 0×A400			
Slot 1	0×A000	40960	-	440961
Slot 2	0×A020	40992	-	440993
Slot 3	0×A040	41034	-	441035
...				
Slot 32	0×A3E0	41952		441953

Table 6-4: Mapping of BL67-GW-EN Modbus registers (holding registers)

Description	Hex	Decimal	5-digit	Modicon
Parameters (max. 32 modules per station × 32 registers for module-ID)	0×B000 - 0×B400			
Slot 1	0×B000	45056	-	445057
Slot 2	0×B020	45088	-	445089
Slot 3	0×B040	45120	-	445121
...				
Slot 32	0×B3E0	46048		446049

6.3.1 Structure of the packed in-/output process data

In order to assure a largely efficient access to the process data of a station, the module data are consistently packed and mapped to a coherent register area.

The I/O-modules are divided into digital and intelligent modules (analog modules, serial interfaces).

Both module types are mapped in separate register ranges.

The data mapping always starts with the mapping of the intelligent modules. Each module occupies as many Modbus registers as necessary, depending on it's data width. At least one register is occupied. A RS232-module, for example, occupies 4 consecutive registers (8 bytes) in the input and in the output area.
The data byte arrangement is done according to the physical order in the station, from the left to the right.

The data of the intelligent modules are followed by the data of the digital modules, also structured according to their physical appearance in the station. The Modbus registers for the digital data are filled up to 16 bit. This means on the one hand that one Modbus register can contain data of different digital modules and on the other hand that the data of one digital module can be distributed over multiple registers. Bit 0 of a digital module is thus not necessarily located on a word limit.

NOTE

An example in chapter 7, page 7-16ff. describes the data mapping.

Additionally, the software I/O-ASSISTANT offers the possibility to create a mapping table for every station.

Packed input process data

- Input register area **0000h** to **01FFh**

0000h			01FFh
Intelligent modules, input data	Digital Input modules	status/ Diagnostics	free

NOTE

Independent of the I/O-configuration, an access to all 512 registers is always possible. Registers that are not used send "0".

Status/diagnosis

The area "status/diagnosis" comprises a maximum of 9 registers.

The first register contains a common gateway-/station-status.

The following registers (max. 8) contain a group diagnostic bit for each I/O-module which shows whether a diagnostic message is pending for the relevant module or not.

Status/diagnosis	
n + 0000h	**n + 0008h**
Gateway status (reg. 100Ch)	group diagnosis I/O-modules 0...127 (registers 1018h to 101Fh)

Packed output process data

- Output register area **0800h** to **09FFh**

0800h		**09FFh**
Intelligent modules, output data	Digital output modules	free

NOTE

Independent of the I/O-configuration, an access to all 512 registers is always possible. Registers that are not used send "0" answering a read access, write accesses are ignored.

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

The following table shows the data width of the BL67-I/O-modules within the Modbus register area and the type of data alignment.

Table 6-5: Data width of the I/O-modules

Module	Process input	Process output	Alignment
– Digital inputs			
BL67-4DI-x	4 Bit	-	bit by bit
BL67-8DI-x	8 Bit	-	bit by bit
BL67-16DI-x	16 Bit	-	bit by bit
– Digital outputs			
BL67-4DO-x	-	4 Bit	bit by bit
BL67-8DO-x	-	8 Bit	bit by bit
BL67-16DO-x	-	16 Bit	bit by bit
– Analog inputs			
BL67-2AI-x	2 words		word by word
BL67-4AI-x	4 words		word by word
– Analog outputs			
BL67-2AO-x		2 words	word by word
BL67-4AO-x		4 words	word by word
– Digital combi modules			
BL67-4DI4DO-PD	4 Bit	4 Bit	bit by bit
BL67-8XSG-P(D)	8 Bit	8 Bit	bit by bit
– Analog combi modules			
BL67-2AI2AO-V/I	2 words	2 words	word by word
BL67-4AI4AO-V/I	4 words	4 words	word by word
– Technology modules			
BL67-1RS×××	4 words	4 words	word by word
BL67-1SSI	4 words	4 words	word by word
BL67-1CVI	4 words	4 words	word by word
BL67-1CNT/ENC	6 words	4 words	word by word
BL67-2RFID-x	12 words	12 words	word by word

6.3.2 Register 100Ch: "Gateway status"

This register contains a general gateway/ station status.

Table 6-6: Register 100Ch: Gateway status

Bit	Name	Description
gateway		
15	I/O Controller Error	The communication controller for the I/O-system is defective.
14	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.
13	reserved	-
12	Modbus Wdog Error	A timeout occurred in the Modbus-communication.
Module bus		
11	I/O Cfg Modified Error	The I/O-configuration has be changed and is no longer compatible.
10	I/O Communication Lost error	No Communication on the module bus.
Voltage errors		
9	V_I too low	System supply voltage too low (< 18 V DC).
8	V_I too high	System supply voltage too high (> 30 V DC).
7	V_O too low	Load voltage too low (< 18 V DC).
6	V_O too high	Load voltage too high (> 30 V DC).
5	I_{sys} too high	Overload of the system voltage supply.
4	reserved	-
Warnings		
3	I/O Cfg Modified Warning	The station configuration has changed.
0	I/O Diags Active Warning	At least one I/O-module sends active diagnosis.

6.3.3 Register 1130h: "Modbus connection mode"

This register defines the behavior of the Modbus connections:

Table 6-7: 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.

6.3.4 Register 1131h: "Modbus Connection Timeout"

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

6.3.5 Register 0×113C and 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 to register 0×113E. 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.

6.3.6 Register 0×113E and 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.

For this purpose, write 0×7361 to 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.

6.4 The Service Object

The service-object is used to execute one-time or acyclic services. It is an acknowledge service which may serve, for example, to parameterize an I/O-module.

2000h	2080h	20FFh
Service request area	Service-response-area	

The service request area allows write access, the service response area only read access.

- Service request area

2000h	2001h	2002h	2003h	2004h	2005h	207Fh
Service number	reserved	Service code	Index/addr	Data-Reg-Count	optional data (0...122 registers)	

The register **service no.** in the request area can contain a user defined value which is deleted after the execution of the service.

The register **service code** specifies which service is requested.

The register **index/addr** is optional and the meaning depends on the particular service.

The register **data-reg-count** contains, depending on the service, the number (0 to 122) of the transferred or of the requested data registers.

Depending on the service, the **optional data area** can contain additional parameters and/or other data to be written.

- Service-response-area

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
Service number	result	Service code	Index/addr	Data-Reg-Count	optional data (0...122 registers)	

After the execution of a request, the registers **service-no.**, **service code** and **index/addr** in the response area contain a copy of the values in the request area.

NOTE

The service no. is thus used for a simple handshake on the application level. The application increases the service no. with every request. The service is blocked, until the service number in the request area matches the service number in the response area.

The register **result** shows whether the execution was successful or not.

The register **data-reg-count** contains the number of data registers (0 to 122).

The **optional data area** can contain, depending on the service, the requested data.

Supported service numbers:

Table 6-8: Supported service numbers

Service code	Meaning
0×0000	no function
0×0003	indirect reading of registers
0×0010	indirect writing of registers

A service request may have the following results:

Table 6-9: results of the service request

Service code	Meaning
0×0000	error free execution of service
0×FFFE	Service parameters incorrect/inconsistent
0×FFFF	Service code unknown

NOTE

The services "indirect reading of registers" and "indirect writing of registers" offer an additional possibility to access any Modbus register.

Current Modbus-masters support only a limited number of register-areas that can be read or written during the communication with a Modbus-server. These areas can not be changed during operation.

In this case, the services mentioned above enables non-cyclic access to registers.

Indirect reading of registers

1 to 122 (Param. Count) Modbus-registers are read, starting with address x (Addr).

- Service request

2000h	2001h	2002h	2003h	2004h	2005h	207Fh
Service number	0×0000	0×0003	Addr	Count	no meaning	

- Service response

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
Service number	result	0×0003	Addr	Count	register contents	

Indirect writing of registers

1 to 122 (Param. Count) Modbus-registers are read, starting with address Addr.)

- Service request

2000h	2001h	2002h	2003h	2004h	2005h	207Fh
Service number	0×0000	0×0010	Addr	Count	register contents	

- Service response

2080h	2081h	2082h	2083h	2084h	2085h	20FFh
Service number	result	0×0010	Addr	Count	no meaning	

6.5 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 modules, 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 area
  All digital inputs are stored in this area (offset "0").
- Mapping: coil area
  All digital outputs are stored in this area (offset "0").

6.6 Output module behavior in case of an error

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0×1120, page 6-7):

- watchdog = 0 ms (default)
  → outputs hold the momentary value
- watchdog > 0 ms
  → outputs switch to 0 after the watchdog-time has run out.

NOTE

Please observe that the change of the watchdog-time has to be stored using the "save"-command (see Register 0×113E and 0×113F: "Save Modbus-Connection-Parameters" (page 6-15)).

NOTE

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

7 Application example: BL67-GW-EN with Modbus TCP (CODESYS Win V3)

7.1 Used hard-/software

7.1.1 Hardware

- BL67-GW-EN (> VN 03-00, IP: 192.168.1.112)
  - Slot 1: BL67-8XSG-PD
  - Slot 2: BL67-8DI-PD
  - Slot 3: BL67-2AO-I
  - Slot 4: BL67-8DO-0.5A-P
  - Slot 5: BL67-4AI-V/I
  - Slot 6: BL67-4DO-2A-P

7.1.2 Software

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

7.2 Network configuration

BL67-stations are delivered in the address-mode "PGM-DHCP" and can be reached using IP-address 192.168.1.254.

NOTE

In order to build up the communication between the BL67-gateway and a PC or a network interface card, both devices have to be hosts in the same network.

To achieve this, you have either

- to adapt the gateway's IP-address via BootP, DHCP in order to integrate the device into your own network (detailed information about the different methods of address assignment can be found under Address assignment, page 3-17).

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 12-2).

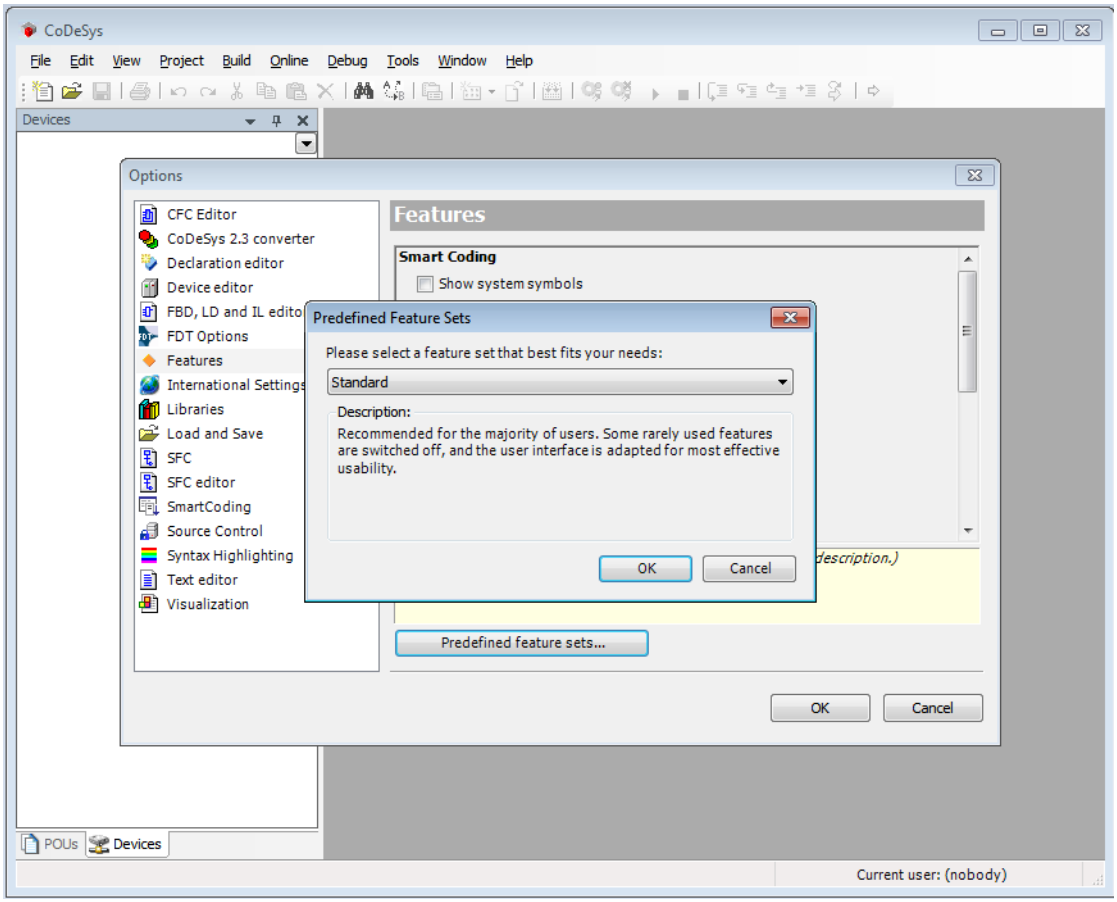
7.3 Programming with CODESYS

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

7.3.1 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.

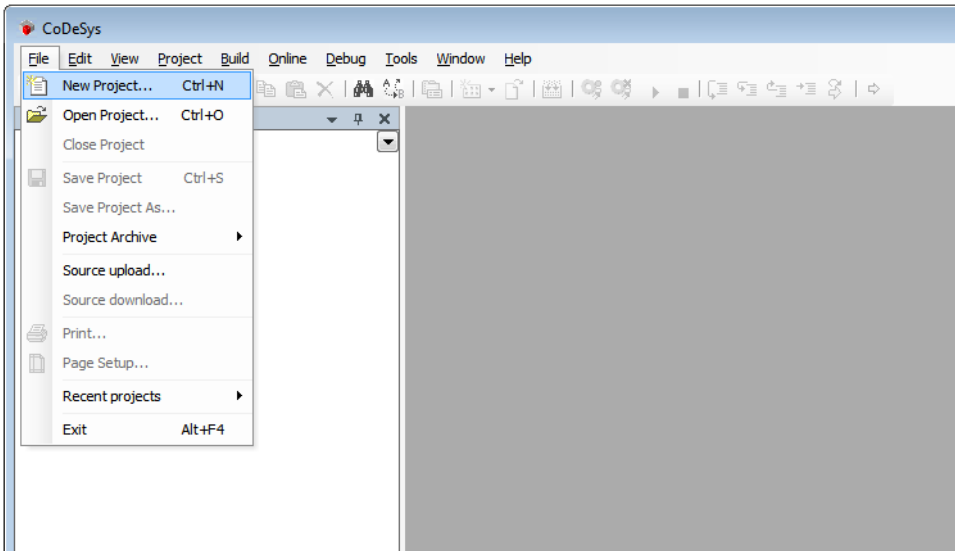
Figure 7-1: Predefined feature sets



7.3.2 Creating a new project

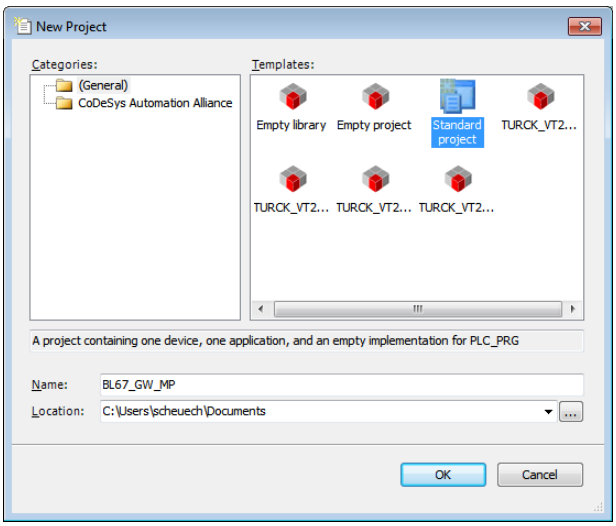
1 Create a new CODESYS-project using the "File → New project" command.

Figure 7-2: New project



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

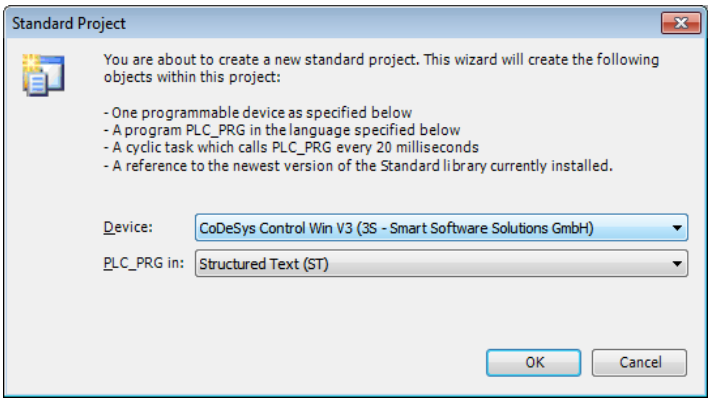
Figure 7-3: Standard project



3 Select the PLC used in the project.
In this example, the CODESYS Control Win V3 is used.

4 Please define also your preferred programming language.
In this example structured text is used.

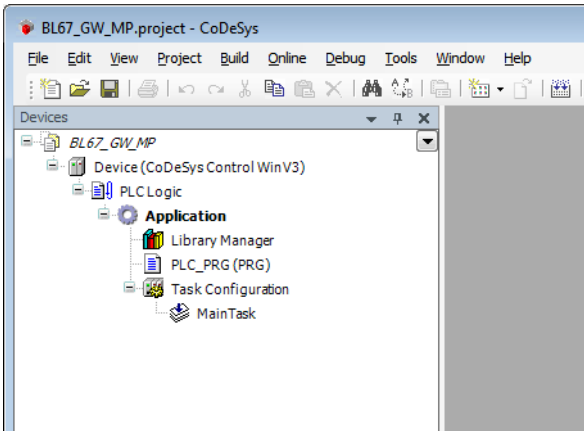
Figure 7-4: Selecting the CODESYS Control Win V3



5 The new project is created.

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

Figure 7-5: Project tree



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

7.3.3 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.

Define a gateway

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.

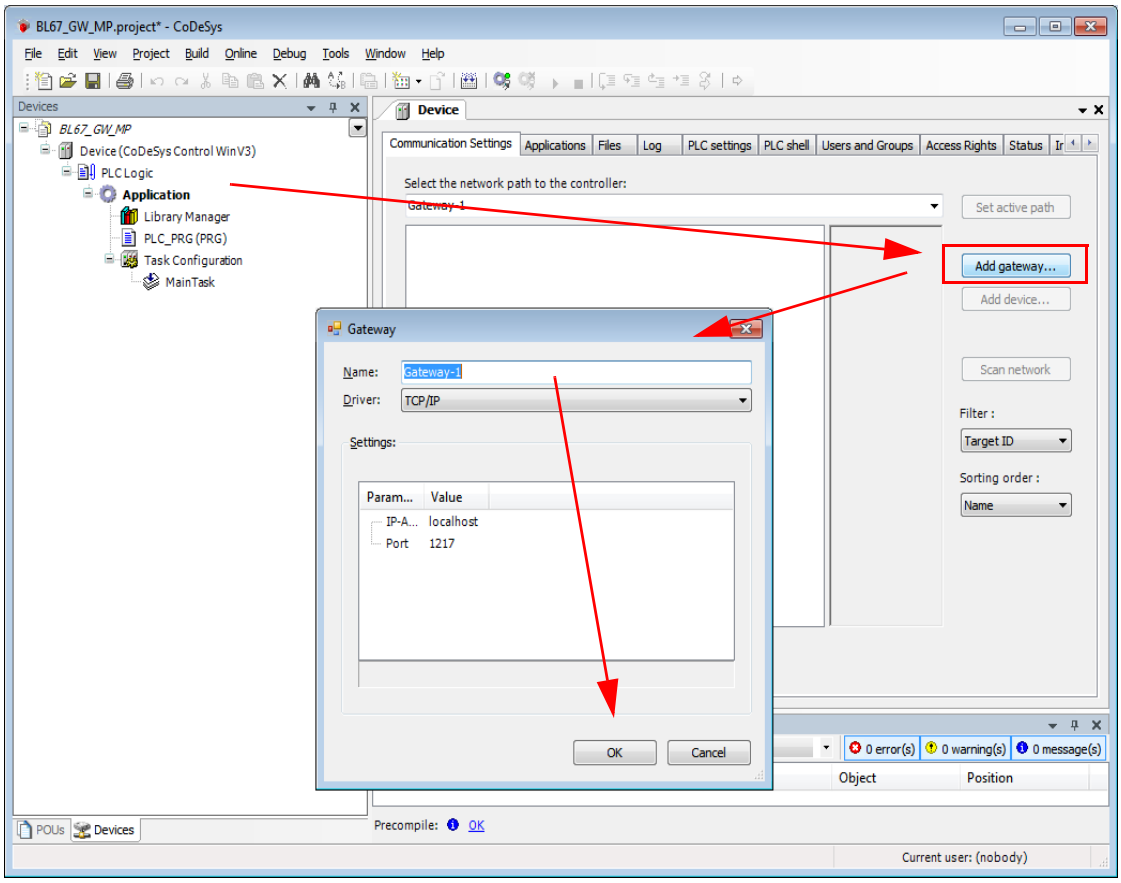


Figure 7-6: Communication settings

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.

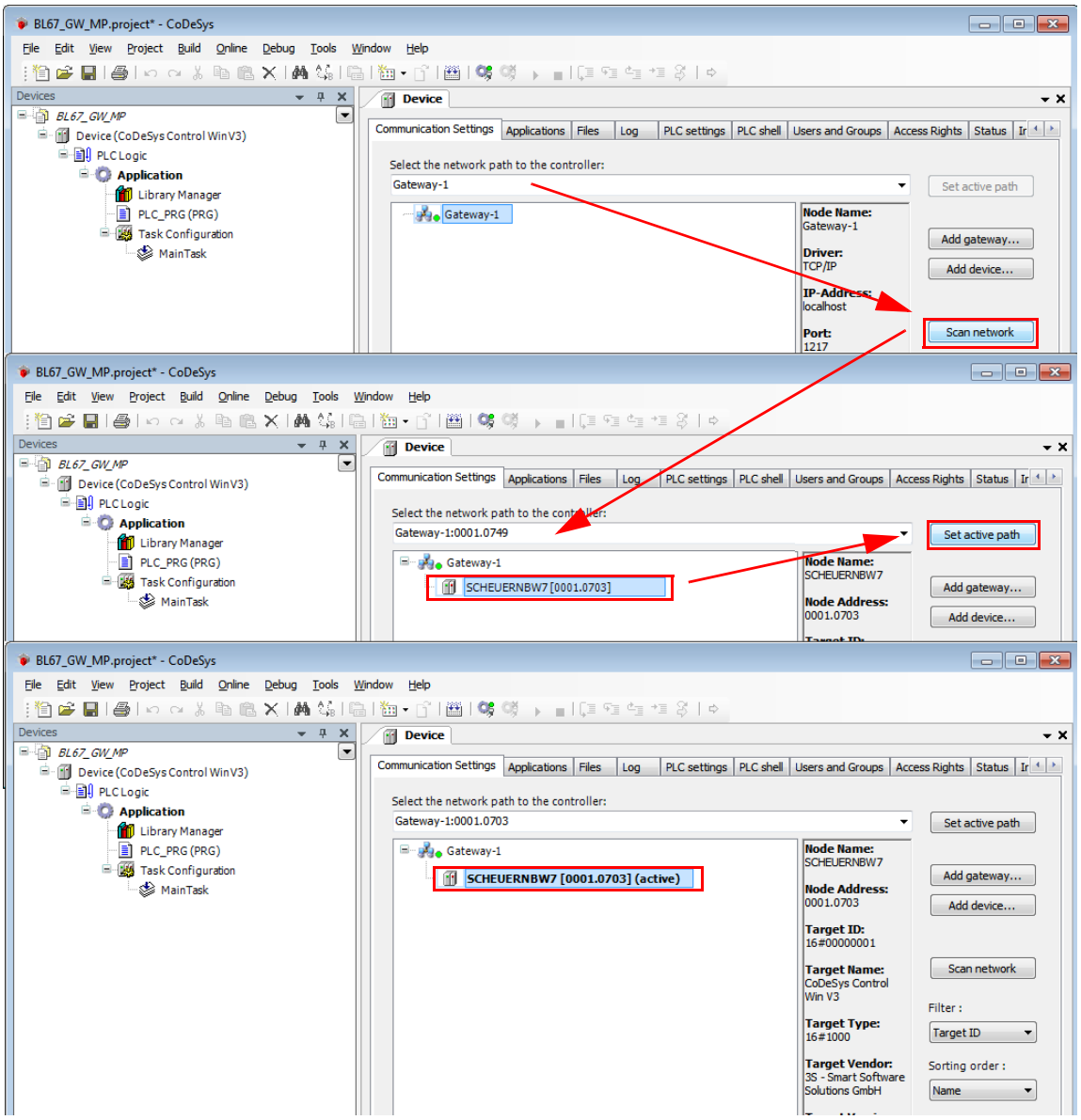


Figure 7-7: Setting the communication path

7.3.4 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.

