Your Global Automation Partner

TURCK

BL20-E-GW-EN
ECO Multi Protocol Gateway

Instructions for Use

1 About These Instructions

These operating instructions describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device. Retain the instructions for future use during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Target groups

These instructions are aimed a qualified personal and must be carefully read by anyone mounting, commissioning, operating, maintaining, dismantling or disposing of the device.

1.2 Documentation concept

This manual contains all information about the gateways BL20-E-GW-EN of the product line BL20.

- Version < VN 03-00: gateway for Modbus TCP
- Version ≥ VN 03-00: multiprotocol-gateway for Modbus TCP, EtherNet/IP, PROFINET

In addition to a short BL20-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 5, Implementation of EtherNet/IP**
  - **chapter 6, BL20-E-GW-EN with EtherNet/IP (Allen Bradley)**
- Modbus TCP
  - **chapter 7, Implementation of Modbus TCP**
  - **chapter 8, BL20-E-GW-EN for Modbus TCP (CODESYS Win V3)**
- PROFINET
  - **chapter 9, Implementation of PROFINET**
  - **chapter 10, Application example: BL20-E-GW-EN with PROFINET (S7)**

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

1.3 Explanation of symbols used

The following symbols are used in these instructions:

DANGER

DANGER indicates a dangerous situation with high risk of death or severe injury if not avoided.

WARNING

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

CAUTION

CAUTION indicates a dangerous situation of medium risk which may result in minor or moderate injury if not avoided.

NOTICE

NOTICE indicates a situation which may lead to property damage if not avoided.

NOTE

NOTE indicates tips, recommendations and useful information on specific actions and facts. The notes simplify your work and help you to avoid additional work.

➤ CALL TO ACTION

This symbol identifies steps that the user has to perform.

↪ RESULTS OF ACTION

This symbol identifies relevant results of steps

1.3.1 Additional documents

The following additional documents are available online at www.turck.com

- Data sheet
- Declaration of Conformity

1.4 Feedback about these instructions

We make every effort to ensure that these instructions are as informative and as clear as possible. If you have any suggestions for improving the design or if some information is missing in the document, please send your suggestions to techdoc@turck.com.

2 Notes on the Product

2.1 Product identification

These instructions apply to the BL20 gateway BL20-E-GW-EN.

2.2 Scope of delivery

- BL20-E-GW-EN
- 2 end brackets

2.3 Legal requirements

The device falls under the following EU directives:

- 2014/30/EU (electromagnetic compatibility)
- 2011/65/EU (RoHS Directive)

2.4 Manufacturer and service

Hans Turck GmbH & Co. KG
Witzlebenstraße 7
45472 Muelheim an der Ruhr
Germany

Turck supports you with your projects, from initial analysis to the commissioning of your application. The Turck product database contains software tools for programming, configuration or commissioning, data sheets and CAD files in numerous export formats. You can access the product database at the following address:www.turck.de/produkte

Should you have any further questions, please contact the sales and service team in Germany under the following telephone numbers:

Sales: +49 208 4952-380

Technology: +49 208 4952-390

Internet: www.turck.de

Outside Germany, please contact your local Turck representative.

3 For Your Safety

The product is designed according to state-of-the-art technology. However, residual risks still exist. Observe the following warnings and safety notices to prevent damage to persons and property. Turck accepts no liability for damage caused by failure to observe these warning and safety notices.

3.1 Intended use

The devices are only intended for use in industrial applications.

The BL20 gateway BL20-E-GW-EN is part of the BL20 system. It forms the interface to an Ethernet network and forwards the data collected by the BL20 I/O modules within the BL20 station from the field to the higher-level master. The current BL20-E-GW-EN (from VN 03-00) serves as a multi-protocol interface between the BL20 system and the Ethernet protocols Modbus TCP, EtherNet/IP and PROFINET (Version ≥ VN 03-00).

The devices may only be used as described in these instructions. Any other usage shall be considered improper and Turck shall not be held liable for any resulting damage.

3.2 General safety instructions

- The device may only be assembled, installed, operated and maintained by professionally trained personnel.
- The device may only be used in accordance with applicable national and international regulations, standards and laws.
- The device only meets the EMC requirements for industrial areas and is not suitable for use in residential areas.