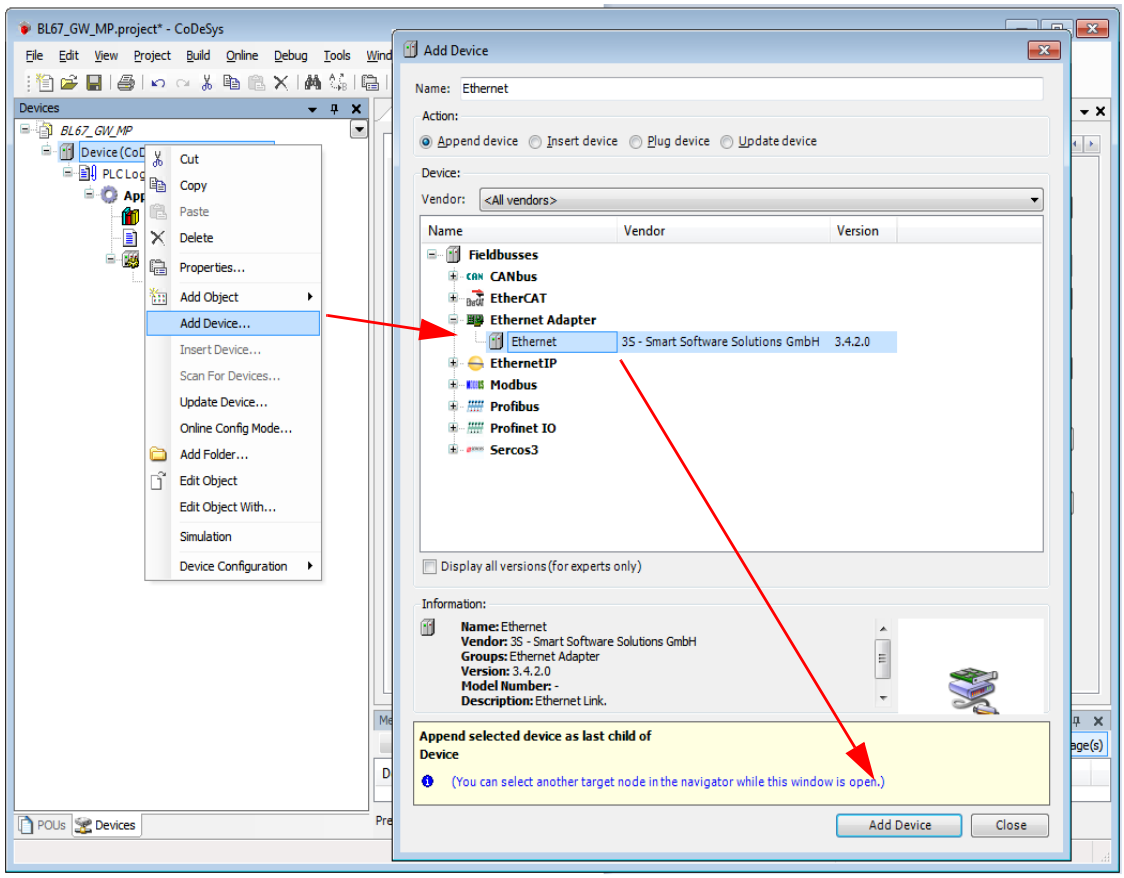
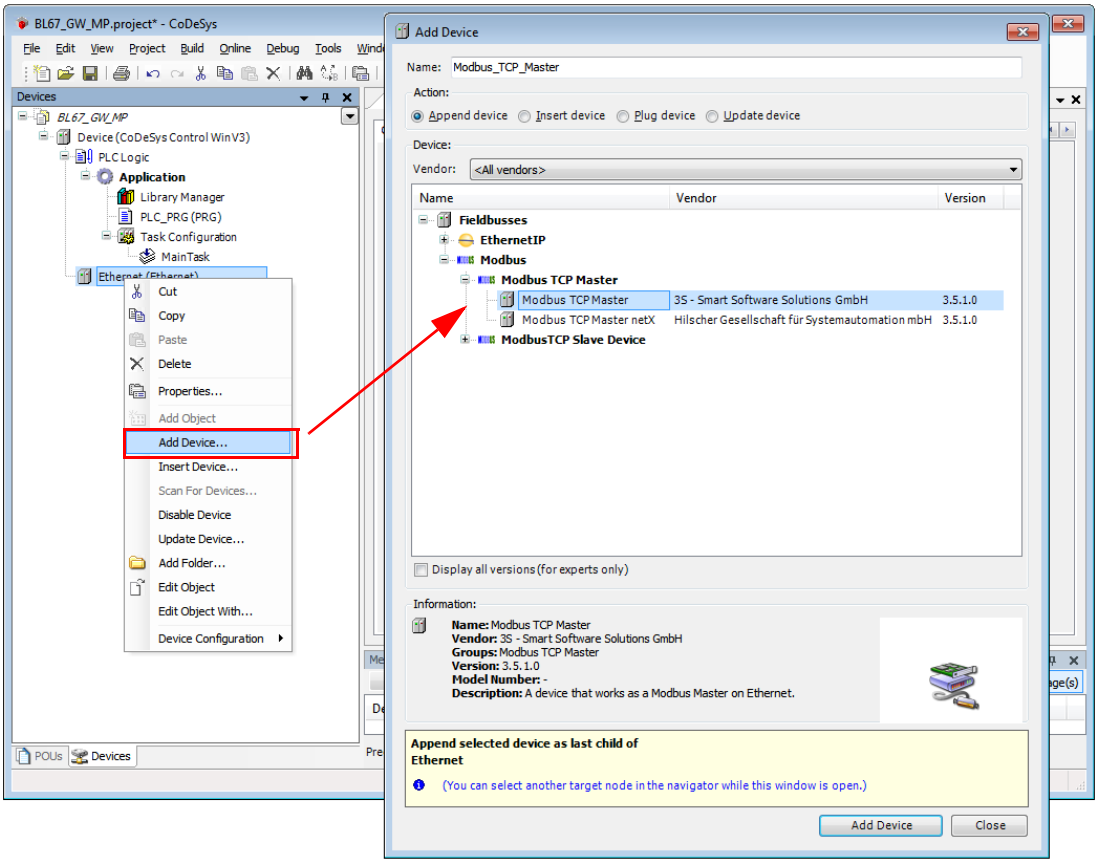


Figure 7-8: Adding the Ethernet Adapter as device

7.3.5 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.

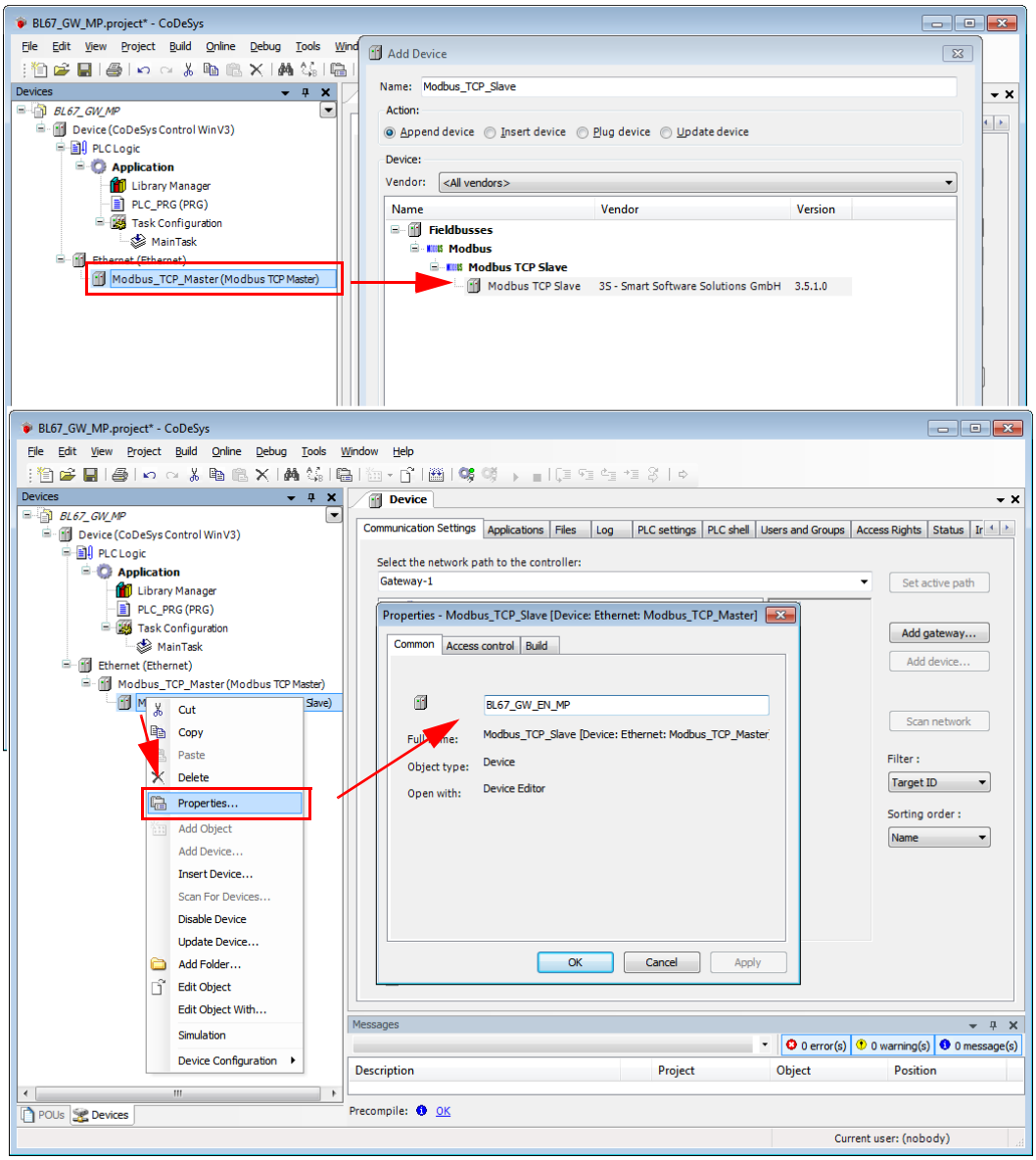
Figure 7-9: Adding the Modbus master



7.3.6 Adding a Modbus TCP slave

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

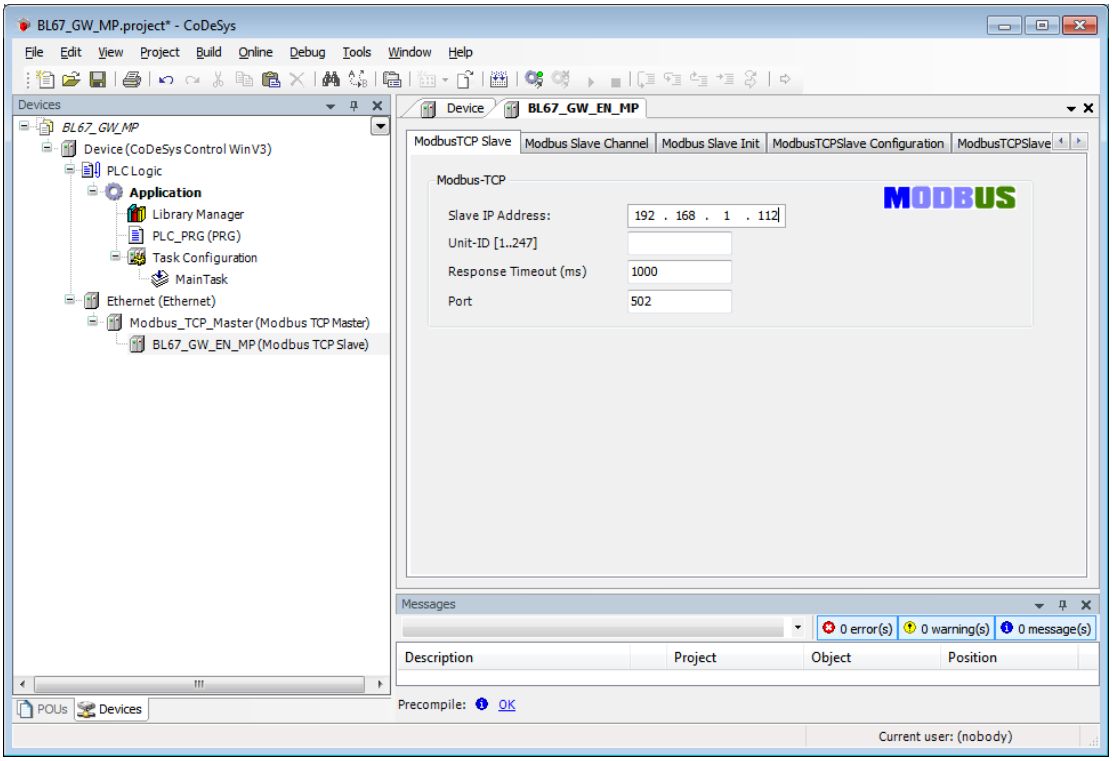
Figure 7-10: Selecting a slave



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: address **192.168.1.16)**. All other settings can be kept.

Figure 7-11: Setting the node address at the slave



7.3.7 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 7-5).

Small example program

1. The counter counts up,
2. Counter-reset via setting the variable "xReset" (BOOL) to "1".
   "xReset" has been defined in the global variables (see also page page 7-14)

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 7-29) is enabled.

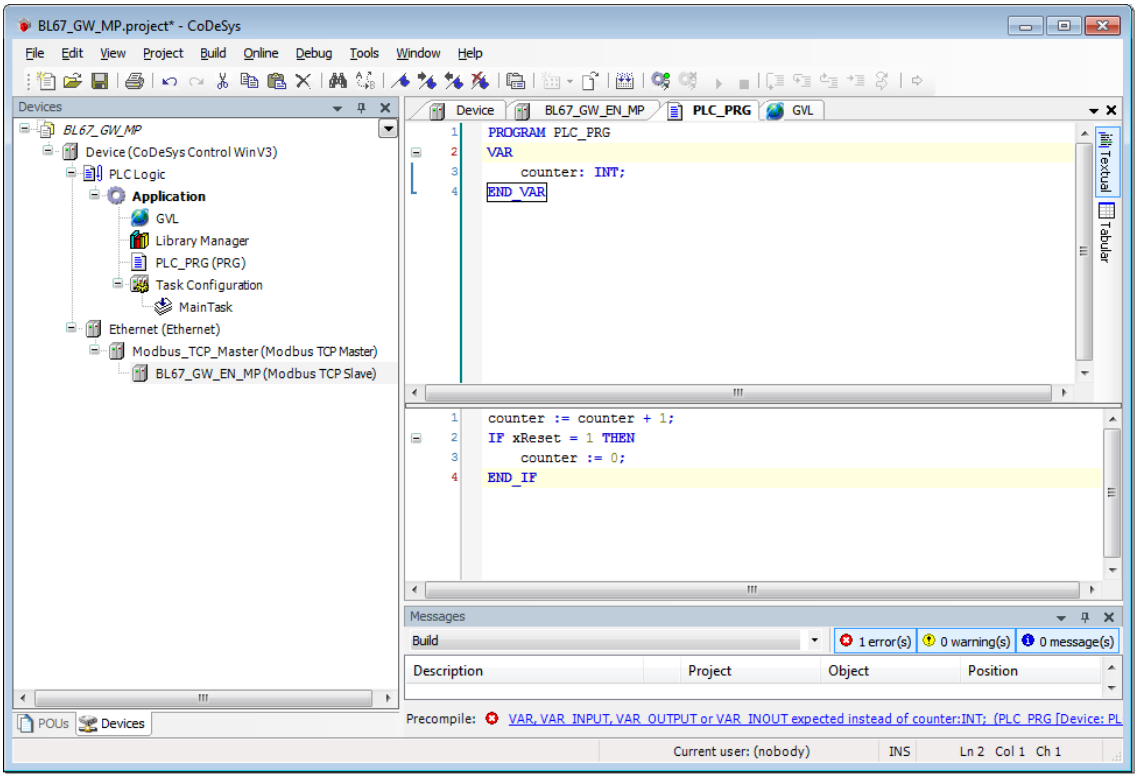
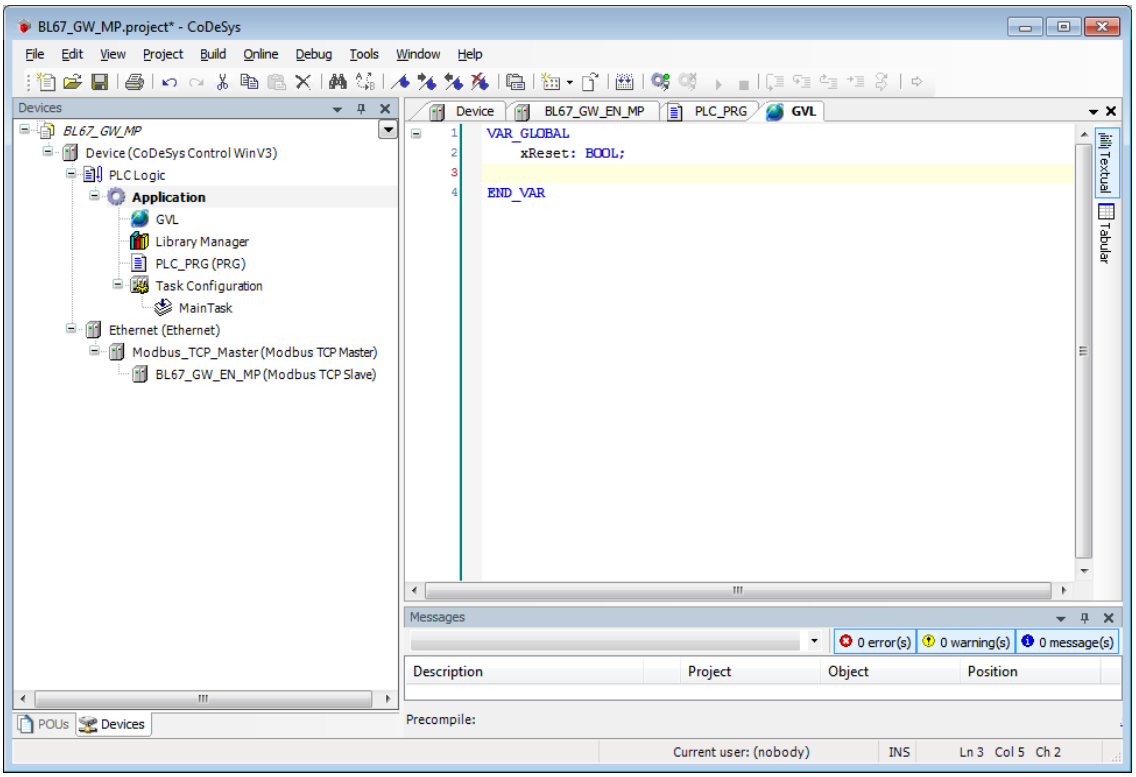


Figure 7-12: Example program

7.3.8 CODESYS: Global variables

Global variables are defined either in the Global Variable List (see page 7-14) or directly in the I/O Mappings of the single stations.

Figure 7-13: 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 Æ→ Add object Æ→ 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 7-1:, page 7-4).

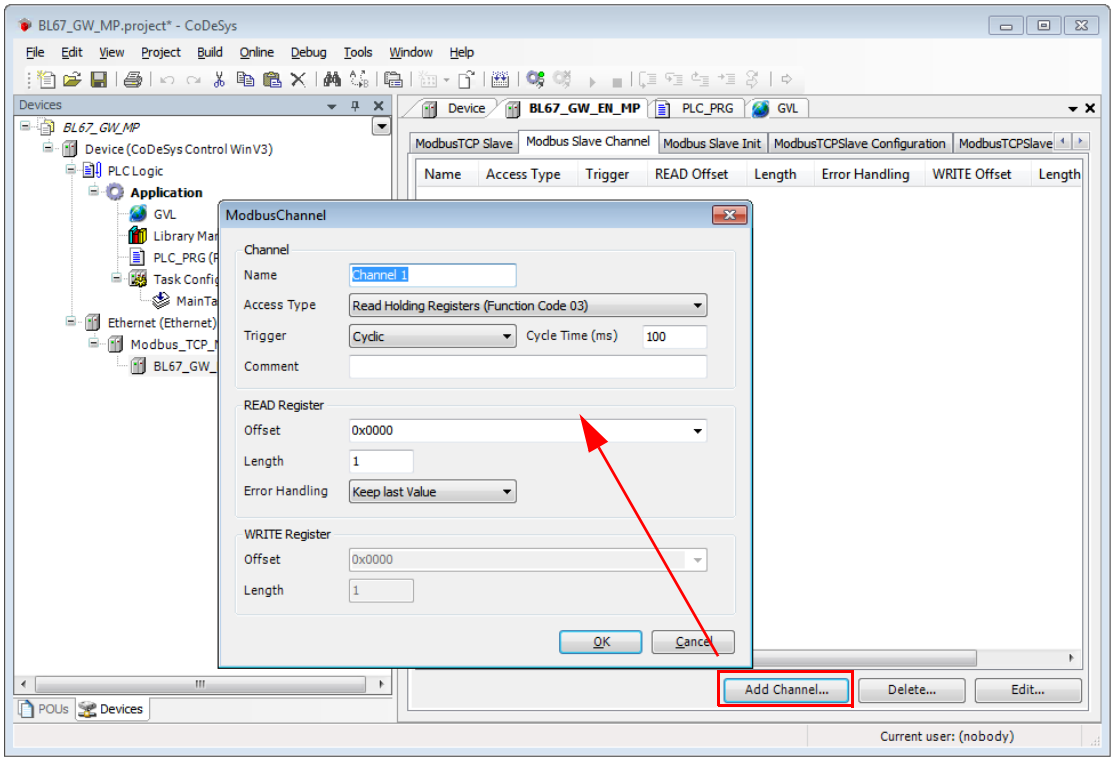
7.3.9 Modbus channels

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 7.3.11, „Reading out the process data“, page 7-29)

Figure 7-14: 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 BL67-Modbus-station depends on it's configuration.

The TURCK-software "I/O-ASSISTANT (FDT/DTM" offer the possibility to create a Modbus-report for each Modbus-station, which shows the in-and output data mapping as well as the parameter- and diagnostic data mappings for the respective station.

Modbus mapping (I/O-ASSISTANT)

Figure 7-15: Modbus report - Mapping of in- and output data

2. Modbus report

2.1. Station description

Station address: 192.168.1.7

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL67-GW-EN (>= VN 03-00)	192.168.1.7/BL67-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL67-8XSG-PD	01/BL67-8XSG-PD	8 bit	8 bit
2	BL67-8DI-PD	02/BL67-8DI-PD	8 bit	0 bit
3	BL67-2AO-I	03/BL67-2AO-I	0 bit	32 bit
4	BL67-8DO-0.5A-P	04/BL67-8DO-0.5A-P	0 bit	8 bit
5	BL67-4AI-V/I	05/BL67-4AI-V/I	64 bit	0 bit
6	BL67-4DO-2A-P	06/BL67-4DO-2A-P	0 bit	4 bit
	Local I/O data incl. status/control		6 Words	4 Words
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**7 Words**	**4 Words**

*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	05.15	05.14	05.13	05.12	05.11	05.10	05.09	05.08	05.07	05.06	05.05	05.04	05.03	05.02	05.01	05.00
0x0001	0001	05.31	05.30	05.29	05.28	05.27	05.26	05.25	05.24	05.23	05.22	05.21	05.20	05.19	05.18	05.17	05.16
0x0002	0002	05.47	05.46	05.45	05.44	05.43	05.42	05.41	05.40	05.39	05.38	05.37	05.36	05.35	05.34	05.33	05.32
0x0003	0003	05.63	05.62	05.61	05.60	05.59	05.58	05.57	05.56	05.55	05.54	05.53	05.52	05.51	05.50	05.49	05.48
0x0004	0004	02.07	02.06	02.05	02.04	02.03	02.02	02.01	02.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0005	0005	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
**0x0006	0006	-	-	-	-	-	-	-	-	-	-	M05	M04	M03	M02	M01	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: 7 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	03.15	03.14	03.13	03.12	03.11	03.10	03.09	03.08	03.07	03.06	03.05	03.04	03.03	03.02	03.01	03.00
0x0801	2049	03.31	03.30	03.29	03.28	03.27	03.26	03.25	03.24	03.23	03.22	03.21	03.20	03.19	03.18	03.17	03.16
0x0802	2050	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
0x0803	2051	-	-	-	-	-	-	-	-	-	-	-	-	06.03	06.02	06.01	06.00

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

Process output data: 4 Words

Figure 7-16: Modbus report - Mapping of parameter and diagnostic data

2.4. Map for parameter data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
B000	0	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	8	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	0	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	8	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	1	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	9	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	1	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	9	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	2	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	10	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	2	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	10	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	3	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	11	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	3	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	11	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	4	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	12	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
...	...			...	...	...

2.5. Map for diagnostic data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
A000	0	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A000	8	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	1	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : -
A000	9	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	2	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A000	10	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	3	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
...	...			...	...	...
A020	0	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	8	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	1	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	9	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	2	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	10	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	3	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	11	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	4	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	12	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate

NOTE

Detailed information about the Modbus registers of the BL67-stations can be found in the descriptions in chapter 6.3.

Setting the Modbus-channels (examples) and data mapping

1 Writing of **%QW0** and mapping of the counter value (VAR "Counter", see PLC_PRG, page 7-13) to the output byte of the station (%QW0).

1.1 Write: %QW0

– Access Type:
Write Single Register (function code **06**)

– Write Register, Offset:
0×0802 (see below)
The process output data of the station can be found in register 0×0800.

Figure 7-17: Mapping of output data acc. to Modbus-report

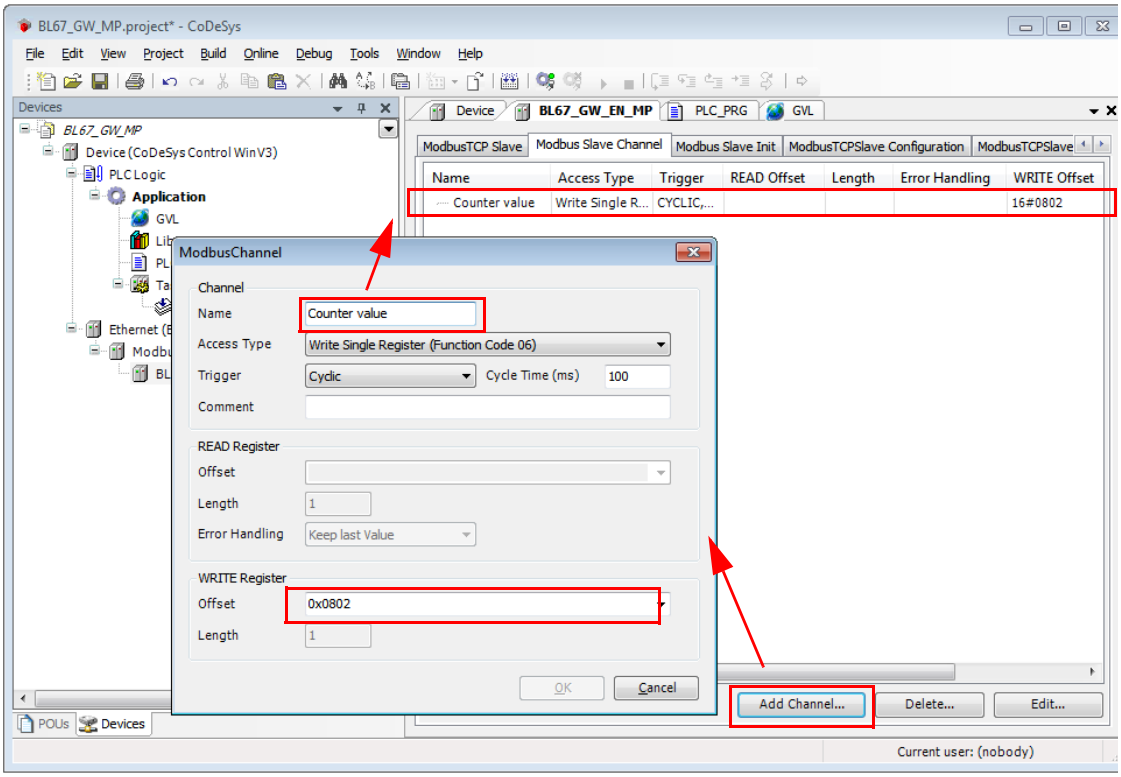
2.3. I/O map for output data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	2048	03.15	03.14	03.13	03.12	03.11	03.10	03.09	03.08	03.07	03.06	03.05	03.04	03.03	03.02	03.01	03.00
0x0801	2049	03.31	03.30	03.29	03.28	03.27	03.26	03.25	03.24	03.23	03.22	03.21	03.20	03.19	03.18	03.17	03.16
0x0802	2050	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
0x0803	2051	-	-	-	-	-	-	-	-	-	-	-	-	06.03	06.02	06.01	06.00

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

Process output data: 4 Words

Figure 7-18: Modbus channel, counter value, FC06

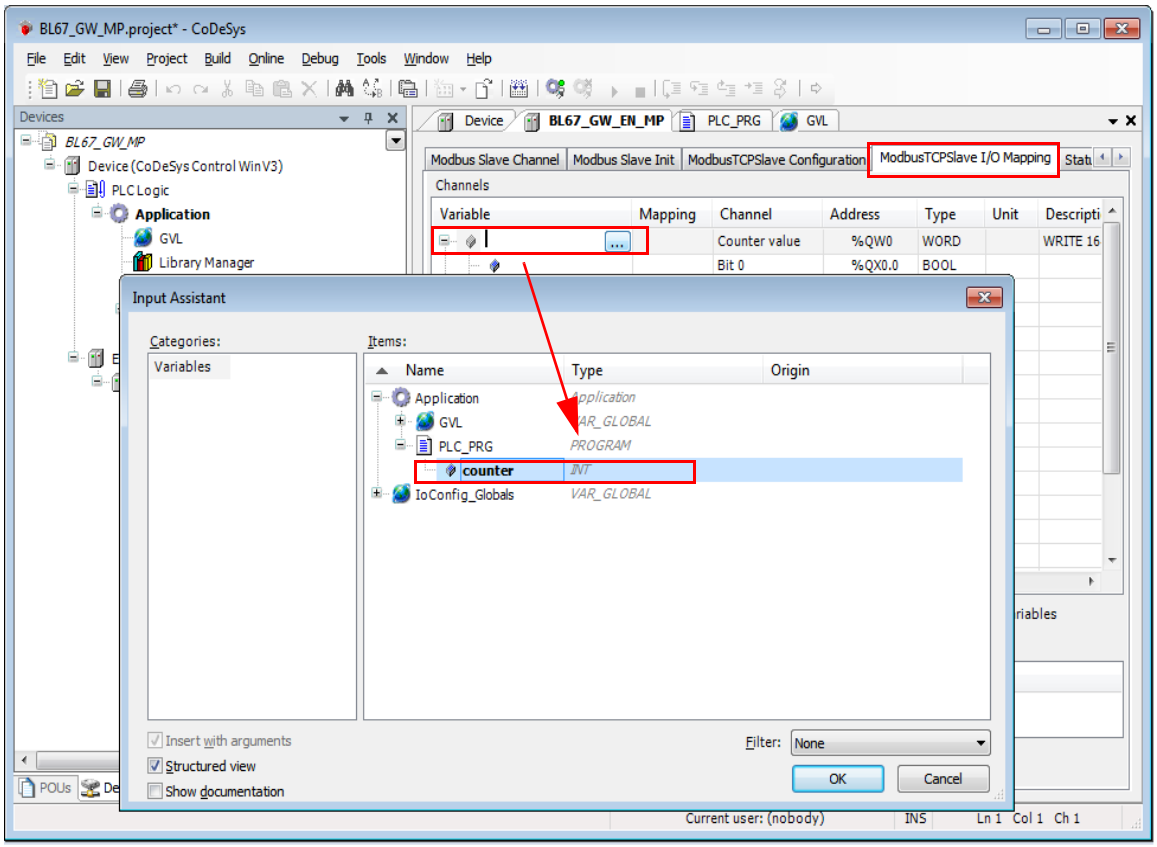


1.2 Mapping: counter value to %QW0

– The mapping of the counter value (VAR "Counter") to the station 's output register is done 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 7-19: 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 in register 0×0004 has to be read out
(→ reset the counter (with "xReset" = 1)

2.1 Read: %IW0

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

– Read Register, Offset:
0×0004 (see below)

Figure 7-20: Mapping of input data acc. to Modbus-report

2. Modbus report

2.1. Station description

Station address: 192.168.1.7

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL67-GW-EN (>= VN 03-00)	192.168.1.7/BL67-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL67-8XSG-PD	01/BL67-8XSG-PD	8 bit	8 bit
2	BL67-8DI-PD	02/BL67-8DI-PD	8 bit	0 bit
3	BL67-2AO-I	03/BL67-2AO-I	0 bit	32 bit
4	BL67-8DO-0.5A-P	04/BL67-8DO-0.5A-P	0 bit	8 bit
5	BL67-4AI-V/I	05/BL67-4AI-V/I	64 bit	0 bit
6	BL67-4DO-2A-P	06/BL67-4DO-2A-P	0 bit	4 bit
	Local I/O data incl. status/control		6 Words	4 Words
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**7 Words**	**4 Words**

*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	05.15	05.14	05.13	05.12	05.11	05.10	05.09	05.08	05.07	05.06	05.05	05.04	05.03	05.02	05.01	05.00
0x0001	0001	05.31	05.30	05.29	05.28	05.27	05.26	05.25	05.24	05.23	05.22	05.21	05.20	05.19	05.18	05.17	05.16
0x0002	0002	05.47	05.46	05.45	05.44	05.43	05.42	05.41	05.40	05.39	05.38	05.37	05.36	05.35	05.34	05.33	05.32
0x0003	0003	05.63	05.62	05.61	05.60	05.59	05.58	05.57	05.56	05.55	05.54	05.53	05.52	05.51	05.50	05.49	05.48
0x0004	0004	02.07	02.06	02.05	02.04	02.03	02.02	02.01	02.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0005	0005	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
**0x0006	0006	-	-	-	-	-	-	-	-	-	-	M05	M04	M03	M02	M01	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: 7 Words

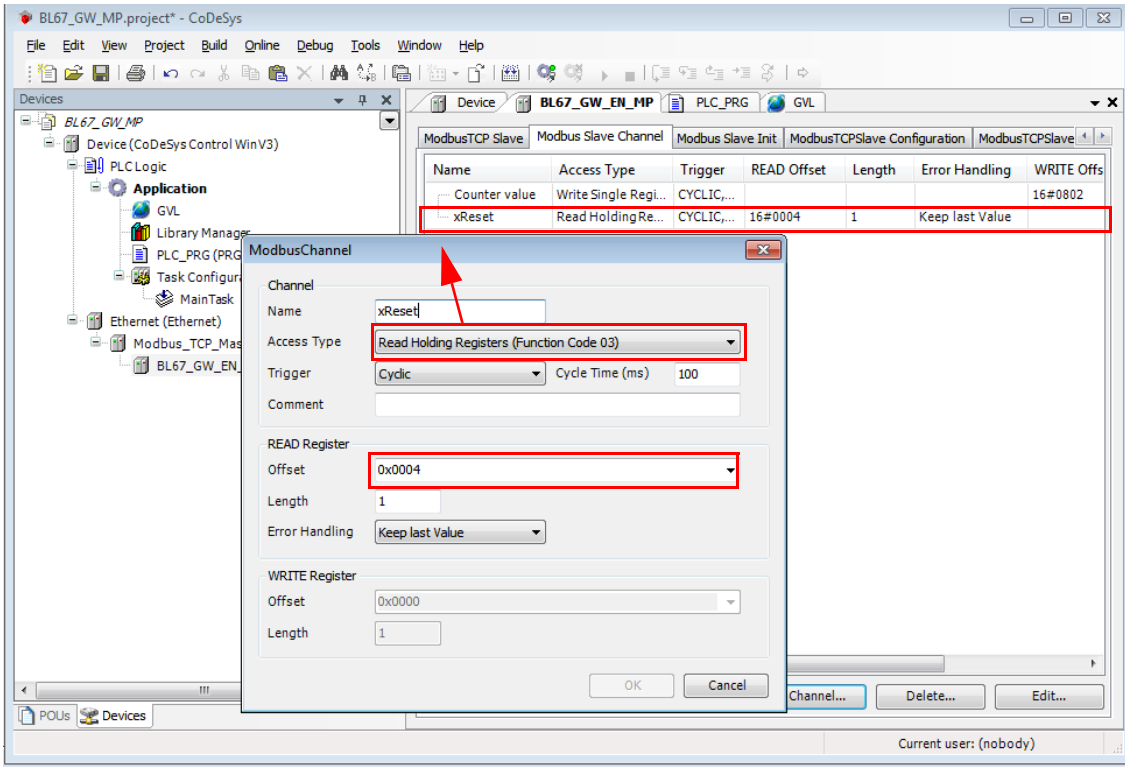
2.3. I/O map for output data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0800	2048	03.15	03.14	03.13	03.12	03.11	03.10	03.09	03.08	03.07	03.06	03.05	03.04	03.03	03.02	03.01	03.00
0x0801	2049	03.31	03.30	03.29	03.28	03.27	03.26	03.25	03.24	03.23	03.22	03.21	03.20	03.19	03.18	03.17	03.16
0x0802	2050	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
0x0803	2051	-	-	-	-	-	-	-	-	-	-	-	-	06.03	06.02	06.01	06.00

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

Process output data: 4 Words

Figure 7-21: Modbus channel, read "xReset", FC03



2.2 Mapping:
"xReset" (global variable) to %IX0.0 in %IW0

- "xReset" is mapped to the first bit in %IW0 of BL67-8DI-PD at slot 2. 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.

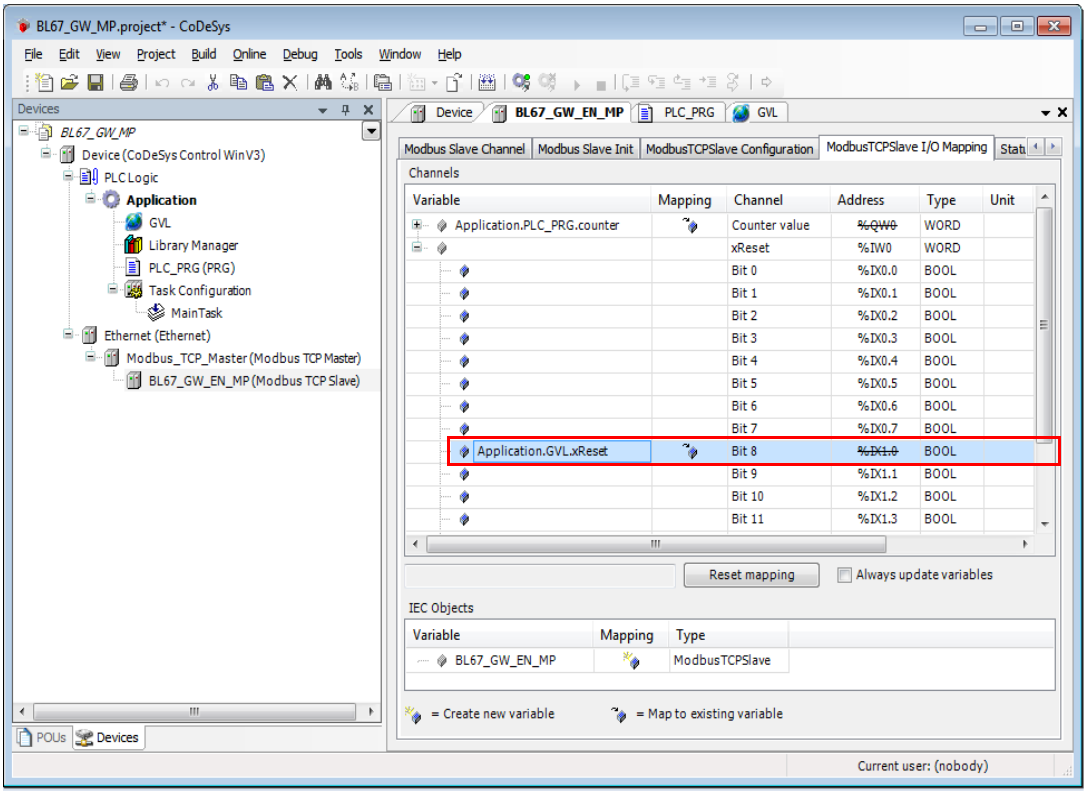


Figure 7-22: Mapping of "xReset" to bit %IX0.0

3 Read:
→Reading the station's Status Word

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

– Read Register, Offset:
0×0004 (see below)

– The station's Status Word is read from register 0×0004 and displayed in &IW1 in the Modbus TCP Slave I/O Mapping.

Figure 7-23: Status Word mapping acc. to Modbus report

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	05.15	05.14	05.13	05.12	05.11	05.10	05.09	05.08	05.07	05.06	05.05	05.04	05.03	05.02	05.01	05.00
0x0001	0001	05.31	05.30	05.29	05.28	05.27	05.26	05.25	05.24	05.23	05.22	05.21	05.20	05.19	05.18	05.17	05.16
0x0002	0002	05.47	05.46	05.45	05.44	05.43	05.42	05.41	05.40	05.39	05.38	05.37	05.36	05.35	05.34	05.33	05.32
0x0003	0003	05.63	05.62	05.61	05.60	05.59	05.58	05.57	05.56	05.55	05.54	05.53	05.52	05.51	05.50	05.49	05.48
0x0004	0004	02.07	02.06	02.05	02.04	02.03	02.02	02.01	02.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0005	0005	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
**0x0006	0006	-	-	-	-	-	-	-	-	-	-	M05	M04	M03	M02	M01	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: 7 Words

Figure 7-24: Setting the Modbus channel for reading the status word

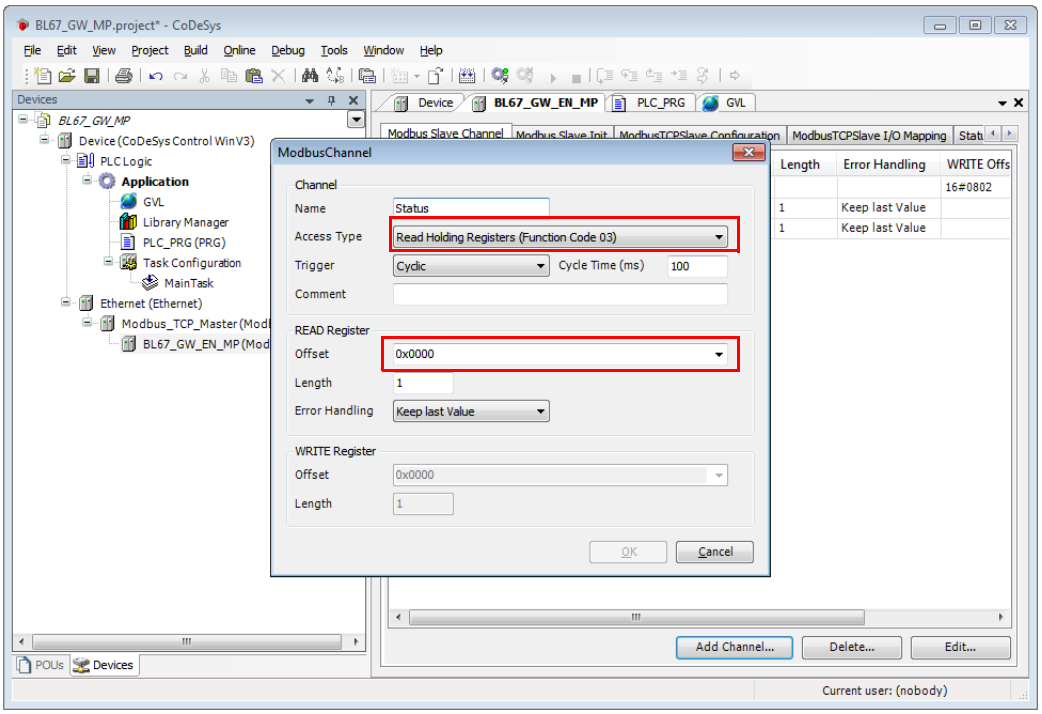
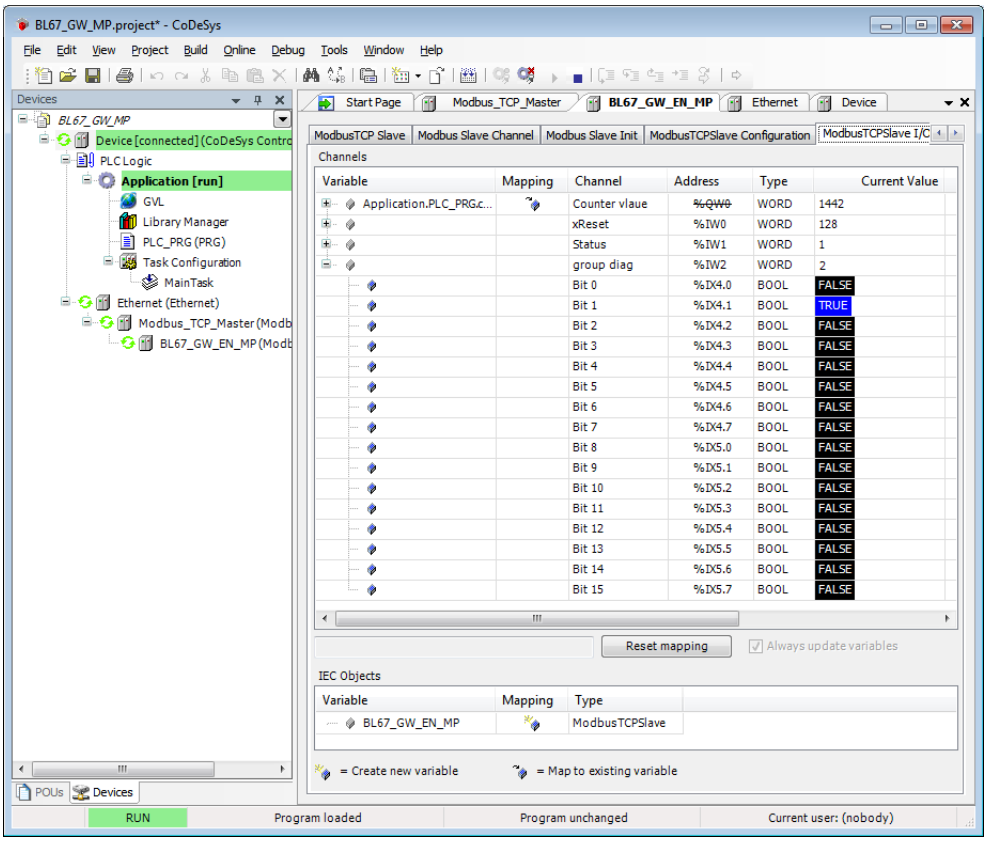


Figure 7-25: Status Word in the process image



4 Write:
Parameters of the station
→
Activating the output for channel 1 at slot 1 of the station BL67-8XSG-PD.

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 Abbildung 8: Setting the initialization channel for the parameterization).

– Access Type:
Write Single Register (function code **06**)

– Write Register, Offset:
0×B040 (see below)

The parameters of the station can be found in register 0×B040 to 0×B060.

Parameterization of the station

Activating the output for channel 1 at slot 1, Register 0×B001, bit 8.

The parameter register is build up as follows:

Figure 7-26: Assignment of parameter registers

2.4. Map for parameter data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
B000	0	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	8	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	0	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	8	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	1	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	9	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	1	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	9	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	2	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	10	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	2	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	10	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	3	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	11	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted
B001	3	1	1	BL67-8XSG-PD	Output at overcurrent	0 : automatic recovery 1 : controlled recovery
B001	11	1	1	BL67-8XSG-PD	Output	0 : deactivate 1 : activate
B000	4	1	1	BL67-8XSG-PD	Input filter	0 : deactivate 1 : activate
B000	12	1	1	BL67-8XSG-PD	Digital In	0 : normal 1 : inverted

A 2^8 = **256** will be written to register 0**×B001**, which results from the station's the parameter byte assignment.

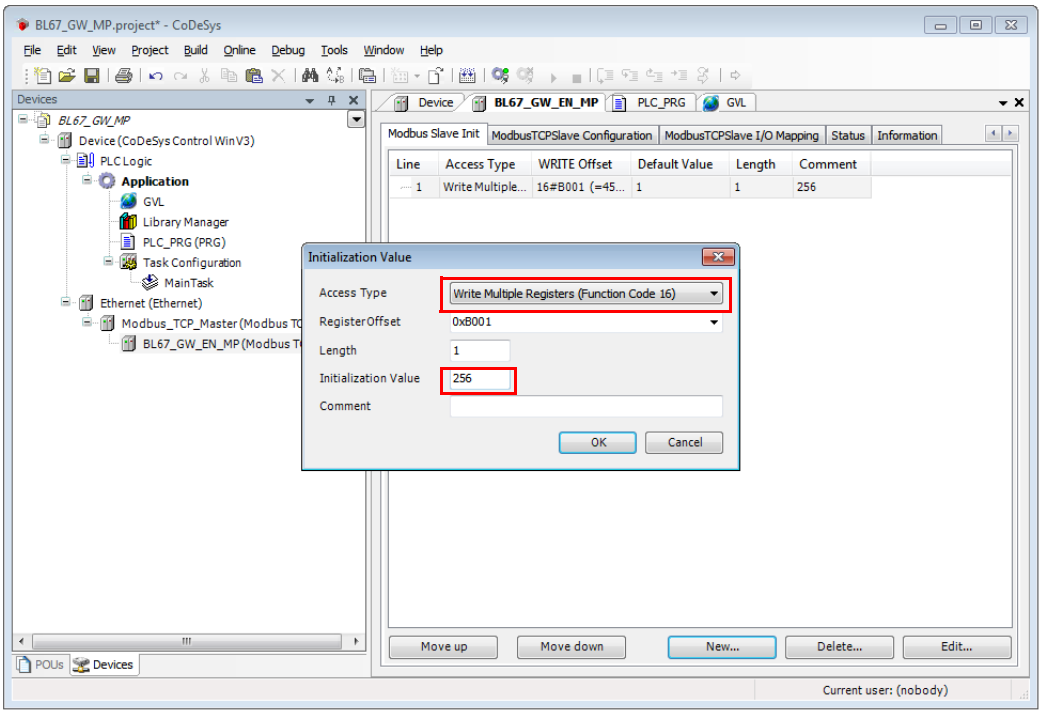
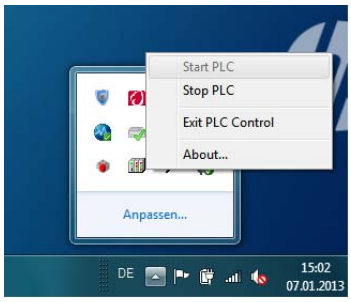


Abbildung 8: Setting the initialization channel for the parameterization

7.3.10 Building, login and start

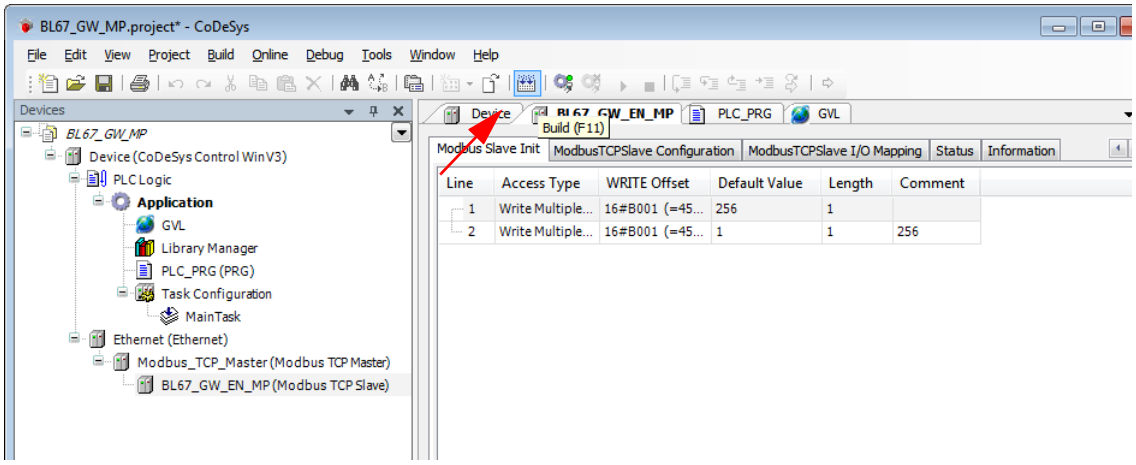
1 The WIN V3-PLC has to be running. This is done in the Windows-task bar:

Figure 7-1: Starting the WIN V3-PLC



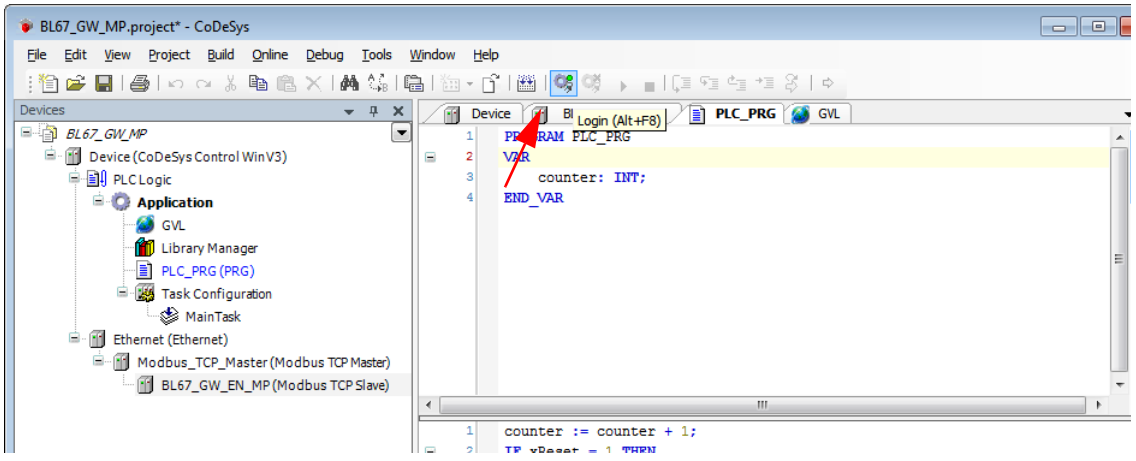
2 Building the program:

Figure 7-2: Building the program



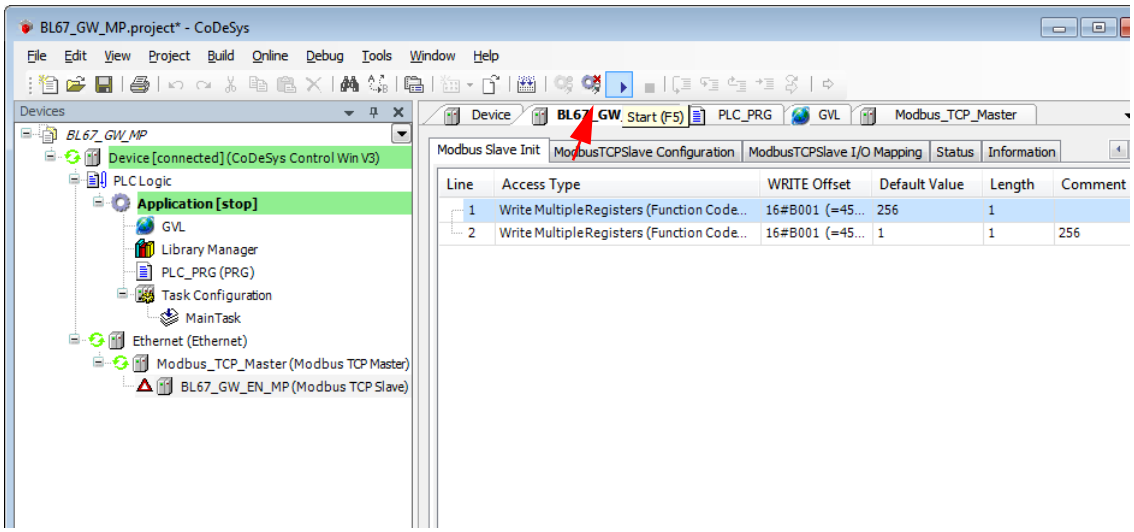
3 Login:

Figure 7-3: Login



4 Start the program:

Figure 7-4: Starting the program



7.3.11 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".