4 Properties: gateway and I/O-modules

4.1 Function of the gateway

The BL20-E-GW-EN (≥ VN 03-00) is used as multiprotocol-interface between the BL20-system and the Ethernet-protocols Modbus TCP, EtherNet/IP and PROFINET.

4.1.1 Version overview

Please observe, that the previous version of the gateway did only support the Modbus TCP protocol.

- Version **< VN 03-00**
  BL20-gateway supports only the Ethernet protocol
  - Modbus TCP
- Version ≥ **VN 03-00**
  BL20-gateway supports the Ethernet protocols
  - Modbus TCP
  - EtherNet/IP
  - PROFINET

NOTE

The multiprotocol gateway replaces the Modbus TCP version and is fully compatible.

Only the LED-designation has changed. Please find detailed information under **LED-displays (page 14)**.

4.2 Technical data

4.2.1 Top view BL20-E-GW-EN (< VN 03-00)

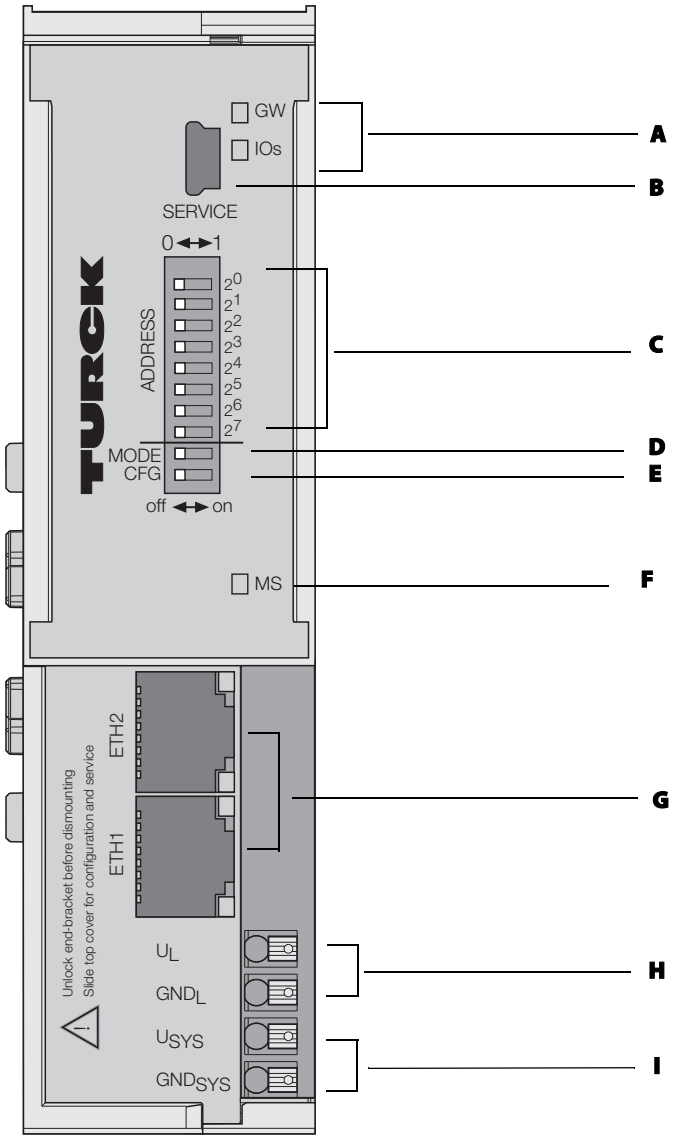


Fig. 1: Top view BL20-E-GW-EN (< VN 03-00)

A LEDs for BL20 module bus
B service interface, no function
C DIP-switch for the fieldbus-address
D DIP-switch for the operation mode
E DIP-switch for the configuration acceptance
F LEDs for the Modbus-communication
G EtherNet-switch with EtherNet-LEDs
H terminals for field supply
I terminals for system supply