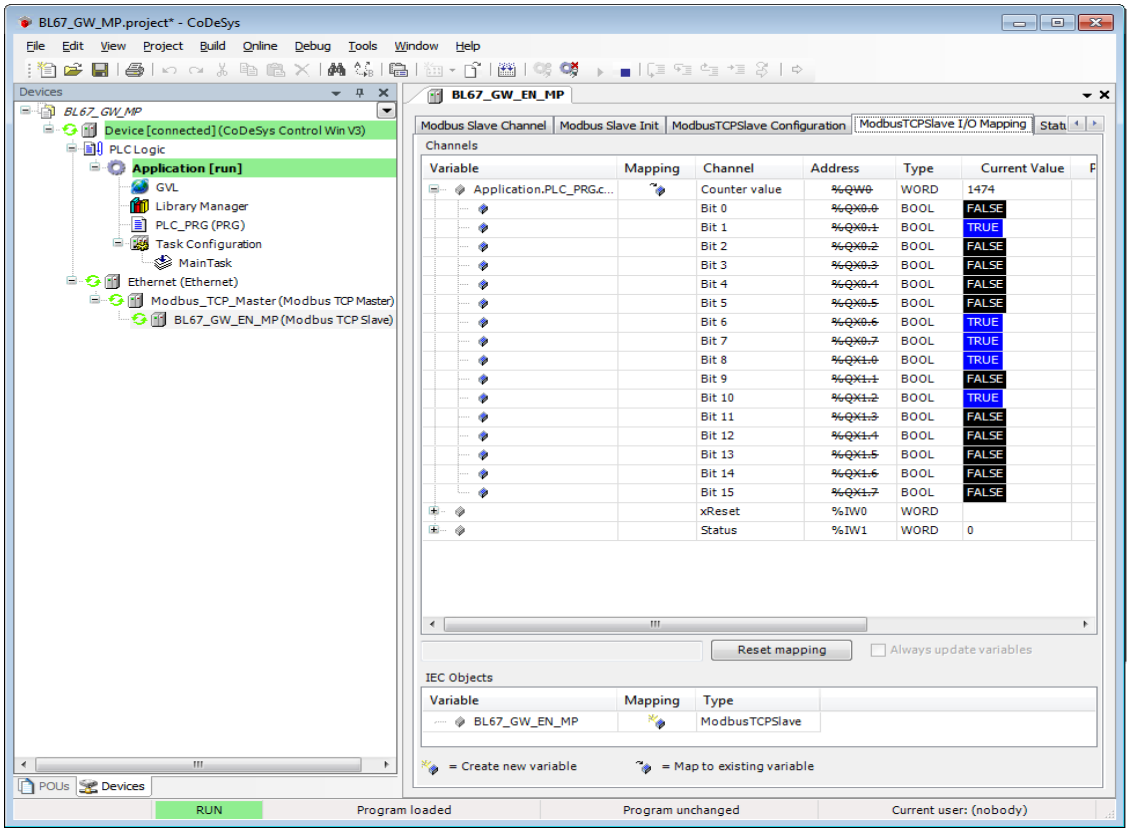


Figure 7-5: Modbus TCP Slave I/O image with process data

7.3.12 Diagnosis evaluation

Evaluation of the Status Word of the BL67-Station (%IW1)

Register 0×0005 contains the Status-word of the station (see Modbus data mapping (page 7-16)).

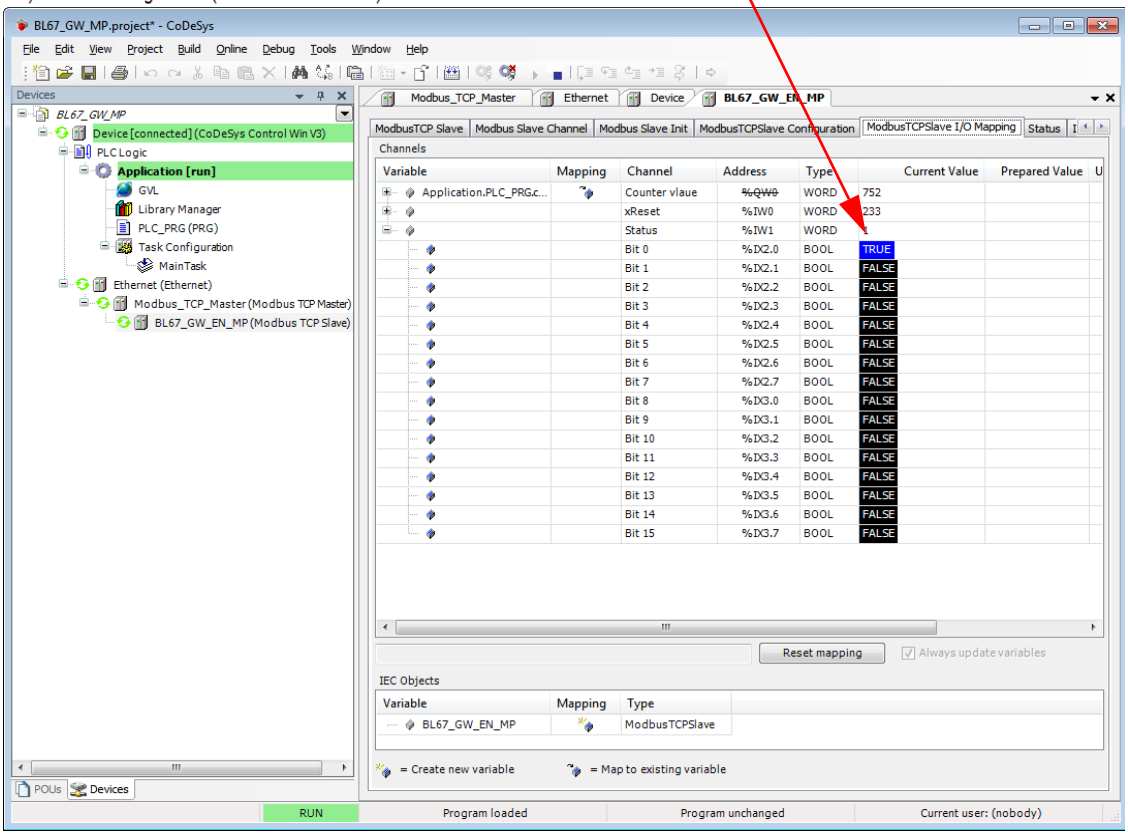
According to the definition of the Modbus communication channel (see Setting the Modbus-channels (examples) and data mapping (page 7-18), it is read from **%IW1** of the station image.

Figure 7-6: Status Word of the station

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	05.15	05.14	05.13	05.12	05.11	05.10	05.09	05.08	05.07	05.06	05.05	05.04	05.03	05.02	05.01	05.00
0x0001	0001	05.31	05.30	05.29	05.28	05.27	05.26	05.25	05.24	05.23	05.22	05.21	05.20	05.19	05.18	05.17	05.16
0x0002	0002	05.47	05.46	05.45	05.44	05.43	05.42	05.41	05.40	05.39	05.38	05.37	05.36	05.35	05.34	05.33	05.32
0x0003	0003	05.63	05.62	05.61	05.60	05.59	05.58	05.57	05.56	05.55	05.54	05.53	05.52	05.51	05.50	05.49	05.48
0x0004	0004	02.07	02.06	02.05	02.04	02.03	02.02	02.01	02.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0005	0005	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
**0x0006	0006	-	-	-	-	-	-	-	-	-	-	M05	M04	M03	M02	M01	M00

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



The message is to be interpreted as follows:

Status register
→ %IW 1, bit 0 = 1

→ Status message: "DiagWarn" = active diagnosis

at least one module at the gateway sends a diagnostic message (see also Register 100Ch: "Gateway status" (page 6-14)).

Register	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0×0005	0	U_L low	-	-	-	I/O Cfg Warn.	-	-	Diag Warn
	1	-	FCE	-	MB Wdg	I/O CFG	I/O COM	U_{sys} low	U_{sys} high

Evaluation on the group diagnosis

In order to identify the modules, which send diagnostic information, the group diagnosis register is read out. The group diagnosis register always follows the Status word of the gateway in the register mapping. Its position thus depends on the station configuration.

In this example, the group diagnosis register is register 0×0006. It contains on bit per module in the BL67-station, which displays whether the module sends diagnostic information or not.

The order of the bits in the registers corresponds to the order of the I/O-modules within the BL67-station.

Figure 7-7: Group diagnosis register

2. Modbus report

2.1. Station description

Station address: 192.168.1.7

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL67-GW-EN (>= VN 03-00)	192.168.1.7/BL67-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL67-8XSG-PD	01/BL67-8XSG-PD	8 bit	8 bit
2	BL67-8DI-PD	02/BL67-8DI-PD	8 bit	0 bit
3	BL67-2AO-I	03/BL67-2AO-I	0 bit	32 bit
4	BL67-8DO-0.5A-P	04/BL67-8DO-0.5A-P	0 bit	8 bit
5	BL67-4AI-V/I	05/BL67-4AI-V/I	64 bit	0 bit
6	BL67-4DO-2A-P	06/BL67-4DO-2A-P	0 bit	4 bit
	Local I/O data incl. status/control		6 Words	4 Words
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**7 Words**	**4 Words**

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

2.2. I/O map for input data

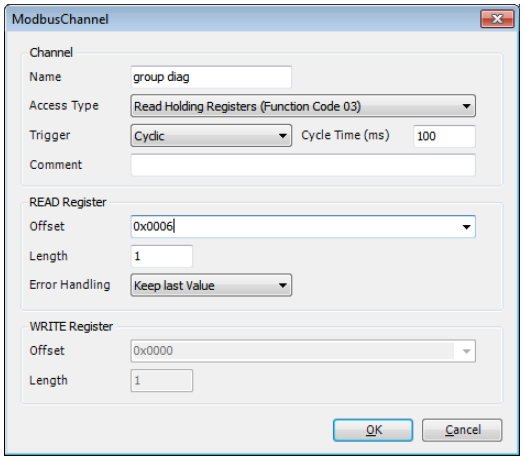
Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	0000	05.15	05.14	05.13	05.12	05.11	05.10	05.09	05.08	05.07	05.06	05.05	05.04	05.03	05.02	05.01	05.00
0x0001	0001	05.31	05.30	05.29	05.28	05.27	05.26	05.25	05.24	05.23	05.22	05.21	05.20	05.19	05.18	05.17	05.16
0x0002	0002	05.47	05.46	05.45	05.44	05.43	05.42	05.41	05.40	05.39	05.38	05.37	05.36	05.35	05.34	05.33	05.32
0x0003	0003	05.63	05.62	05.61	05.60	05.59	05.58	05.57	05.56	05.55	05.54	05.53	05.52	05.51	05.50	05.49	05.48
0x0004	0004	02.07	02.06	02.05	02.04	02.03	02.02	02.01	02.00	01.07	01.06	01.05	01.04	01.03	01.02	01.01	01.00
*0x0005	0005	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
**0x0006	0006	-	-	-	-	-	-	-	-	-	-	M05	M04	M03	M02	M01	M00

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

According to the examples for setting the Modbus channels (see Setting the Modbus-channels (examples) and data mapping (page 7-18)), the following channel is add to read out the group diagnosis register.

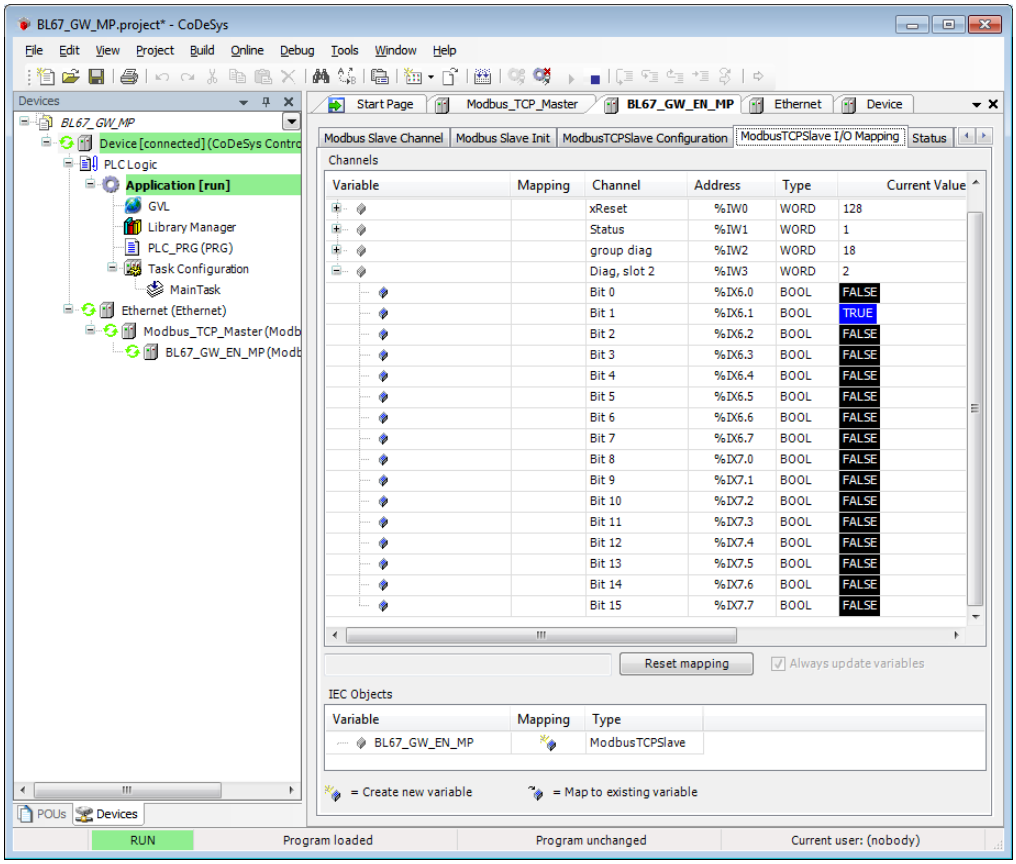
Read Holding Registers (FC3), register 0×0006, length 1

Figure 7-8: Channel for reading out the group diagnosis



In the example, the group diagnosis is in %IW2:

Figure 7-9: group diagnosis



→ bit 1 = 1

→ slot 2 sends diagnosis information

→ BL67-8DI-PD (see also Used hard-/software (page 7-2))

Evaluation of the module diagnosis information

The diagnosis data of module BL67-8DI-PD at slot 2 of the example station can be found in registers 0×A020 to 0×A03F (see also Modbus TCP-report (Figure 7-16: Modbus report - Mapping of parameter and diagnostic data (page 7-17)), whereby only register 0×A020 contains diagnosis information.

According to the examples for setting the Modbus channels (see Setting the Modbus-channels (examples) and data mapping (page 7-18)), the following channel is add to read out the module diagnosis.

Read Holding Registers (FC3), register 0×A020, length 1:

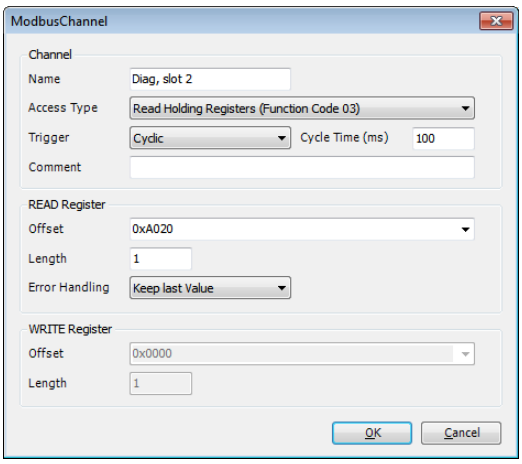
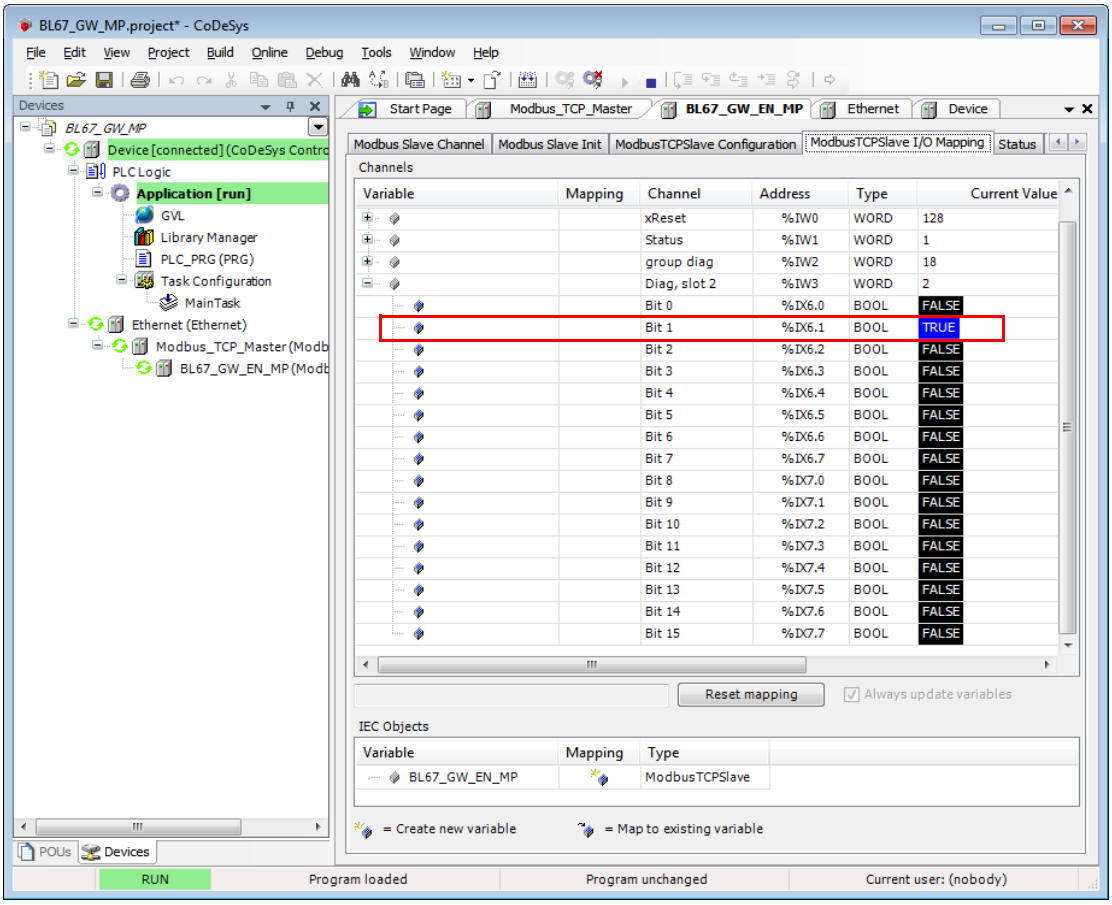


Figure 7-10: Diagnosis channel

%IW3 in the I/O image of the example station shows the diagnosis information available at slot 2:

Figure 7-11: Diagnosis data at slot 2



Meaning:
Bit 1: Overcurrent/short circuit sensor at channel 1

(see also Diagnostics of the I/O-modules (page 3-44))

Figure 7-12: Mapping of diagnosis data acc. to Modbus Report

2.5. Map for diagnostic data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
A000	0	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A000	8	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	1	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : -
A000	9	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	2	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A000	10	1	1	BL67-8XSG-PD	Overcurrent/short-circuit channel	0 : - 1 : activate
A000	3	1	1	BL67-8XSG-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
...	...			...	...	...
A020	0	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	8	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	1	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate
A020	9	1	2	BL67-8DI-PD	Open circuit	0 : - 1 : activate
A020	2	1	2	BL67-8DI-PD	Overcurrent/short-circ. Sensor	0 : - 1 : activate

8 Implementation of PROFINET

8.1 PROFINET

TECHNICAL BASICS

PROFINET is the innovative open standard for the implementation of end-to-end integrated automation solutions based on Industrial Ethernet. With PROFINET, simple distributed I/O and time-critical applications can be integrated into Ethernet communication just as well as distributed automation system on an automation component basis.

Distributed I/O with PROFINET

Distributed I/O is connected into communication through PROFINET. Here, the familiar I/O view of PROFIBUS is retained, in which the peripheral data from the field devices are periodically transmitted into the process model of the control system.

Device Model

PROFINET describes a device model oriented to the PROFIBUS framework, consisting of places of insertion (slots) and groups of I/O channels (sub slots). The technical characteristics of the field devices are described by the so-called GSD (General Station Description) on an XML basis.

Field bus integration

PROFINET offers a model for integration of existing field buses like PROFIBUS, AS-Interface, and INTERBUS.
This allows the construction of arbitrarily mixed systems consisting of fieldbus- and Ethernet-based segments. Thus a smooth technology transition is possible from fieldbus-based systems to PROFINET. The large number of fieldbus systems makes it necessary to support their simple integration into PROFINET for reasons of investment protection.
The integration is done with so-called "proxies". A proxy is a device which connects an underlying fieldbus with PROFINET. The proxy concept allows the device manufacturer, the plant and machine builder as well as the end user a high degree of investment protection.

Communications in PROFINET

Communications in PROFINET contain different levels of performance:
The non-time-critical transmission of parameters, configuration data, and switching information occurs in PROFINET in the standard channel based on UDP and IP. This establishes the basis for the connection of the automation level with other networks (MES, ERP).
For the transmission of time critical process data within the production facility, there is a Real-Time channel (RT) available.
For particularly challenging tasks, the hardware based communication channel Isochronous Real-Time (IRT) can be used for example in case of Motion Control Applications and high performance applications in factory automation.

UDP/IP communication

For non-time-critical processes, PROFINET uses communications with the standard Ethernet mechanisms over UDP/IP which follow the international standard IEEE 802.3.
Similar to standard Ethernet, PROFINET field devices are addressed using a MAC and an IP address. In UDP/IP communications, different networks are recognized based on the IP address. Within a network, the MAC address is a unique criterion for the addressing of the target device. PROFINET field devices can be connected to the IT world without limitations. A prerequisite for this is that the corresponding services, for instance file transfer, must be implemented in the field device involved. This can differ from manufacturer to manufacturer.

Real-time communication (RT)

A data communication over the UDP/IP channel is provided with a certain amount of administrative and control information for addressing and flow control, all of which slows data traffic.
To enable Real-Time capability for cyclical data exchange, PROFINET abandons partially IP addressing and flow control over UDP for RT communications. The communication mechanisms of the Ethernet (Layer 2 of the ISO/OSI model) are very suitable for this. RT communications can always run in parallel with NRT communications.

The services of PROFINET

– Cyclic data exchange
  For the cyclic exchange of process signals and high-priority alarms, PROFINET uses the RT channel.
– Acyclic data exchange (record data)
  The reading and writing of information (read/write services) can be performed acyclically by the user. The following services run acyclically in PROFINET:
  – parameterization of individual submodules during system boot
  – reading of diagnostic information
  – reading of identification information according to the "Identification and Maintenance (I&M) functions"
  – reading of I/O data

Address assignment

In IP-based communications, all field devices are addressed by an IP address.
PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.
In the delivery state each device amongst others has a MAC address. This information is enough to assign each field device a unique name (appropriate to the installation).
Address assignment is performed in two steps:
– Assignment of a unique plant specific name to the field device.
– Assignment of the IP address by the IO-Controller before system boot based on the plant specific (unique) name.

8.2 FSU - Fast Start-Up (prioritized startup)

8.2.1 General

TECHNICAL BASICS

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.

Ethernet-connection for BL67 in QC-/FSU-applications

NOTE

Please read Ethernet-connection for QC-/FSU-applications (page 3-13) for information about the correct Ethernet-cabling in FSU-applications with BL67.

8.2.2 FSU in BL67

The TURCK BL67-gateway BL67-GW-EN (VN ≥ 03-00) supports the prioritized startup FSU.

The following table contains a list of all electronic modules which are ready for FSU:

QuickConnect (QC) and Fast Start-Up (FSU) (page 3-6).

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

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

NOTE

Please read chapter 9, Fast Start-Up - configuration of fieldbus nodes (page 9-17).

8.3 MRP (Media Redundancy Protocol)

The BL67-GW-EN (≥ VN 03-04) supports MRP.

TECHNICAL BASICS

MRP is a standardized protocol according to IEC 62439. It describes a mechanism for media redundancy in ring topologies. A Media Redundancy Manager (MRM) checks the ring topology of a PROFINET network defined by the network configuration for functionality.
All other network nodes are Media Redundancy Clients (MRC).

NOTE

Detailed information about MRP in PROFINET can be found on the homepage of the PROFIBUS
user organization under www.profibus.com.

8.4 Address assignment

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.

The device name can be freely chosen.

NOTE

It is not necessary to address the station's internal module bus.

8.5 GSDML file

You can download the actual GSDML file for the gateway BL67-GW-PN "GSDML-V××-Turck-BL67-×××.xml" from our Homepage www.turck.com.

8.6 Default values

Default values:

IP address:	192.168.1.254
subnet mask:	255.255.255.0
name:	-

NOTE

When storing the device name or the IP address or when resetting the gateway to the default values, the GW-LED switches to orange.

During this time, the gateway's voltage supply must not be interrupted. In case of a power failure, faulty data will be stored in the gateway.

NOTE

Resetting the gateway is only possible when the station is not connected to the fieldbus (no AR active). (no AR active).

8.7 Diagnosis in PROFINET

In PROFINET, critical events (diagnostic messages) are reported acyclically as alarms.

In addition to information as slot-number, subslot-number, channel type etc., the diagnostic telegrams contain error codes which define the diagnostic event more precisely.

The error codes are interpreted by the PLC-software or respective function block, so that the diagnostic messages are normally displayed as plain text.

You will find an example of a diagnostic telegram in chapter 9, under Diagnostic telegram with error code (page 9-20).

Please read the following sections, for the meaning of the error codes of the BL67-gateway and the I/O-modules.

8.7.1 Gateway Error codes

Table 8-1: Gateway error codes

Value (dec.)	Diagnostics meaning for the gateway
Error codes (1 to 9 according to the standards)	
2	Undervoltage: Undervoltage channel 0: Undervoltage at U_{SYS} Undervoltage channel 1: Undervoltage at U_L
Error codes (16 to 31 manufacturer specific)	
16	Parameterization error This Error Code covers several gateway messages which can be specified more exactly using the TURCK software tool IO-ASSISNTANT (FDT/DTM) or the device's web server. – **Station configuration changed** The process data exchange is still running even if the current station configuration does not match the reference module list in the gateway (e.g. module pulled). – **Master- or I/O-configuration error**: The process data exchange is stopped, because – the actual module list has been changed and is incompatible (e.g. wrong module in station) or – the station configuration could not be prepared by the gateway to be read out. The station configuration set in the configuration software of the corresponding controller serves as a reference.
22	Communication error – **Module bus error** → Communication with the module bus station on the module bus is not possible.

8.7.2 Channel-specific error codes of the I/O-modules

The channel-specific diagnostic messages of the I/O-modules using error codes are defined as follows:

Table 8-2: Channel specific error codes

Value (dec.)	Diagnostics
Error codes (1 to 9 according to the standards)	
1	Short circuit
2	Undervoltage
4	Overload
5	Overtemperature
6	Wire break
7	Upper limit value exceeded
8	Underflow lower limit
9	Error
Error codes (16 to 28 manufacturer specific)	
16	Parameterization error After a validity check, the parameter data are (partially) rejected by the module. Check the context of parameters. Check the context of parameters.
21	Hardware error The module detected a hardware failure. Exchange the module.
22	Communication error The module detected a communication problem at its ports, e. g. RS232/485/422, SSI or other interface. Check the connection or the function of the attached devices.
23	Direction error The direction is detected to be wrong. Check the parameterization or the control interface versus use case.
24	User software error The module detected an user application software error.
25	Cold-junction compensation error The module detected a defect or missing cold-junction compensation.
26	Overload sensor supply The module detected an overload at the sensor supply.
28	Common error The module detected an error. Refer to the I/O-module manuals for a more detailed description of possible errors. Error types can depend on the operation mode and the parameterization.

Meaning of the PROFINET error codes for the BL67 I/O-modules

The gateway changes the diagnostic messages sent by the BL67 I/O-modules to PROFINET error codes.

The following table shows, which module message will be changed to which error code.

NOTE

The description of the diagnostics for the BL67 I/O modules is part of the user manual "BL67 I/O module" (D300529www.turck.de.

Table 8-3: Error Codes/ module diagnostics

Error code			Module diagnostics	
No. (dec.)	**Text**	**BL67**	**I/O module**	**Diagnostic message of the module**
1	Short circuit			
2	Undervoltage	BL67	BL67-PF-24VDC	Undervoltage VI/ Undervoltage VO/
			BL67-2RFID-×	Transceiver indicates power supply error
3	Overvoltage			
4	Overload			
4	Overload	BL67	BL67-2RFID-x	Ident-overcurrent (supply of transceiver is switched-off)
			BL67-4DI4DO-PD	Overcurrent
			BL67-8XSG-PD	
			BL67-1CNT/ENC	DIA_DOx
			BL67-1CVI	Overcurrent VC (at the valve power supply)
			BL67-2AI-PT	Short circuit
5	Overtemperature			
6	Wire break	BL67	BL67-×DI-PD	Wire break
			BL67-2AI-I	
			BL67-2AI-PT	
			BL67-2AI-TC	
			BL67-4AI-V/I	
			BL67-4AI4AO-V/I	
			BL67-1SSI	

Table 8-3: Error Codes/ module diagnostics

Error code			Module diagnostics	
No. (dec.)	**Text**	**BL67**	**I/O module**	**Diagnostic message of the module**
7	Upper limit value exceeded	BL67	BL67-1CNT/ENC	STS_OFLW (overflow)
			BL67-1SSI	Sensor value overflow
			BL67-×AI-×/ BL67-×AO-×	Measured value out of range
			BL67-2AI2AO-V/I	
8	Underflow lower limit	BL67	BL67-1CNT/ENC	STS_UFLW (underflow)
			BL67-1SSI	Sensor value underflow
			BL67-×AI-×/ BL67-×AO-×	Measured value out of range
			BL67-2AI2AO-V/I	
9	Error	BL67	BL67-1CVI	DiagNode x/DiagCVI: Emergencies transmitted since module start.
			BL67-×AO-×	Overflow/underflow OUFL
			BL67-4AO-V	
16	Parameterization error	BL67	BL67-1RS×××	Configuration error
			BL67-1SSI	
			BL67-1CNT/ENC	Parameterization error, ERR_PARA
			BL67-2RFID-×	Module parameter invalid
21	Hardware error	BL67	BL67-2RFID-×	Hardware failure transceiver
			BL67-1RS×××	Hardware error
			BL67-×AO-×	
22	Communication error	BL67	BL67-1CVI	Communication error transmitted since module start/Guard Time timeout Communication error/Guard Time timeout
			BL67-2RFID-×	Transceiver parameter not supported
			BL67-1RS×××	Data flow control error
23	Direction error			
24	User software error	BL67	BL67-2RFID-×	Software error

Table 8-3: Error Codes/ module diagnostics

Error code			Module diagnostics	
No. (dec.)	**Text**	**BL67**	**I/O module**	**Diagnostic message of the module**
25	Cold-junction compensation error	BL67	BL67-2AI-TC	Cold junction compensation Wire break
26	Overload sensor supply	BL67	BL67-×DI-PD	Overcurrent VC (at the valve power supply)
			BL67-4DI4DO-PD	
			BL67-8XSG-PD	
27	Unknown error			
28	Common error	BL67	BL67-1SSI	SSI group diagnostics
29	Configuration error			

.

8.8 Parameterization

8.8.1 Gateway parameters

The BL67-gateways for PROFINET occupy 4 parameter bytes.

Description of the gateway parameters

Table 8-4: gateway parameters

A *Default settings*

Byte	Bit Parameter	Value	Meaning
0	**Byte 0**		
	Bit 0 and bit 1 Output behavior, if 1 module missing		
	00	output 0 **A**	The gateway switches the outputs of modules to "0". No error information is transmitted. No error information is transmitted.
	01	output substitute value	The gateway switches the outputs of all modules to "0" (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
	10	hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
	11	exchange process data	The gateway carries on exchanging process data with the other module bus stations. No error information is transmitted.
	Bit 2 and bit 3 Output behavior, if 1 module wrong		
	00	output 0 **A**	The gateway switches the outputs of modules to "0". No error information is transmitted. No error information is transmitted.
	01	output substitute value	The gateway switches the outputs of all modules to "0" (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".

Table 8-4: gateway parameters

Byte	Bit	Parameter	Value	Meaning
		10	hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
		11	exchange process data	The gateway carries on exchanging process data with the other module bus stations. No error information is transmitted.
		Bit 4 and bit 5 Output behavior at communication loss		
		00	output 0 **A**	The gateway switches the outputs of modules to "0". No error information is transmitted. No error information is transmitted.
		01	output substitute value	The gateway switches the outputs of all modules to "0" (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
		11	hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
1		**Bit 0:** reserved		
		Bit 1: Deactivate all diagnostics		
		0	no **A**	Diagnostic messages and alarms are generated.
		1	yes	Diagnostic messages and alarms are generated.

A *Default settings*

Table 8-4: gateway parameters

A *Default settings*

Byte	Bit Parameter	Value	Meaning
1	**Bit 2:** Deactivate load voltage diagnostics		
	0	no **A**	A monitoring of the field supply V_O (from the gateway and the Power-Feeding modules) is activated. If this parameter is set but the parameter "Diagnostics from modules" (see bit 1) deactivated, then only the voltage supply at the gateway is monitored. The voltage supply with V_O at the Power-Feeding modules is not monitored at the power feeding modules.
	1	yes	An possible over- or undervoltage for V_O is not monitored.
	Bit 3: reserved		
	Bit 4: Deactivate I/O-ASSISTANT Force Mode		
	0	no **A**	-
	1	yes	The I/O-ASSISTANT is not able to access the gateway via Force Mode.
	Bit 5: reserved		
	Bit 6: Startup if configuration does not match		
	0	no **A**	Changes in the station configuration are stored in the gateway following a power-on reset.
	1	yes	If the static configuration is deactivated, a dynamic configuration take-over is realized directly following station configuration changes (important for acyclic parameterization).
	Bit 7: reserved		
2	**Bit 0:** Deactivate EtherNet/IP		
	0	no **A**	Explicit deactivating of the other Ethernet-protocols as well as of the web server.
	1	yes	
	Bit 1: Modbus TCP deactivated		
	0	no **A**	
	1	yes	
	Bit 2 to Bit 7: reserved		
3	**Bit 0 to Bit 6**: reserved		
	Bit 7: Web server deactivated		
	0	no **A**	Explicit deactivating of the web server
	1	yes	

8.8.2 I/O module parameters

The description of the parameters for the BL67 I/O modules is part of the user manual "BL67 I/O module" (**D300529**) at www.turck.de.

8.9 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 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)
- Reading of differences between the expected and the actually plugged modules

8.9.1 Description of the acyclic gateway user data

Table 8-5: Gateway Application Instance

Index	Name	Data Type	r/w	Comment
1 (0×01)	Gateway parameters	WORD	r/w	Parameter data of the module
2 (0×02)	Gateway Designation	STRING	r	Product name of the gateway
3 (0×03)	Gateway revision	STRING	r	Firmware-revision of the gateway
4 (0×04)	Vendor ID	WORD	r	Ident number for TURCK
5 (0×05)	Gateway name	STRING	r	Name assigned to the gateway
6 (0×06)	Gateway type	STRING	r	Device type of the gateway
7 (0×07)	Device ID	WORD	r	Ident number of the gateway
8 (0×08) to 23 (0×17)	reserved			
24 (0×18)	Gateway diagnosis	WORD	r	Diagnosis data of the gateway
025 (0×19) to 31 (0×1F)	reserved			
32 (0×20)	Module input list	Array of BYTE	r	List of all input channels in the station
33 (0×21)	Module output list	Array of BYTE	r	List of all output channels in the station

Table 8-5: Gateway Application Instance

Index	Name	Data Type	r/w	Comment
34 (0×22)	Module diag. list	Array of BYTE	r	List of all module diagnosis messages
35 (0×23)	Module parameter list	Array of BYTE	r	List of all module parameters
36 (0×24) to 45039 (0×AFEF)	reserved			
45040 (0×AFF0)	I&M0-functions		r	Identification & Maintenance
45041 (0×AFF1)	I&M1-functions	STRING[54]	r/w	not supported
45042 (0×AFF2)	I&M2-functions	STRING[16]	r/w	
45043 (0×AFF3)	I&M3-functions	STRING[54]	r/w	
45044 (0×AFF4)	I&M4-functions	STRING[54]	r/w	
45045 (0×AFF5)	I&M5-functions			
28672 (0×7000)	Gateway parameters	WORD	r/w	activating/ deactivating the Ethernet-protocols (see also Gateway parameters (page 8-12))

8.9.2 Description of the acyclic module user data

Table 8-6: Module user data

Index	Name	Data type	r/w	Comment
1 (0×01)	Module parameters	specific	r/w	Parameter of the module
2 (0×02)	Module type	ENUM UINT8	r	Module type
3 (0×03)	Module version	UINT8	r	Firmware-revision of the module
4 (0×04)	Module ID	DWORD	r	Ident number of the module
5 (0×05) to 18 (0×12)	reserved			

	19 (0×13)	Input data	specific	r	Input data of the respective module
	20 (0×14) to 22 (0×16)	reserved			
	23 (0×17)	Output data	specific	r/w	Output data of the respective module
	24 (0×18) to 31 (0×1F)	reserved			
	32 (0×20) to 255 (0×FF)	Profile specific	These indices are reserved for the data of several module profiles (e. g. RFID). The definitions of the profile indices can be found in the respective module descriptions.		

9 Application example: BL67-GW-EN with PROFINET (S7)

9.1 Application example

9.1.1 General

In order to configure the connection of a BL67 multi-protocol gateway for PROFINET to a Siemens PLC S7, the software package "SIMATIC Manager" version 5.5 from Siemens is used.

9.1.2 Example network

- Siemens PLC S7, CPU 315-2 PN/DP, 6ES7 315-2EH14-0AB0, V3.2
  - Device name: pn-io
  - IP address: 192.168.1.112
- FGEN-IOM88-5001
  - Device name: turck-fgen-107
  - IP-address: not assigned, yet
- FGEN-XSG16-5001
  - Device name: turck-fgen-90
  - IP-address: not assigned, yet
- BL67-GW-EN
  Gateway for connecting PROFINET to the BL67 example station (see Table 9-1: Example station).
  - Device name: not assigned, yet
  - IP-address: not assigned, yet

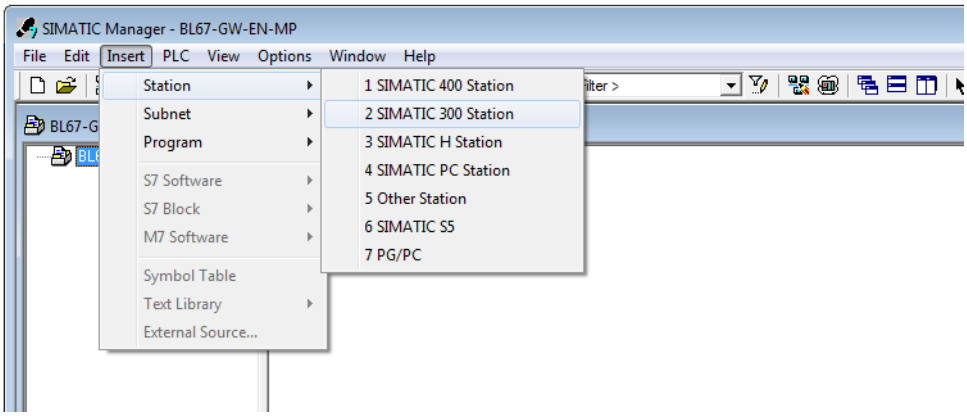
Table 9-1: Example station

Module		Data width	
		Process input	Process output
GW	BL67-GW-EN		
1	BL67-8XSG-PD	8 Bit	8 Bit
2	BL67-8DI-PD	8 Bit	-
3	BL67-2AO-I	-	4 byte
4	BL67-8DO-0.5A-P	-	8 Bit
5	BL67-4AI-V/I	8 byte	-
6	BL67-4DO-2A-P	-	4 Bit

9.1.3 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 9-1: Selecting a SIMATIC station



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

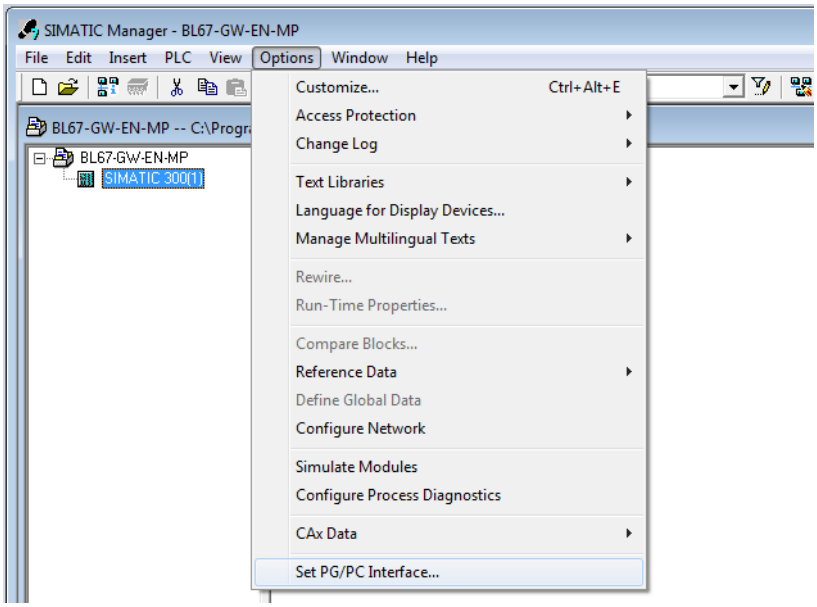
9.1.4 Setting the PG/PC-interface

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.

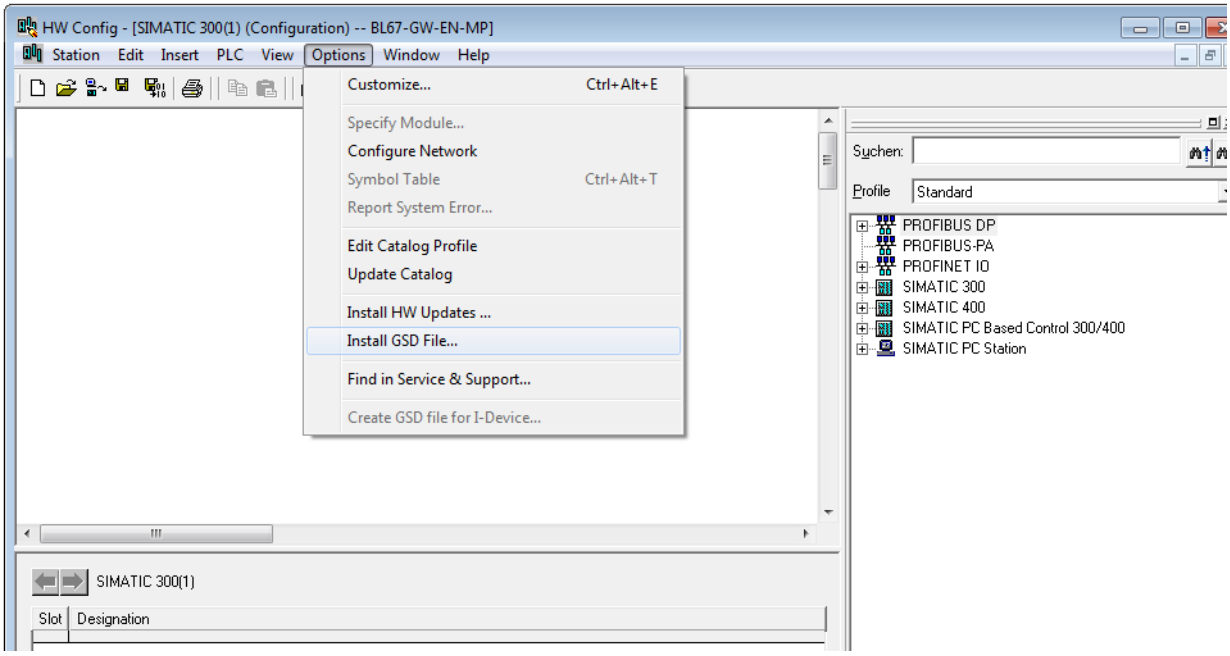
Figure 9-2: Command "Set PG/PC Interface..."



9.1.5 Installation of the GSDML-files

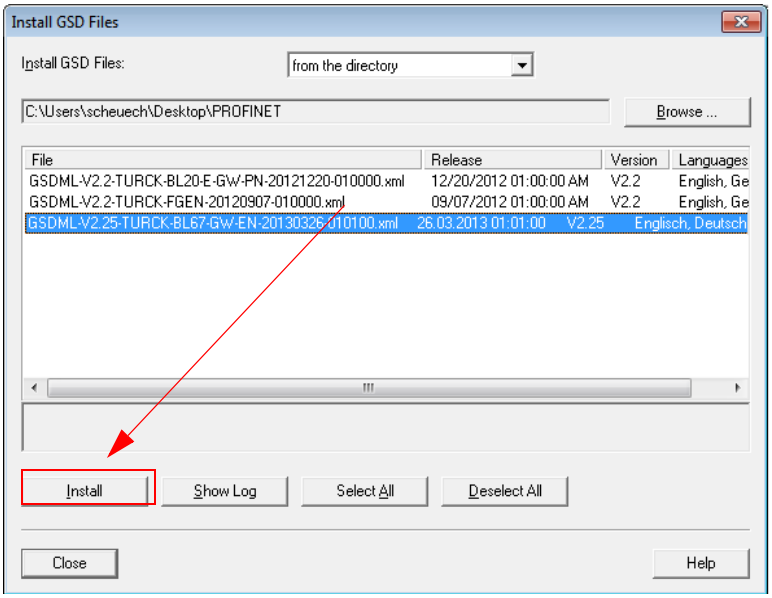
1 In the hardware configuration "HW config", open the "Options→ Install GSD file" command in order to install new GSD-files.

Figure 9-3: Install GSD-file



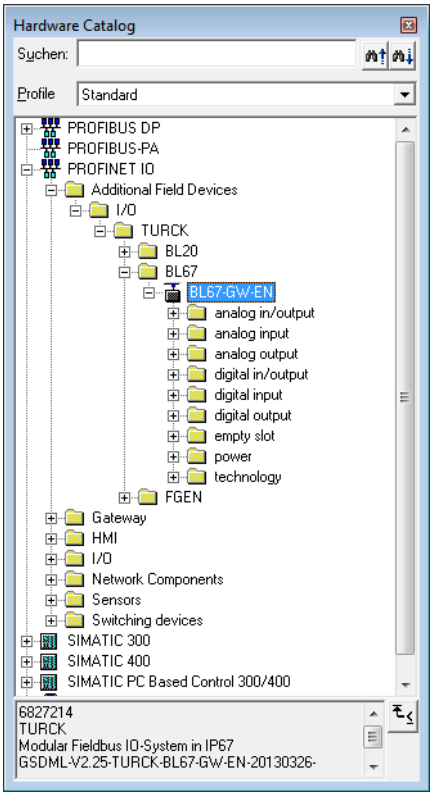
2 Define the directory for the TURCK GSDML-files by browsing the directories and add the BL20 PROFINET gateway to the hardware catalog.

Figure 9-4: Install GSDML file



The new gateway can now be found under "PROFINET IO → Additional Field Devices → I/O → TURCK".

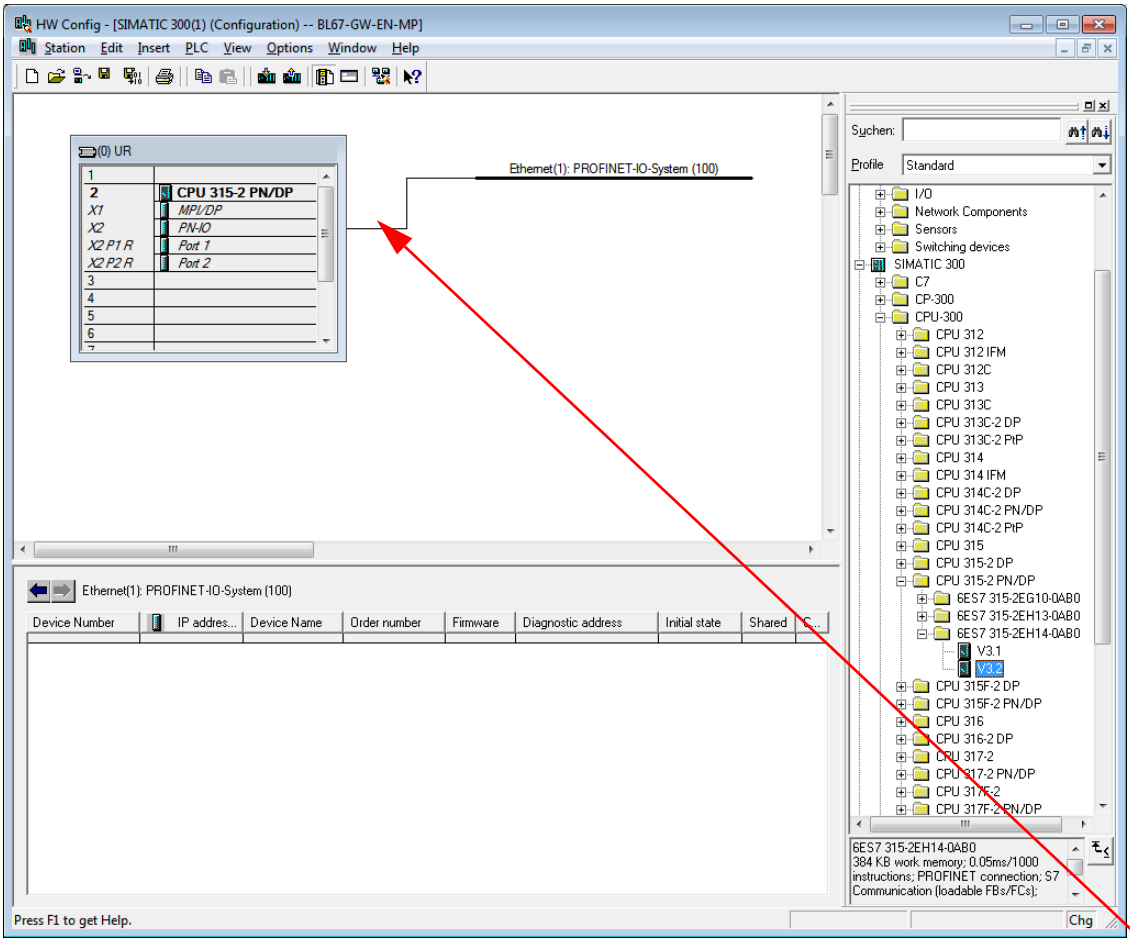
Figure 9-5: BL67-gateway in Hardware Catalog



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 9-6: 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 9-7: Properties Ethernet interface

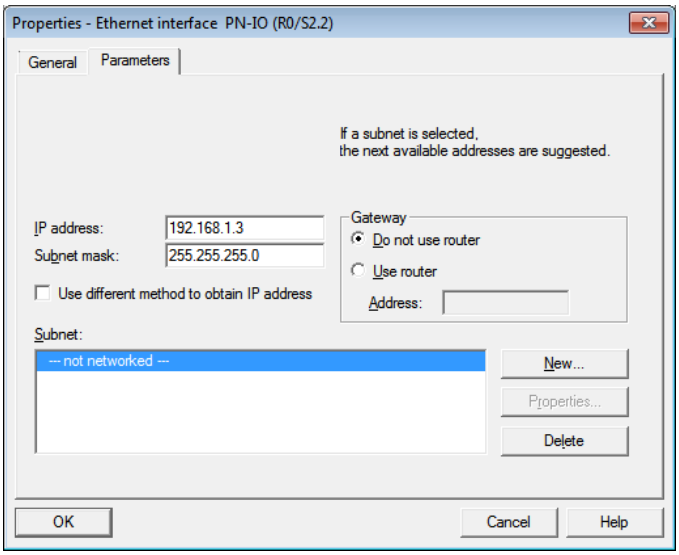
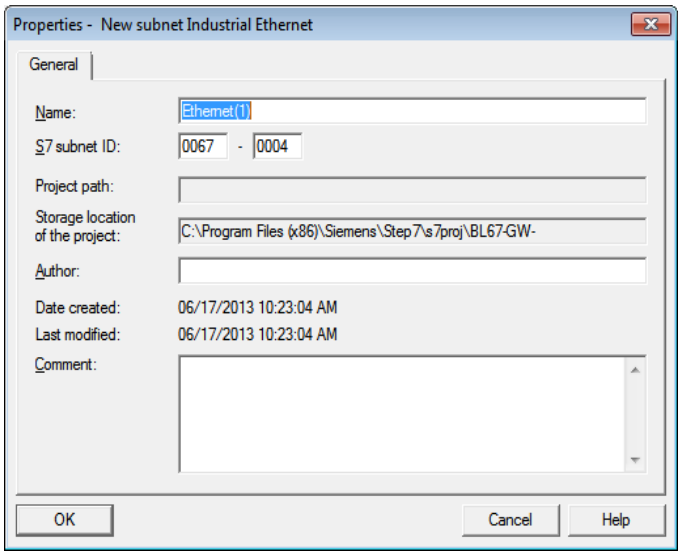


Figure 9-8: Add new Ethernet subnet

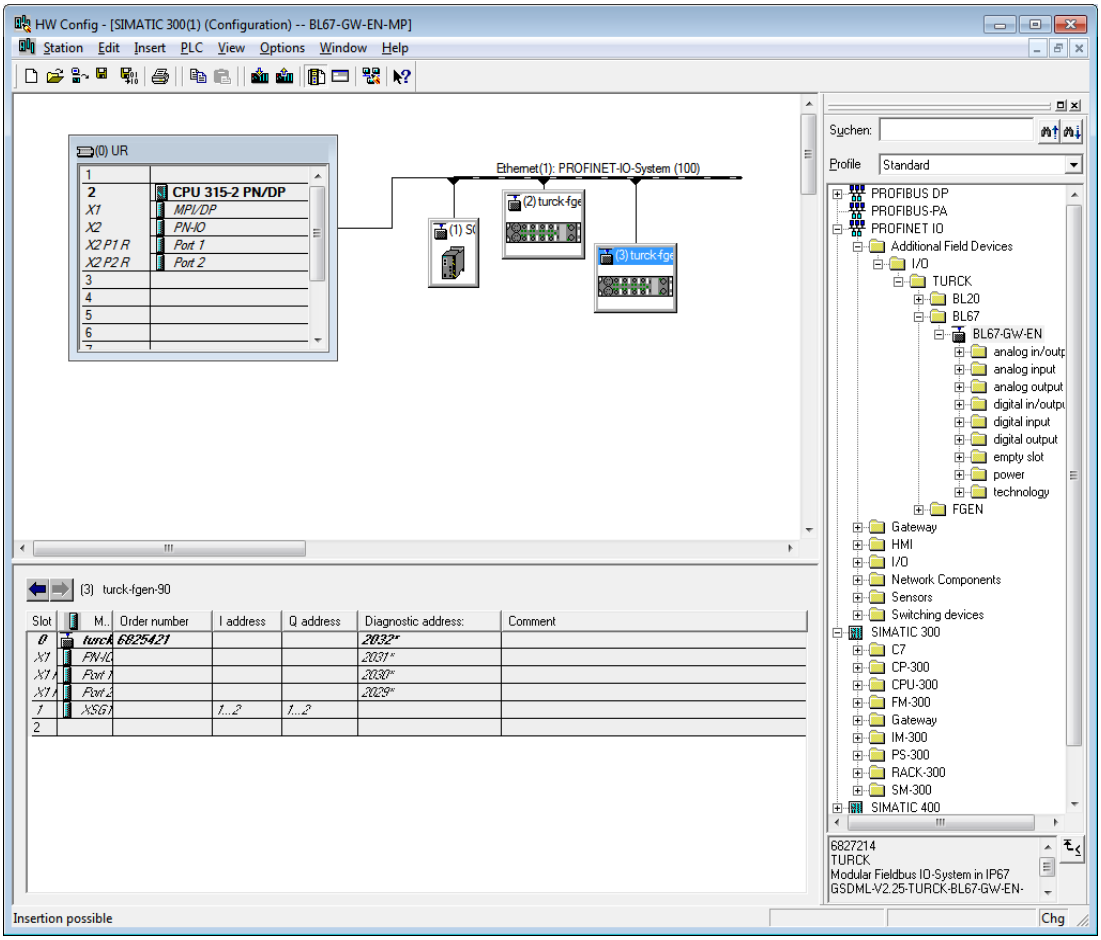


9.1.6 Adding PROFINET network nodes

The nodes of the example network (see page 9-2) are added to the PROFINET as follows:

- FGEN
  - FGEN-IOM88-5001, device name: turck-fgen-107
  - FGEN-XSG16-5001, device name: turck-fgen-90

Figure 9-9: Add network nodes



Adding a BL67-gateway and configuring the BL67-station

Now, the BL67-gateway is selected from the Hardware Catalog and added to the configuration

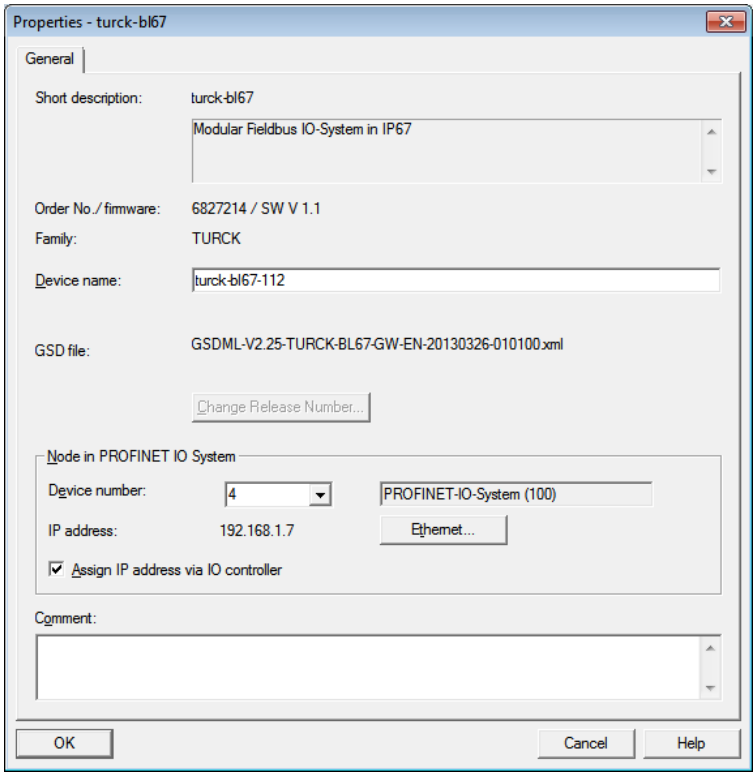
- BL67-GW-EN,
  - Device name: not assigned, yet
  - IP-address: not assigned, yet

1 Select the gateway under "PROFINET IO → Additional Field Devices→ I/O → TURCK → BL67" and add it to the Ethernet-network.

2 A double-click on the gateway-symbol opens the dialog "Properties TURCK".

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

Figure 9-10: Dialog: Properties TURCK



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.

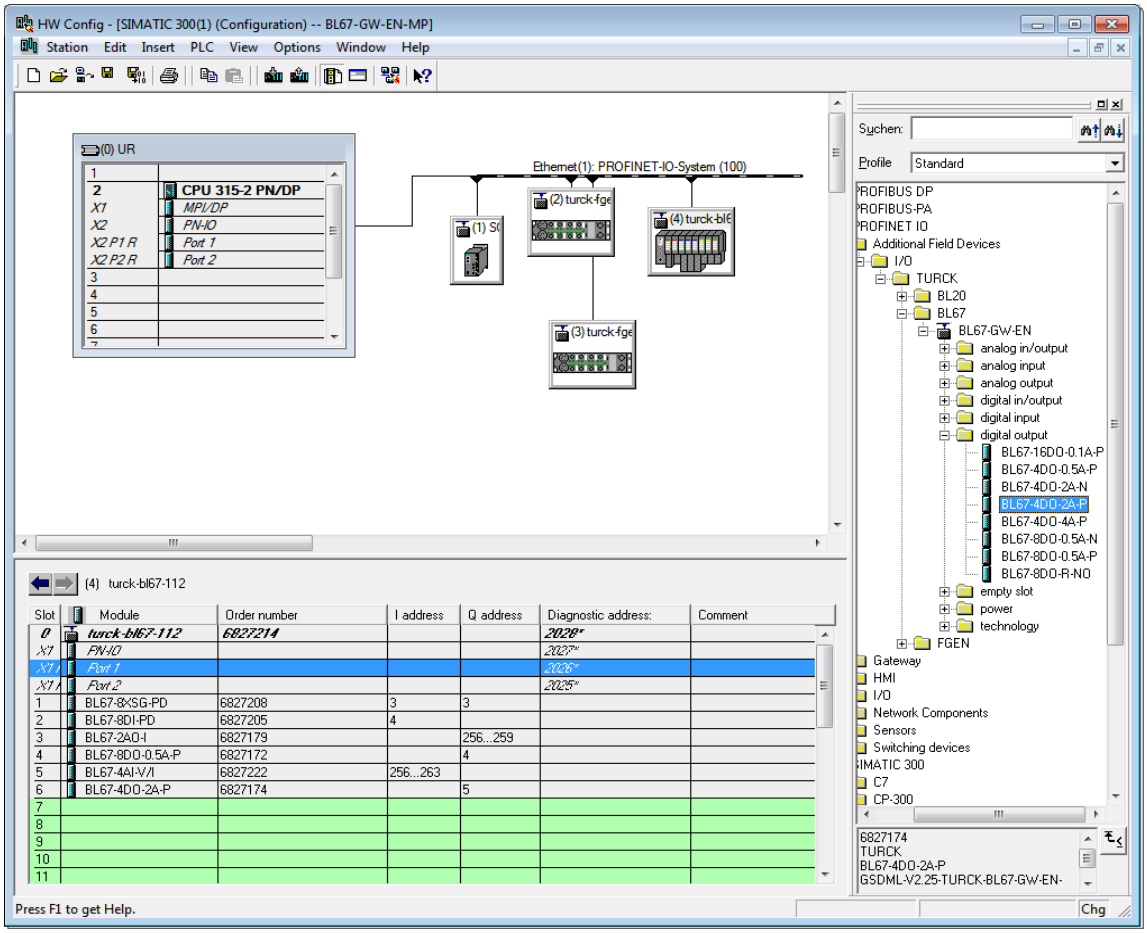
NOTE

When storing the device name or the IP address or when resetting the gateway to the default values, the GW-LED switches to orange. During this time, the gateway's voltage supply must not be interrupted. In case of a power failure, faulty data will be stored in the gateway.

9.1.7 Configuring the BL67-station

After the assignment of the device name, the I/O modules, which are connected to the BL67 gateway, are added to the station. They have to be selected from the Hardware Catalog in the same order as they appear physically in the station.

Figure 9-11: Add I/O-modules to the station
Add a station



1 Save your hardware configuration via "Station → Save and Compile"

2 and download it to the PLC via "PLC → Download..." command.

The hardware configuration is completed.

NOTE

If changes in the configuration of a node are made after the download of the configuration and the starting of the PLC, PROFINET requires a reset for the respective device.

This can be done following different ways:

Hardware reset:

– F_RESET at the gateway (see also F_Reset (reset to factory settings, 900) (page 3-22)

Software reset:

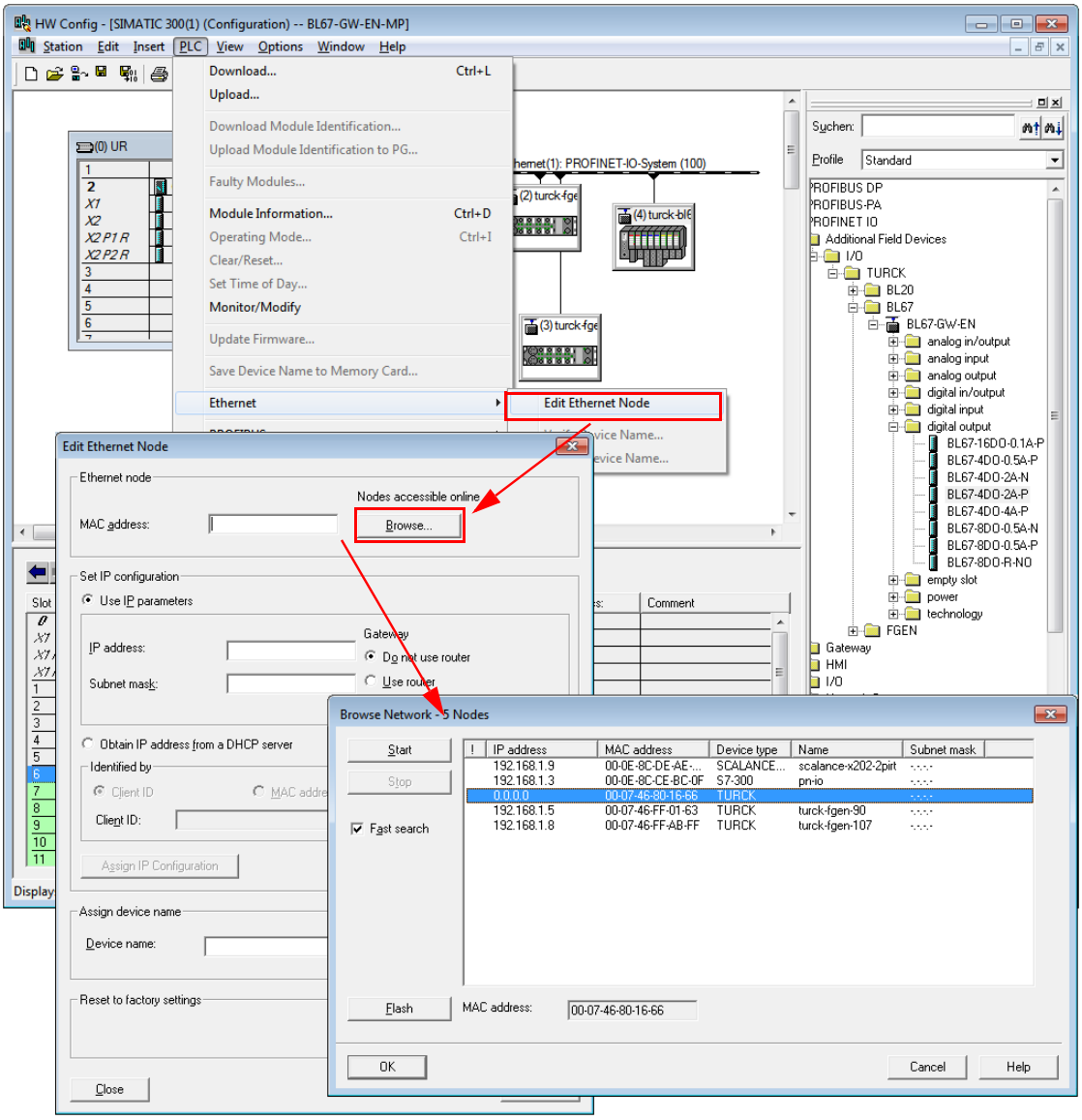
– HW Config: Select a node via "PLC → Ethernet → Edit Ethernet Node...→ Browse" and execute the reset in the dialog box "Edit Ethernet Node..." via "Reset".
– other PROFINET-tool (PST-tool from Siemens, etc.)

9.1.8 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".

Figure 9-12: Configure 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, their IP address and, if available, their device name actually stored in the device.

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".

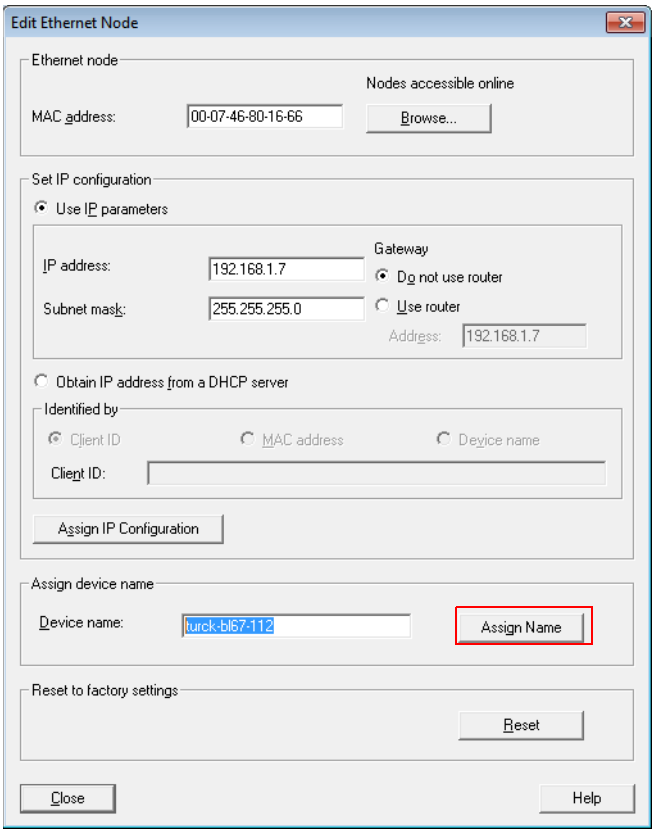
Device name assignment BL67-gateway

If necessary, the device name can now be changed to the needs of the application.

In this example, the following name is assigned to the BL67-gateway:

- Device name: turck-bl67-112

Figure 9-13: 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 9-10: Dialog: Properties TURCK).

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

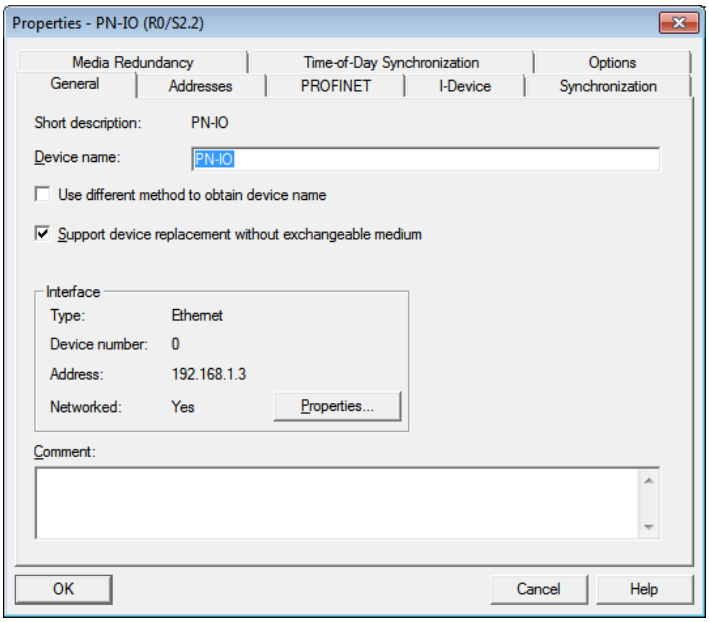
9.1.9 PROFINET neighborhood detection via LLDP

Due to the neighborhood detection, there is no previous PROFINET name assignment (see Device name assignment BL67-gateway (page 9-12) 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 9-14)).

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 9-14: 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.

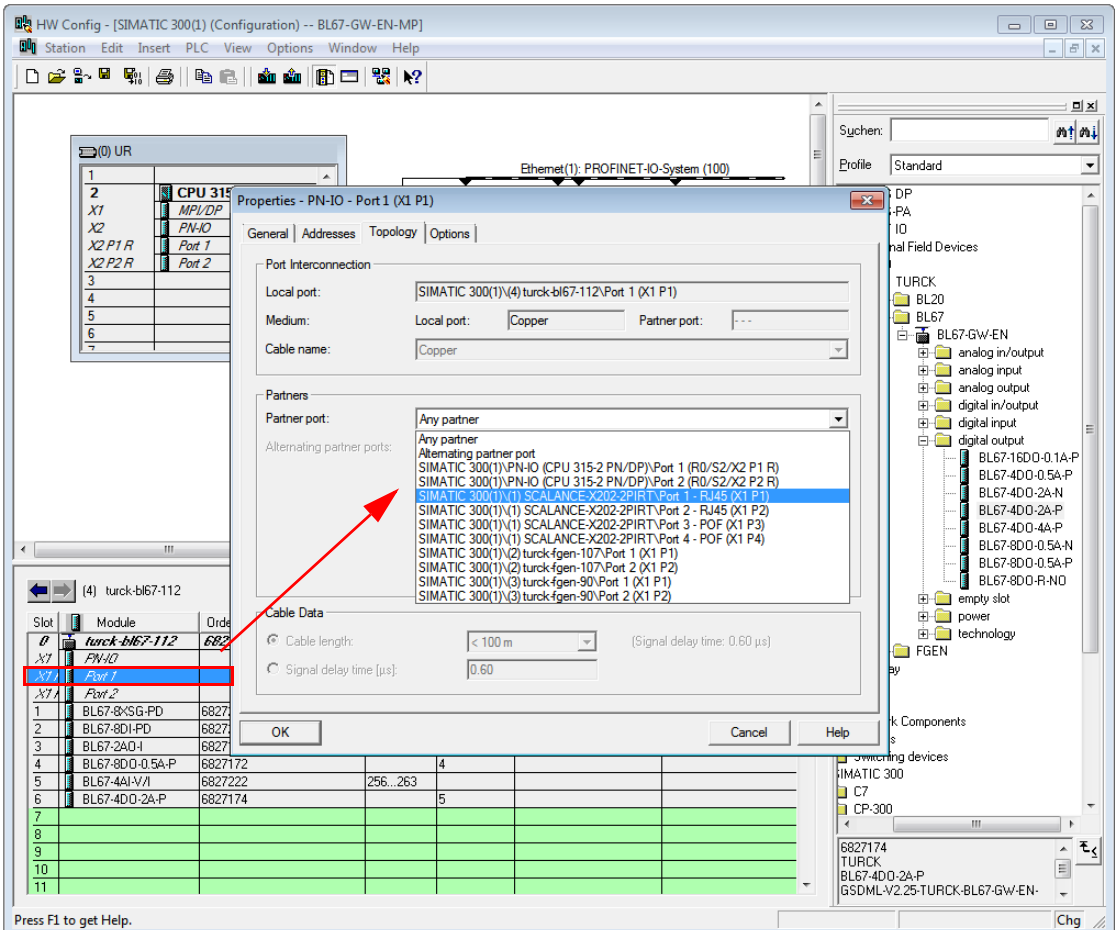
Configuring the neighborhood detection

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 9-15).

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

Figure 9-15: 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.

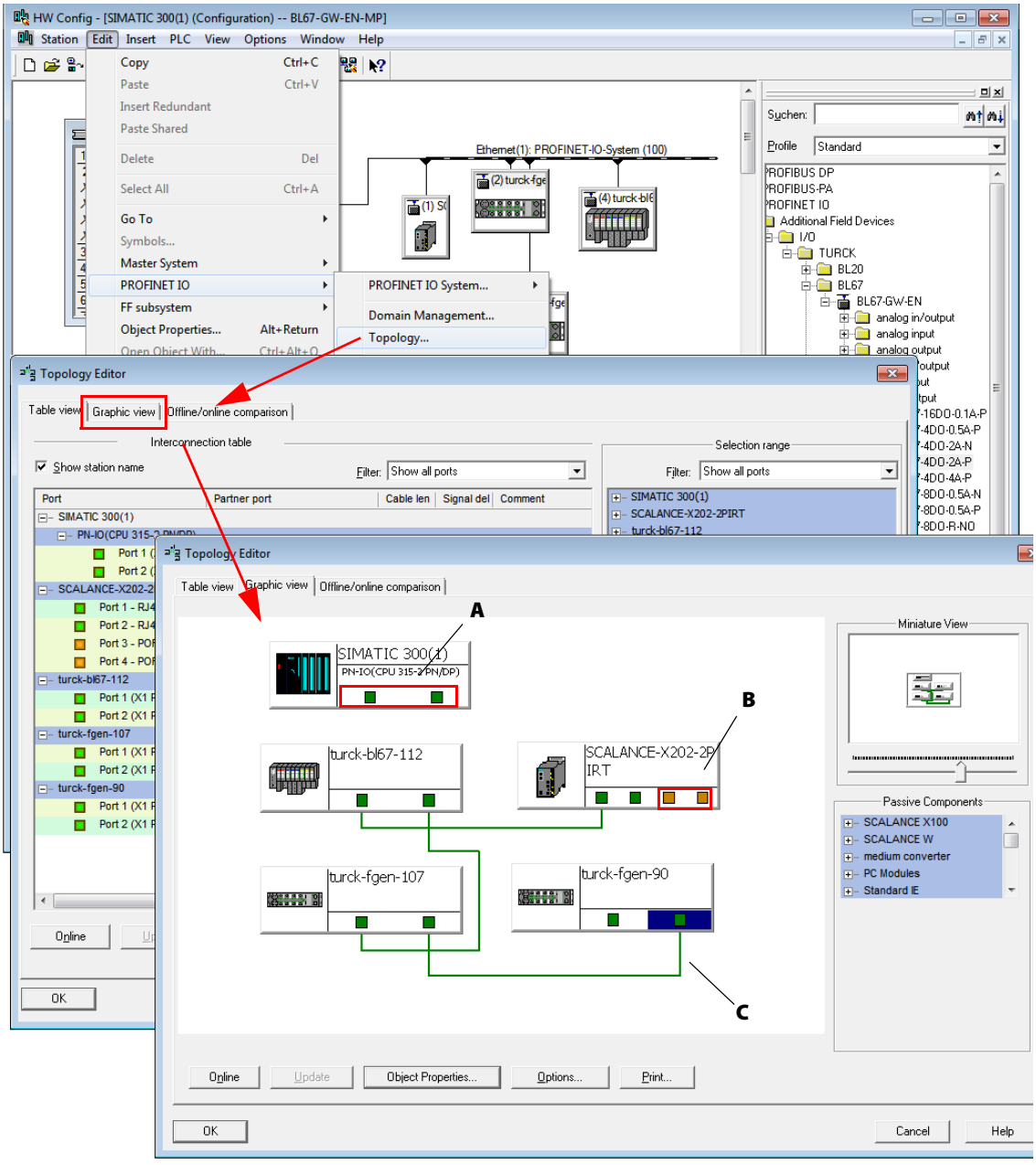


Figure 9-16: PROFINET Topology editor

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

9.1.10 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.

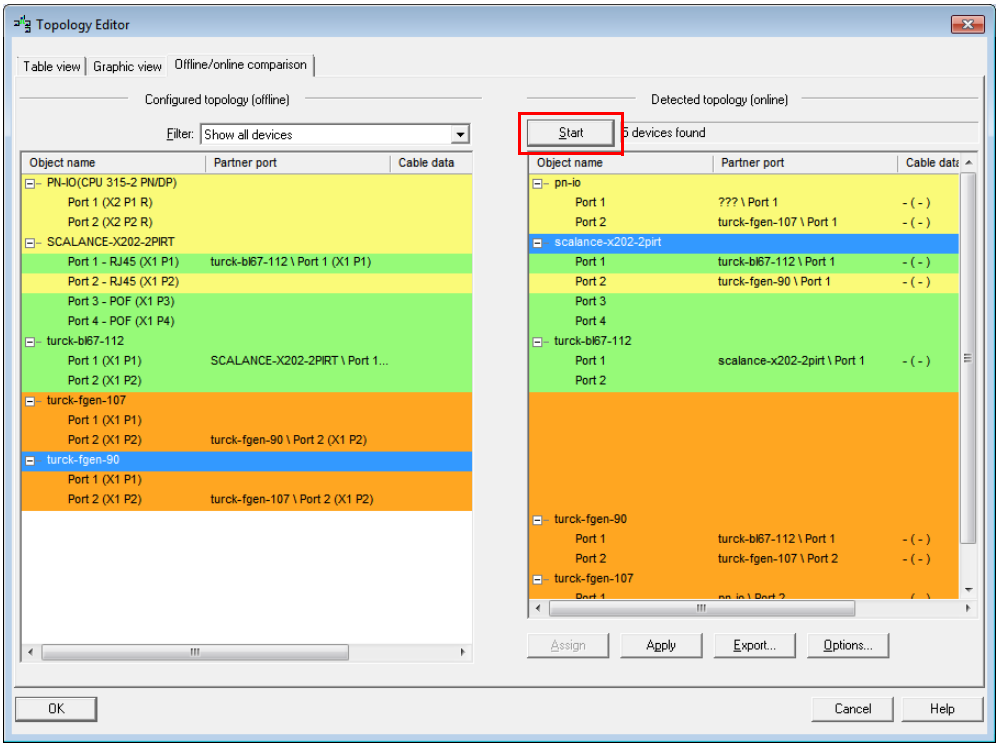


Figure 9-17: PROFINET Topology editor Offline/ online comparison

9.1.11 Fast Start-Up - configuration of fieldbus nodes

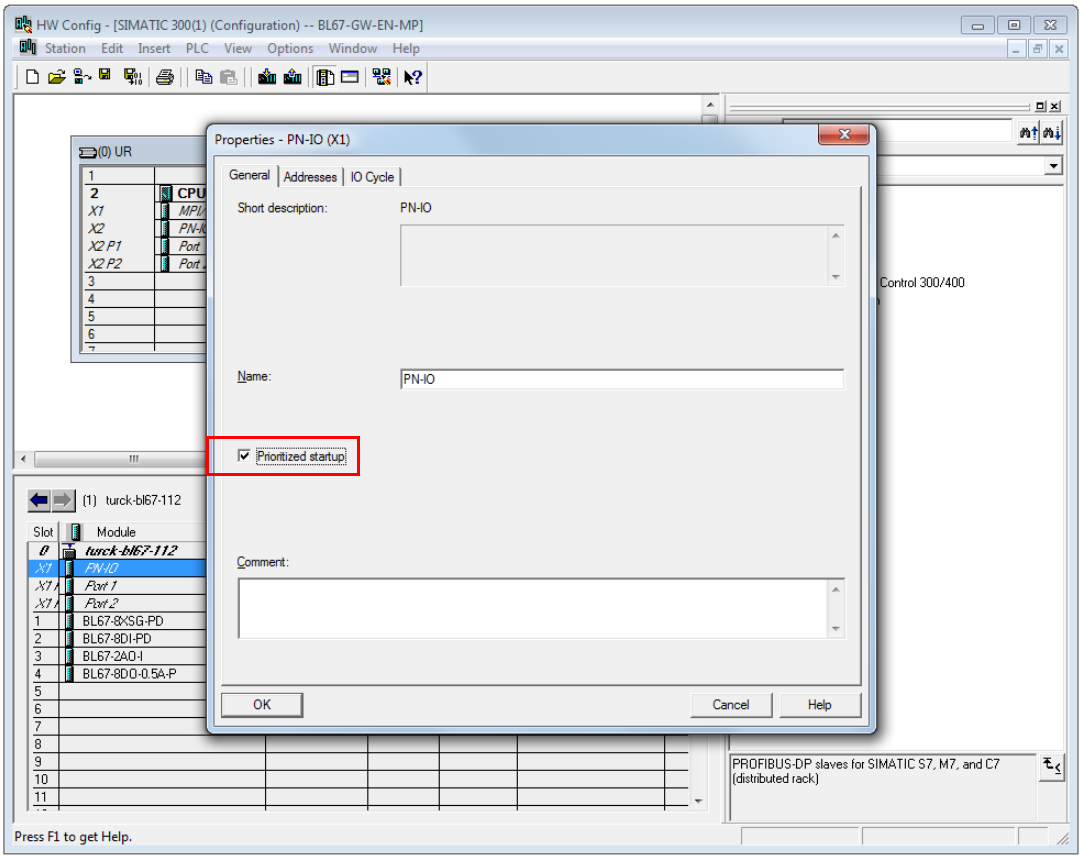
Fast Start-Up has always to be configured for both neighboring nodes.

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:

The following figure shows the activation of the prioritized start-up using the example of the node turck-bl67-112:

Figure 9-18: Prioritized stat-up - activation at PN-IO



NOTE

The neighboring node has to be configured respectively.

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:

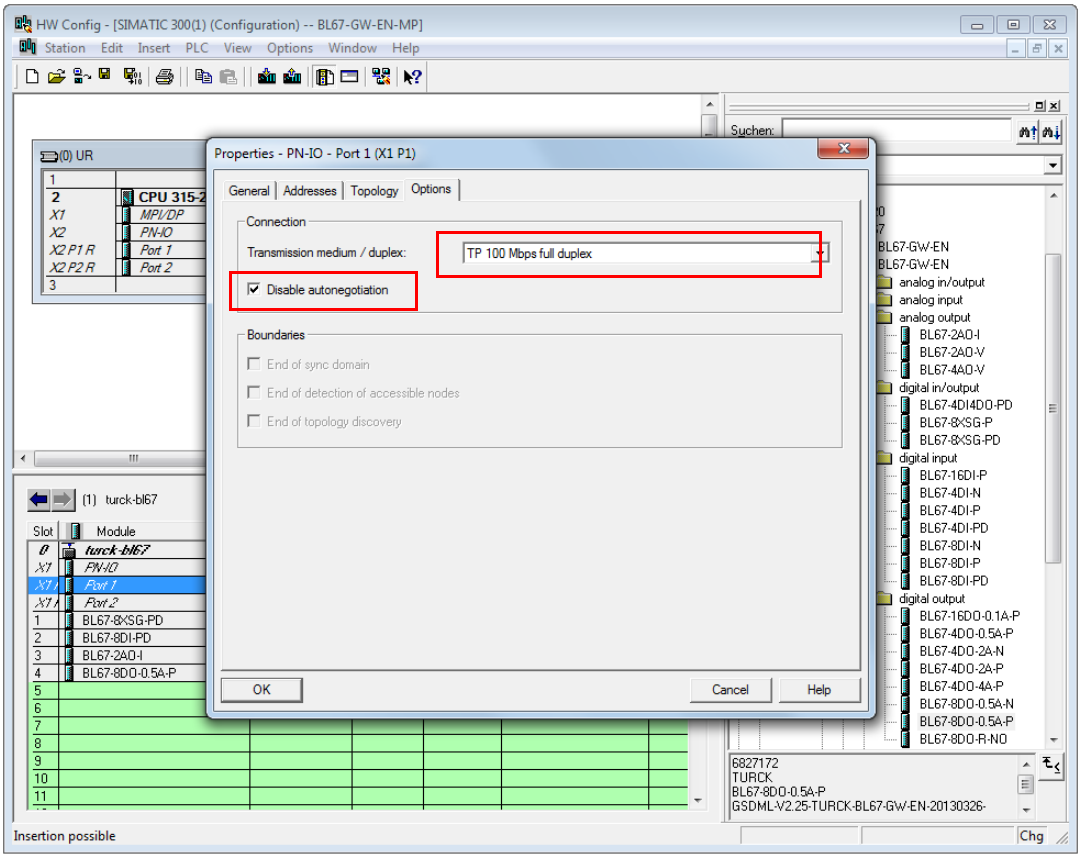
- Auto negotiation: disable
- Transmission medium/duplex: set to a fixed value

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-BL67-112.

Figure 9-19: Configuration of an Ethernet port



NOTE

The neighboring node has to be configured respectively.

9.2 Diagnosis with Step 7

9.2.1 Diagnostic messages in the hardware configuration

The BL67 gateways 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:

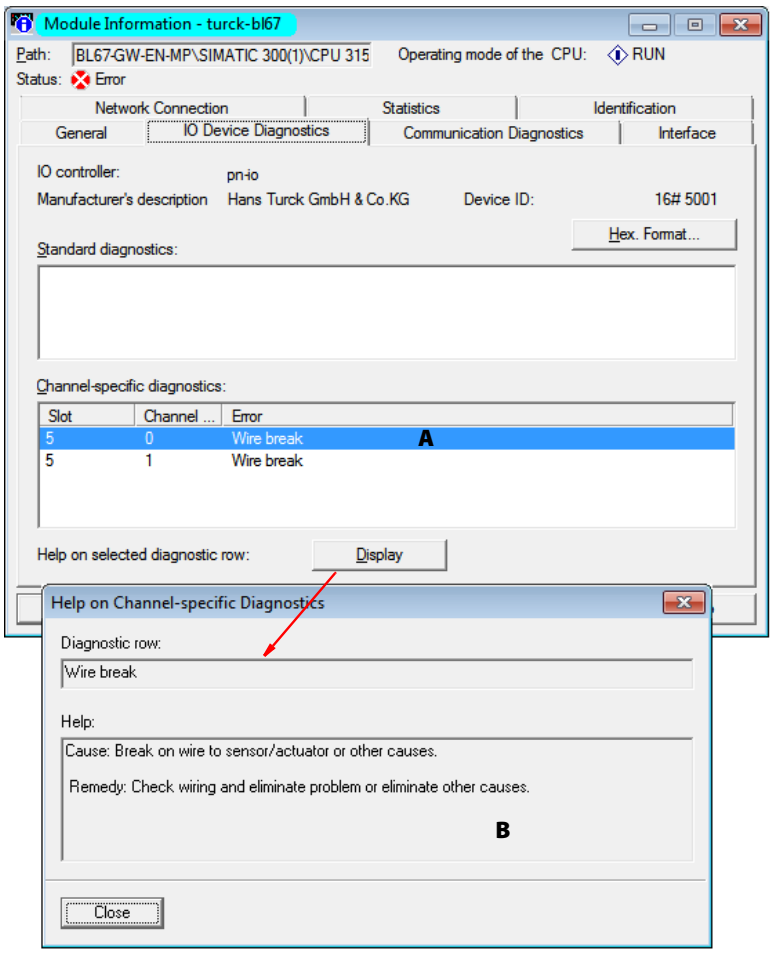


Figure 9-20: Diagnostics

A *channel-specific module diagnostics*

B *manufacturer specific help texts*

9.2.2 Diagnostic telegram with error code

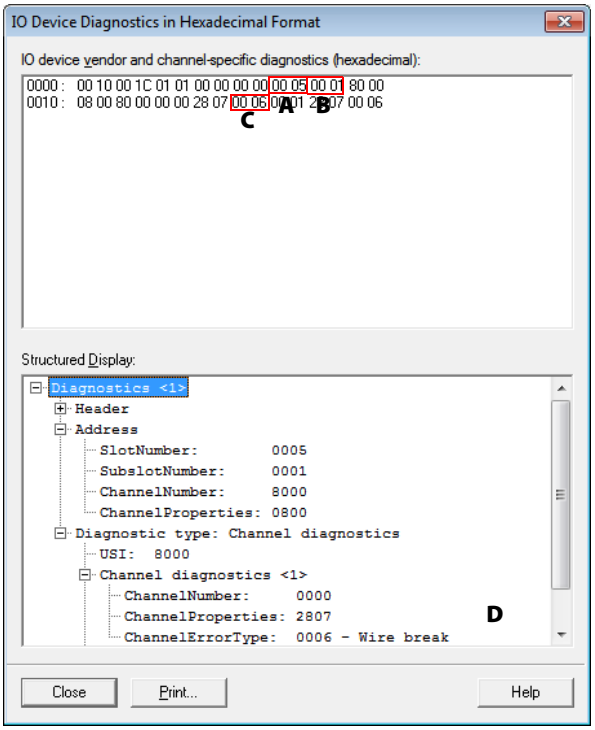


Figure 9-21: Diagnostic telegram

A *slot-no.*
B *sub slot no.*
C *Error Code*
D *Diagnostic message in plain text*

10 Guidelines for station planning

10.1 Module arrangement

10.1.1 Random module arrangement

The arrangement of the I/O-modules within a BL67 station can basically be chosen at will.

Nevertheless, it can be useful with some applications to group certain modules together.

10.2 Complete planning

The planning of a BL67 station should be thorough to avoid faults and increase operating reliability.

ATTENTION!

Empty slots within a station

Interruption of the communication to following modules

➤ Check if the station contains more than two empty slots in sequence.

➤ Eliminate the empty slots.

10.3 Maximum system extension

A BL67 station can consist of a gateway and a maximum of 32 modules (equivalent to 1 m station length).

The following overview shows the maximum number of channels possible under these conditions:

- The entire station is made up of the respective module type only.

Table 10-1: Maximum system extension

module type	Maximum number	
	Channels	Module
BL67-4DI-x	128	32
BL67-8DI-x	256	32
BL67-4DO-xA-P	128	32
BL67-8DO-xA-P	256	32
BL67-8DO-R-NO	256	32
BL67-16DO-0.1A-P	512	32
BL67-4DI4DO-PD	256	32
BL67-8XSG-PD	256	32
BL67-2AI-x	64	32
BL67-2AI-PT	64	32
BL67-2AI-TC	64	32
BL67-4AI-TC	104	26
BL67-4AI-V/I	128	32
BL67-2AO-I	64	32
BL67-2AO-V	42 **A**	21 **A**
BL67-4AO-V	84	21
BL67-2AI2AO-V/I	42	21
BL67-4AI4AO-V/I	84	21
BL67-1RS232	9 **A**	9 **A**

A *limited due to the high current consumption (max. 1,5 A) 1,5 A) at the module bus 5 V*

BL67-1RS485/422	21	21
BL67-1SSI	21	21
BL67-1CVI	32	32
BL67-1CNT/ENC	21	21
BL67-2RFID-x	8	4

NOTE

Ensure that a sufficient number of Bus Refreshing and Power Feeding modules are used if the system is extended to its maximum.

NOTE

If the system limits are exceeded, the software I/O-ASSISTANT 3 (FDT/DTM) generates an error message, if the command "Station → Verify station" is activated.

10.4 Creating potential groups

Power Feeding modules can be used to create potential groups. The potential isolation of potential groups to the left of the respective power distribution modules is provided by the base modules.

10.5 Plugging and pulling electronics modules

BL67 enables the pulling and plugging of electronics modules without having to disconnect the field wiring. The BL67 station remains in operation if an electronics module is pulled.

The voltage and current supplies as well as the protective earth connections are not interrupted

ATTENTION!

Pulling or plugging of modules under load
Interruption of module bus communication, undefined states of I/Os
➤ Disconnect the station from the voltage supply
➤ Pull or plug I/O module

10.6 Extending an existing station

Extending a station is only possible if the station is disconnected from the voltages supply.

CAUTION!

Electric voltage 24 V

Danger of injury due to electric shock!

- ➤ Turn of the voltage supply
- ➤ Secure the voltage supply against restart.
- ➤ Ensure that the unit is de-energized.

10.7 Firmware download

Firmware can only be downloaded
via Ethernet using the software tool I/O-ASSISTANT 3 (FDT/DTM).

The download using the USB-interface is not supported. More information is available in the program's online help.

ATTENTION!

Firmware download
Damage of the firmware

- ➤ Disconnect the station from the modules bus before the download,
- ➤ Disconnect the field side

11 Guidelines for Electrical Installation

11.1 General notes

11.1.1 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.).

11.1.2 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 DC 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!

Cable routing outside buildings
Warning about danger of life due to wrong laying of cables
➤ Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

11.1.3 Lightning protection

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

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

11.1.4 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 field bus lines as premoulded or bulk cables with different connectors.
The ordering information on the available cable types can be taken from the BL67-catalog.

11.2 Potential relationships

11.2.1 General

The potential relationship of a Ethernet system realized with BL67 modules is characterized by the following:

- The system supply of gateway and I/O-modules as well as the field supply are realized via one power feed at the gateway.
- All BL67 modules (gateway, Power Feeding and I/O-modules), are connected capacitively via base modules to the mounting rails.

The block diagram shows the arrangement of a typical BL67 station with Ethernet gateway.

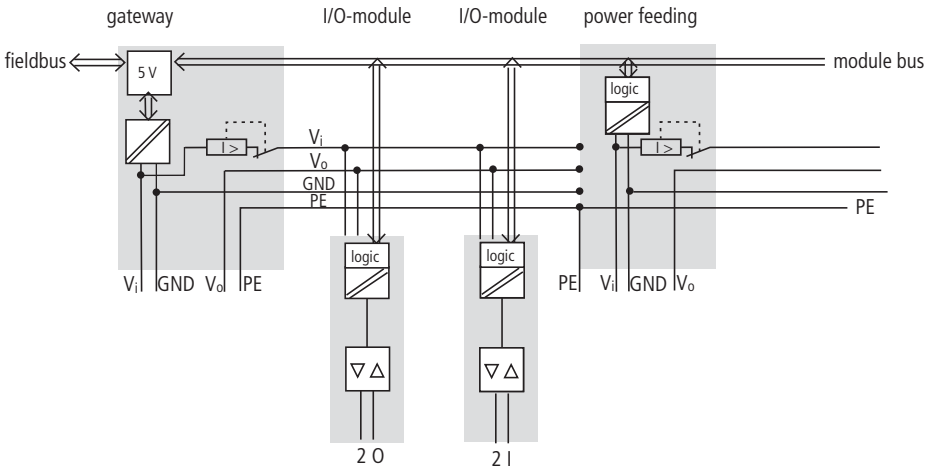


Figure 11-1: Block diagram BL67 station

11.3 Electromagnetic compatibility (EMC)

BL67 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.

11.3.1 Ensuring electromagnetic compatibility

The EMC of BL67 modules is guaranteed when the following basic rules are adhered to:

- Correct and large surface grounding of inactive metal components.
- Correct shielding of cables and devices.
- Proper cable routing – correct wiring.
- Creation of a standard reference potential and grounding of all electrically operated devices.
- Special EMC measures for special applications.

11.3.2 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!

Grounding of inactive metal components
Danger to life due to dangerous contact voltage
➤ Connect earth to the protective conductor

11.3.3 PE connection

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

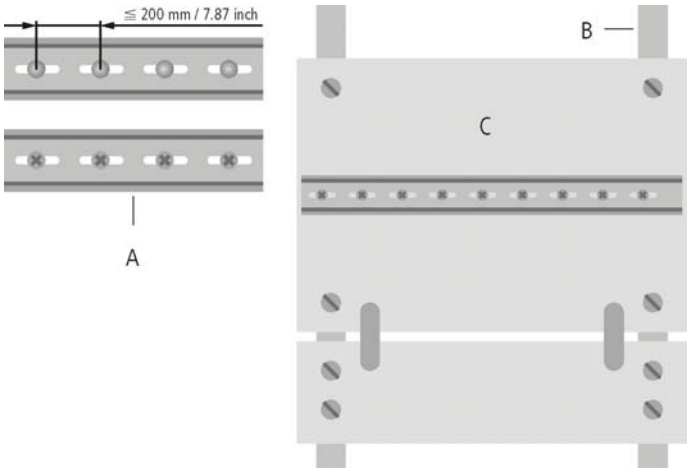
11.3.4 Earth-free operation

Observe all relevant safety regulations when operating an earthfree system.

11.3.5 Mounting rails

All mounting rails must be mounted onto the mounting plate with a low impedance, over a large surface area, and must be correctly earthed. Use corrosion-resistant mounting rails

Figure 11-2: Mounting options



A *TS 35*
B *mounting rail*
C *mounting plate*

Mount the mounting rails over a large surface area and with a low impedance to the support system using screws or rivets.

Remove the isolating layer from all painted, anodized or isolated metal components at the connection point. Protect the connection point against corrosion (for example with grease; caution: use only suitable grease).

11.4 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.

NOTE

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

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

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

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is 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.

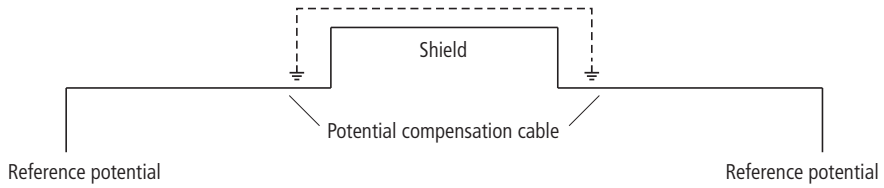
11.5 Potential compensation

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.

Figure 11-3: 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.

11.5.1 Switching inductive loads

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

11.5.2 Protection against Electrostatic Discharge (ESD)

ATTENTION!
Exposed metal contacts
Material damage due to electrostatic discharge
➤ Avoid to touch the metallic contacts with bare hands

12 Appendix

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

12.1.1 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".

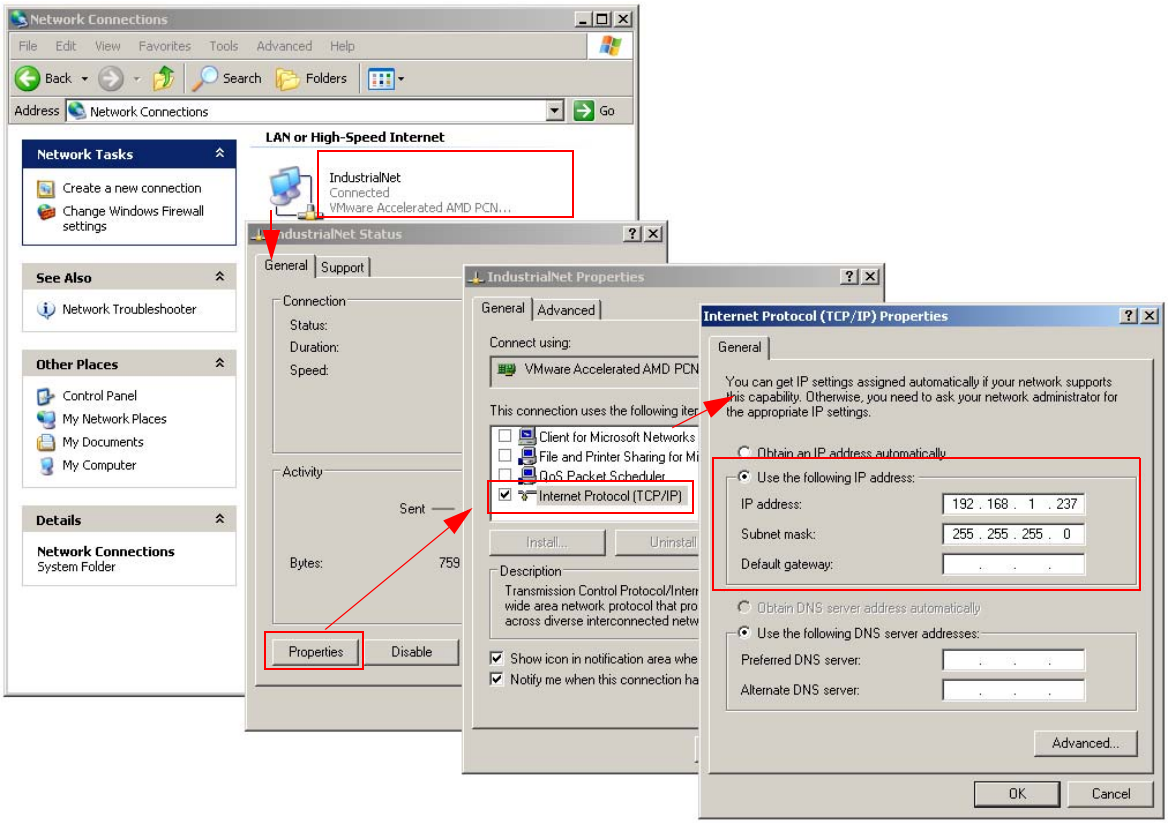
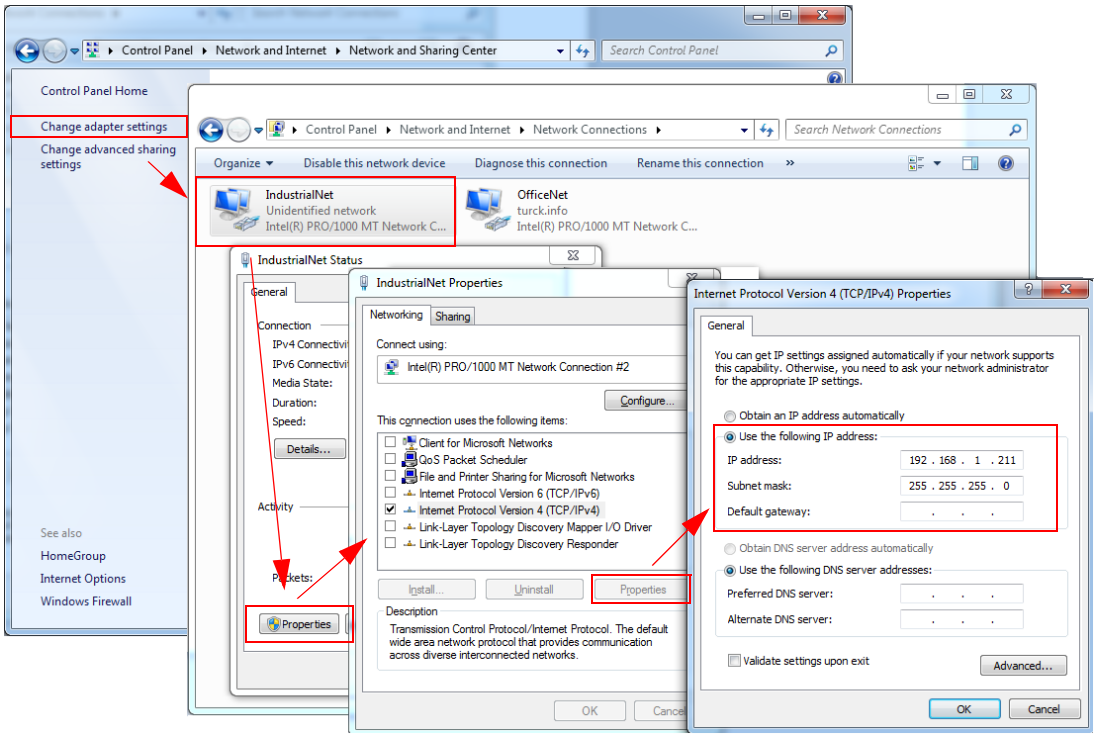


Figure 12-1: Changing the IP address in Windows 2000/ XP

Figure 12-2: Changing the IP address in Windows 7

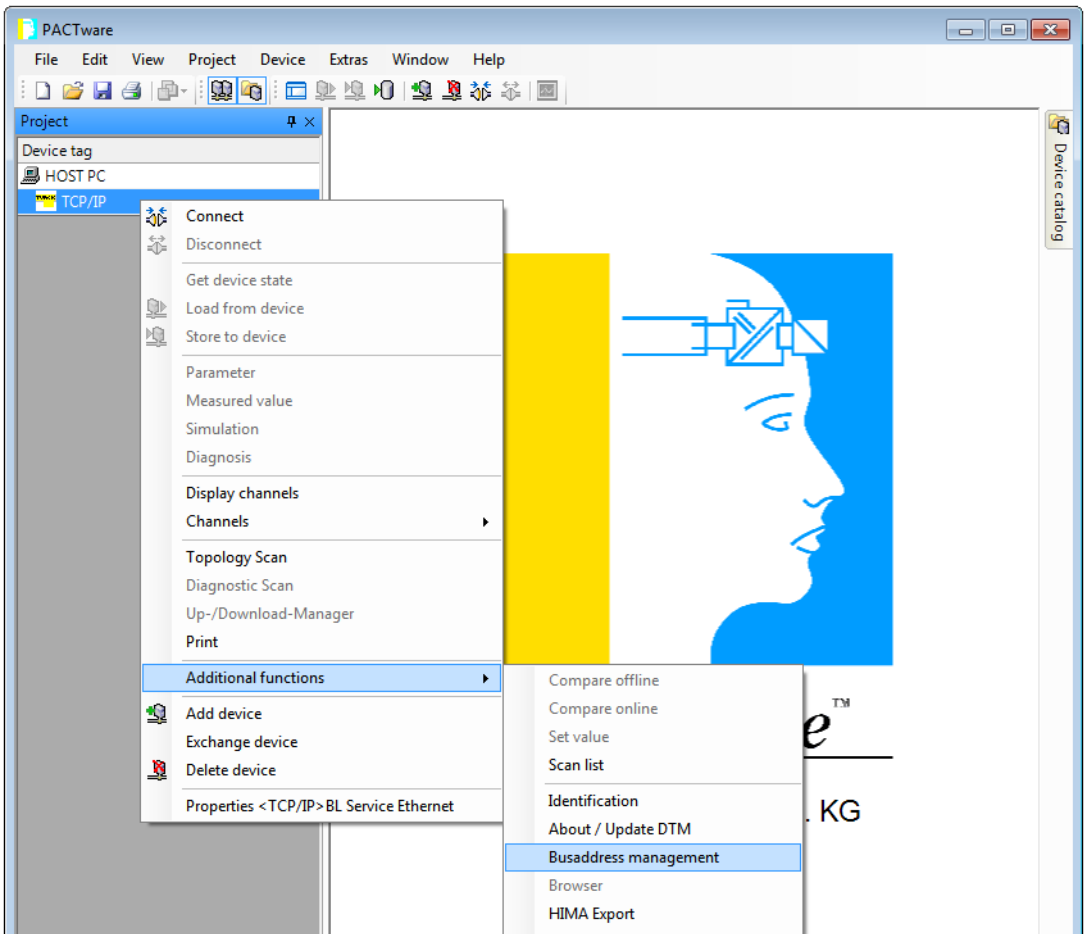


12.1.2 Changing the IP address via PACTware FDT/DTM (I/O-ASSISTANT V3)

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.

Further information about this issue can be found under Addressing via I/O-ASSISTANT 3 (FDT/DTM) (page 3-23).

Figure 12-3: Busaddress Management



12.2 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 12-4: Deactivating the Firewall in Windows 2000/ XP

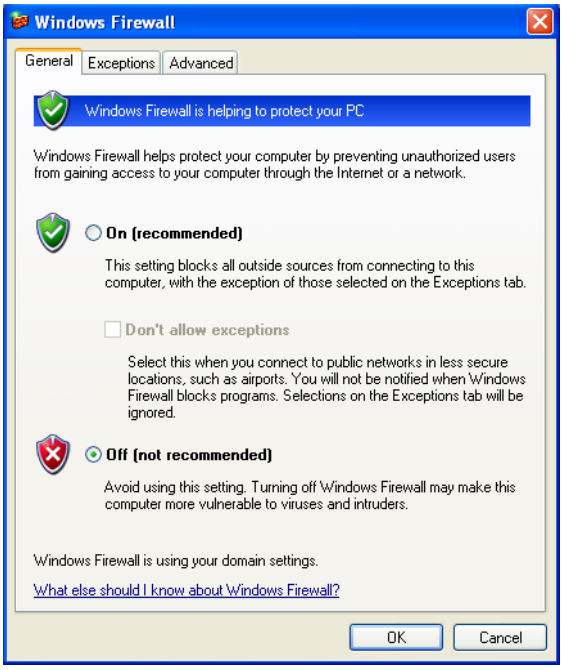
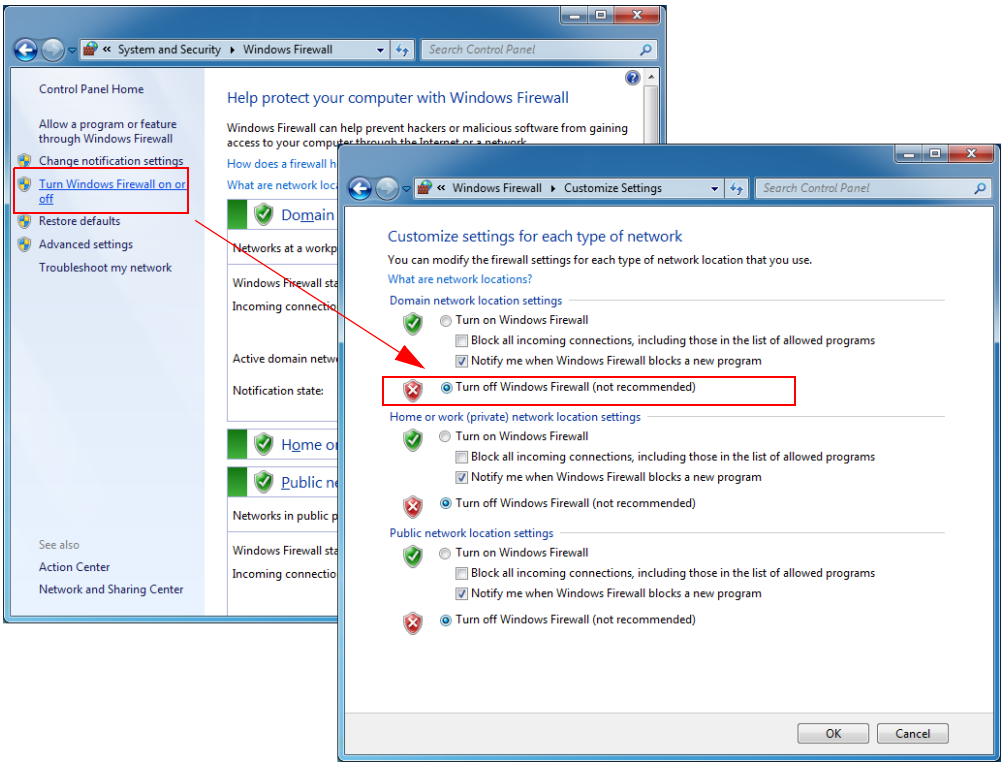


Figure 12-5: Deactivating the Firewall in Windows 7



Adapting the Windows firewall

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

Figure 12-6: Adapting the Firewall in Windows 2000/ XP

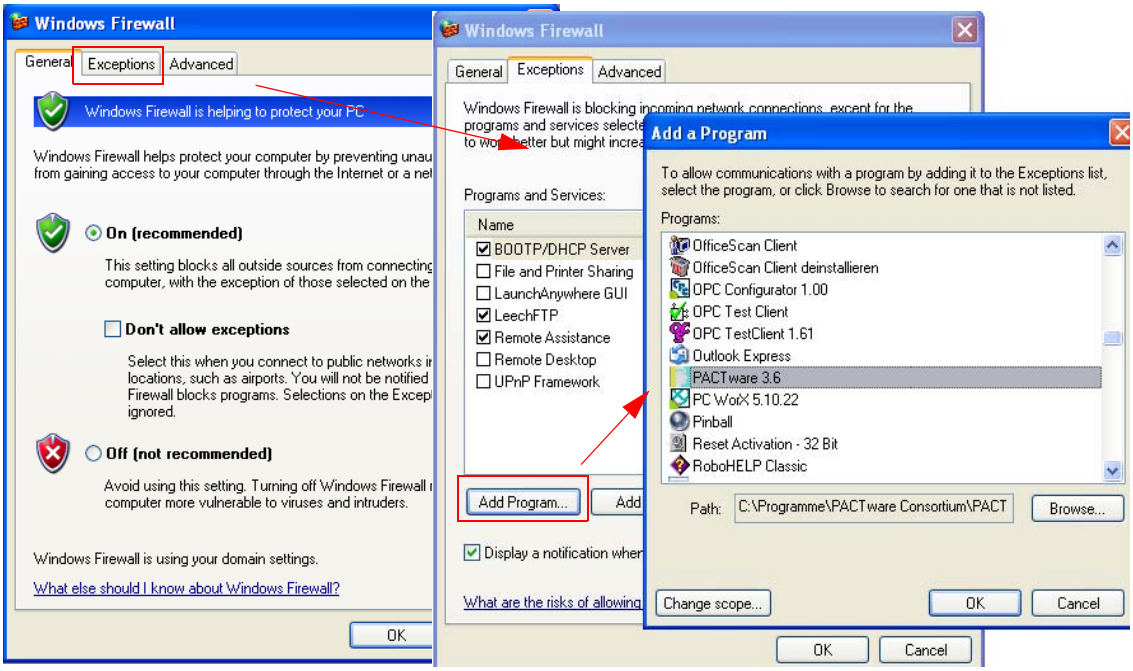
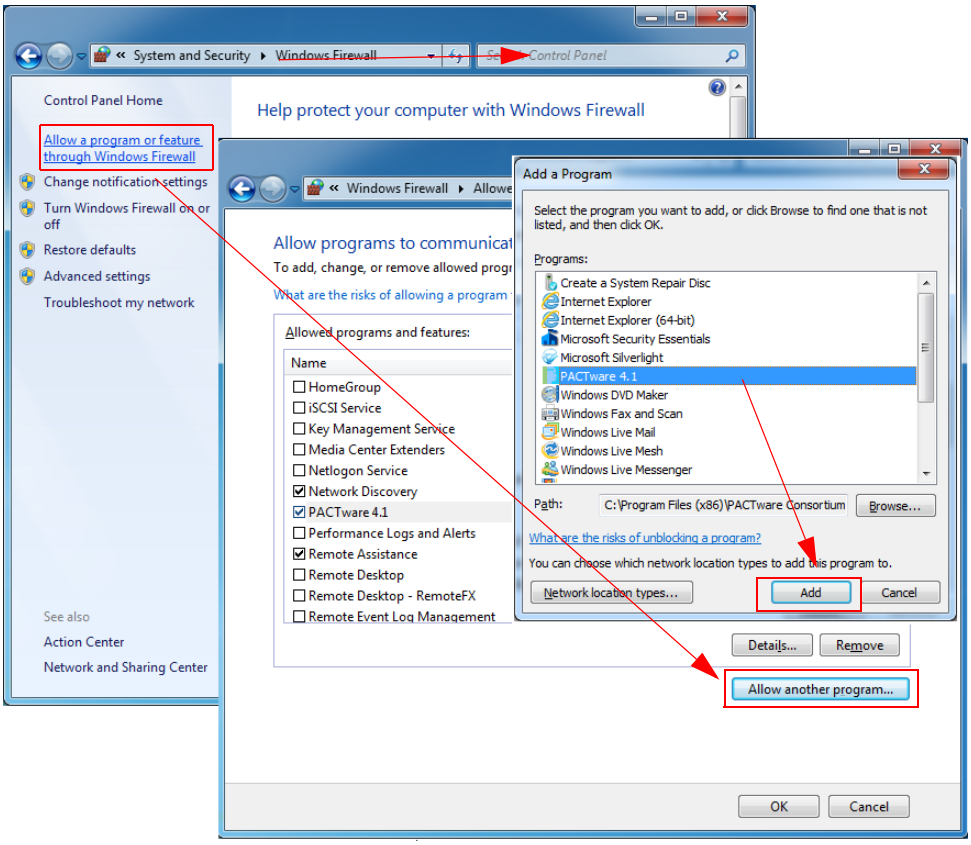


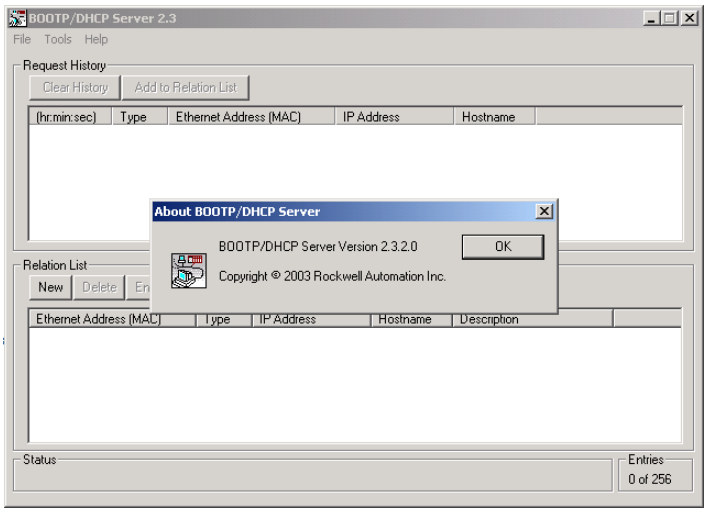
Figure 12-7: Adapting the Firewall in Windows 7



12.3 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 12-8: BootP-Serverfrom Rockwell Automation



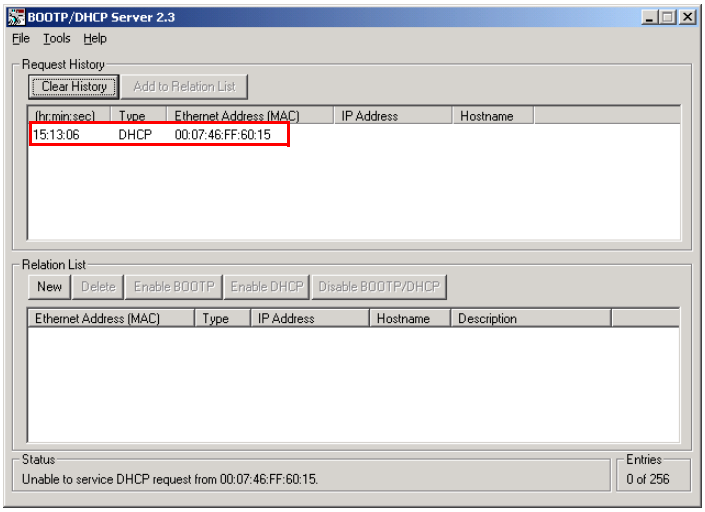
Addresses in the range from 1 to 254 can be allocated. The addresses 0 and 255 are reserved for broadcast messages in the subnet.

NOTE

The rotary coding switches on the gateway must be set to "300" = BootP, "400" = DHCP or "600" = PGM-DHCP in order to enable the BootP/DHCP-Mode.
(see also chapter 3.6, section Address assignment (page 3-17)).

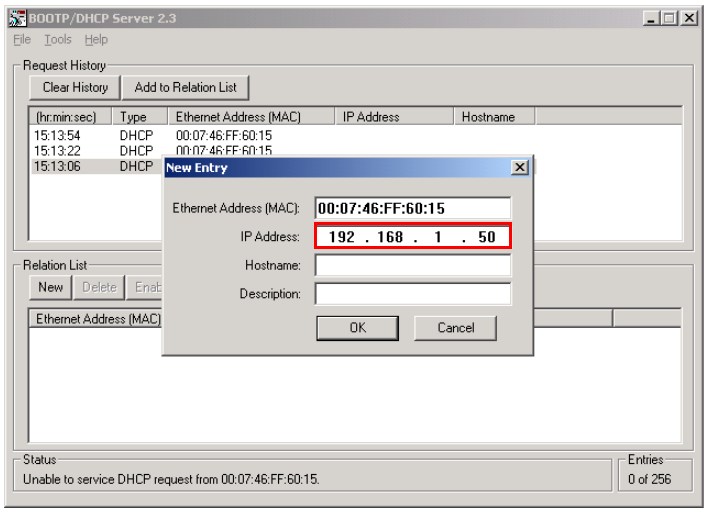
After having been connected to the network, the device sends DHCP requests to the server using its MAC-ID.

Figure 12-9: DHCP-request of the device



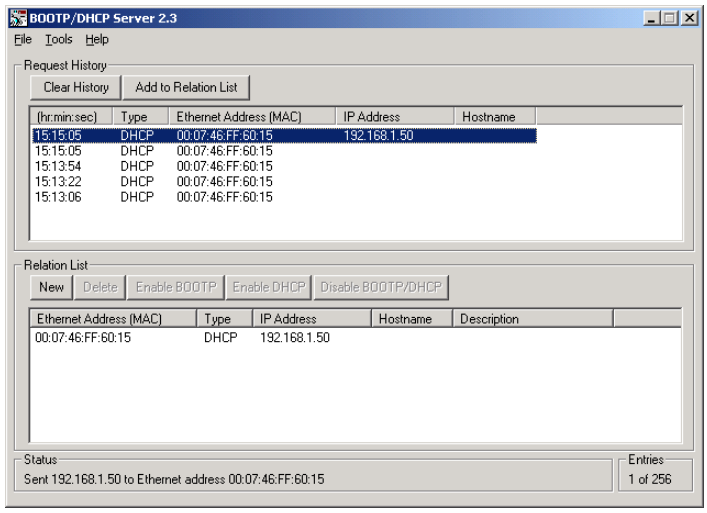
A double click on the request-entry opens the "New Entry" dialog box in which an IP address can be assigned to the s MAC-ID.

Figure 12-10: 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 12-11: Actual IP address



NOTE

The device looses it's IP-address in case of a power-reset, if the BootP/DHCP-server is shut down.

12.4 Nominal current consumption of modules on Ethernet

Table 12-1: Nominal current consumption of modules on Ethernet

Module	Nominal current consumption at 24 V DC (U_{Sys})
BL67-GW-EN	
Power distribution modules	
BL67-PF-24VDC	≤ 9 mA
Digital input modules	
BL67-4DI-P	≤ 9 mA
BL67-8DI-P	≤ 9 mA
BL67-4DI-PD	≤ 9 mA
BL67-8DI-PD	≤ 9 mA
BL67-4DI-N	≤ 9 mA
BL67-4DI-N	≤ 9 mA
BL67-16DI-P	≤ 9 mA
Analog input modules	
BL67-2AI-I	≤ 10 mA
BL67-2AI-V	≤ 10 mA
BL67-2AI-PT	≤ 13 mA
BL67-2AI-TC	≤ 13 mA
BL67-4AI-TC	≤ 15 mA
BL67-4AI-V/I	≤ 12 mA
Digital output modules	
BL67-4DO-0.5A-P	≤ 9 mA
BL67-4DO-2A-P	≤ 9 mA
BL67-4DO-4A-P	≤ 9 mA
BL67-8DO-0.5A-P	≤ 9 mA
BL67-4DO-2A-N	≤ 9 mA
BL67-8DO-0.5A-N	≤ 9 mA
BL67-8DO-R-NO	≤ 9 mA
BL67-16DO-0.1A-P	≤ 9 mA

Table 12-1: Nominal current consumption of modules on Ethernet

Module	Nominal current consumption at 24 V DC (U_{Sys})
Analog output modules	
BL67-2AO-I	≤ 12 mA
BL67-2AO-V	≤ 18 mA
BL67-4AO-V	≤ 15 mA
Digital combi modules	
BL67-4DI4DO-PD	≤ 9 mA
BL67-8XSG-PD	≤ 9 mA
BL67-8XSG-P	
Analog combi modules	
BL67-4AI4AO-V/I	≤ 15 mA
BL67-2AI2AO-V/I	≤ 15 mA
Technology modules	
BL67-1RS232	≤ 50 mA
BL67-1RS485/422	≤ 20 mA
BL67-1SSI	≤ 15 mA
BL67-1CVI	≤ 9 mA
BL67-2RFID-x	≤ 9 mA
BL67-1CNT/ENC	≤ 15 mA

NOTE

Please find any information about the bus-independent, module specific current consumptions in the manual "BL67- I/O-modules" (TURCK-Documentation No.: German D300572/ English D300529).

12.5 Ident codes of the BL67-modules

Each module is identified by the gateway using a unique identifier.

Table 12-2: Module ident codes

Module	ident code
Digital input modules	
BL67-4DI-P	0.410030.××××
BL67-8DI-P	0.610040.××××
BL67-4DI-PD	0.015630.××××
BL67-8DI-PD	0.015640.××××
BL67-4DI-N	0.420030.××××
BL67-4DI-N	0.620040.××××
BL67-16DI-P	0.820050.××××
Analog input modules	
BL67-2AI-I	0.225570.××××
BL67-2AI-V	0.235570.××××
BL67-2AI-PT	0.215770.××××
BL67-2AI-TC	0.215570.××××
BL67-4AI-TC	0.427790.××××
BL67-4AI-V/I	0.417790.××××
Digital output modules	
BL67-4DO-0.5A-P	0.413003.××××
BL67-4DO-2A-P	0.433003.××××
BL67-4DO-4A-P	0.453003.××××
BL67-8DO-0.5A-P	0.614004.××××
BL67-16DO-0.1A-P	0.805505.××××
BL67-4DO-2A-N	0.443003.××××
BL67-8DO-0.5A-N	0.624004.××××
Analog output modules	
BL67-2AO-I	0.220807.××××
BL67-2AO-V	0.210807.××××
BL67-4AO-V	0×427A09××
Relay modules	
BL67-8DO-R-NO	0.62004.××××

Table 12-2: Module ident codes

Module	ident code
Digital combi modules	
BL67-4DI4DO-PD	0.015633.×××
BL67-8XSG-PD	0.015744.×××
BL67-8XSG-P	0.025744.×××
Analog combi modules	
BL67-4AI4AO-V/I	0×419B99××
BL67-2AI2AO-V/I	0.217977.×××
Technology modules	
BL67-1RS232	0.014799.×××
BL67-1RS485/422	0.024799.×××
BL67-1SSI	0.044799.×××
BL67-1CVI	0×018B99×× (0×242224××) **A**
BL67-1CNT/ENC	0×019BA9××
BL67-2RFID-S	0×2179CC××
BL67-2RFID-A	0.017977.×××
Power distribution modules	
BL67-PF-24VDC	0×063000××

A *Default ID of the module → Is only transmitted if the field voltage is missing during module power-up*

13 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.

ARP

Used to definitely allocate the hardware addresses (MAC-IDs) assigned worldwide to the IP addresses of the network clients via internal tables.

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.

Bonding strap

Flexible conductor, normally braided, that joins inactive components, e. g. the door of a switchgear cabinet to the cabinet main body.

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.

Check-back interface

The check-back interface is the interface from the counter module to the internal module bus. The bits and bytes are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

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.

Control interface

The control interface is the interface from the internal module bus to the counter module. The commands and signals directed to the counter module are converted by the gateway from the respective type of communication applicable to the fieldbus in to the module-specific bits and bytes.

CPU

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

D

DHCP

Client-Server-protocol which reduces the effort of assigning IP addresses or other parameters. Serves for dynamic and automatic configuration of devices.

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.

Force Mode

Software mode which enables the user to set his plant to a required state by forcing certain variables on the input and output modules.

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.

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).

IP

Abbreviation for Internet-Protocol, protocol for the packet-oriented and connectionless transport of data packets from a transmitter to a receiver crossing different networks.

L

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.

Modbus TCP

The Modbus protocol is part of the TCP/IP protocol.

The communication is realized via function codes, which are implemented into the data telegram. Modbus TCP uses the Transmission Control Protocol (TCP) for the transmission of the Modbus user protocol in Ethernet-TCP-IP networks.

Module bus

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

MSB

Most Significant bit

P

Ping

Implementation of an echo-protocol, used for testing whether a particular host is operating properly and is reachable on the network from the testing host.

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.

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

Amplifier for signals transmitted via a bus.

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.

T

TCP

Abbreviation for Transmission Control Protocol, connection-oriented transport protocol within the Internet protocol suite. Certain error detection mechanisms (i.e. acknowledgments, time-out monitoring) can guarantee a safe and error free data transport.

Terminating resistance

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

UDP

Abbreviation for User Datagram Protocol. UDP is an transport protocol for the connectionless data between Ethernet hosts.

Unidirectional

Working in one direction.

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