4.2.2 Top view BL20-E-GW-EN (≥ VN 03-00)

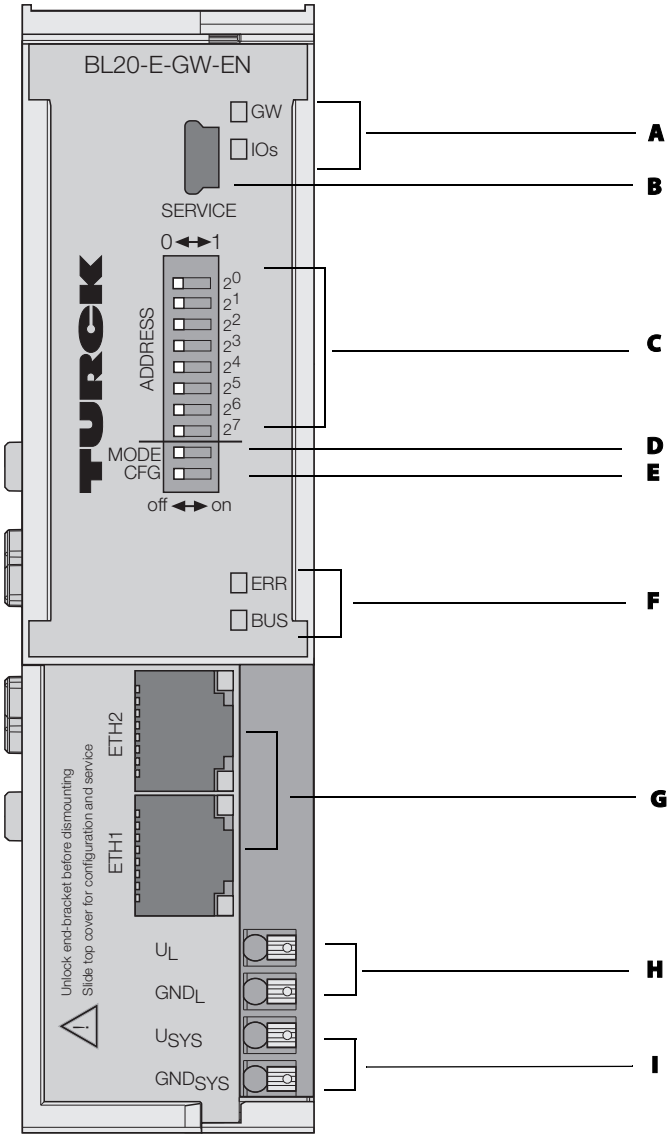


Fig. 2: Top view BL20-E-GW-EN (≥ VN 03-00)

A LEDs for BL20 module bus
B service interface, no function
C DIP-switch for the fieldbus-address
D DIP-switch for the operation mode
E DIP-switch for the configuration acceptance
F LEDs for the Ethernet-communication
G EtherNet-switch with EtherNet-LEDs
H terminals for field supply
I terminals for system supply

4.2.3 Block diagram

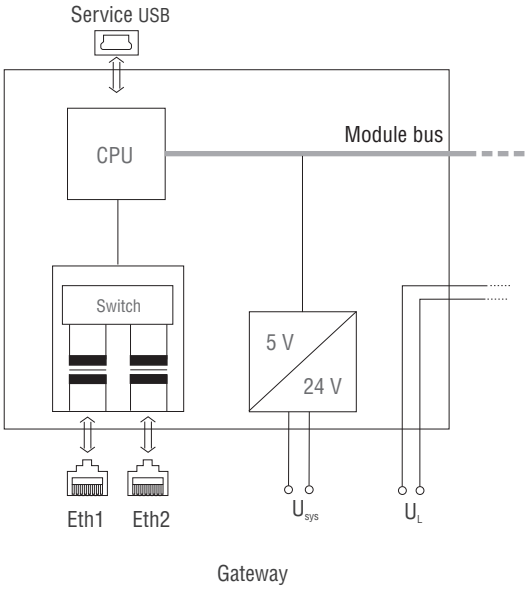


Fig. 3: Block diagram BL20-E-GW-EN

4.2.4 General technical data of a station

WARNING

Defective power supply unit

Danger to life due to dangerous voltages on touchable parts

➤ Only use SELV or PELV power supplies in accordance with EN ISO 13849-2, which allow a maximum of max. 60 VDC or 25 VAC in the event of a fault.

Technical data	
Supply voltage/auxiliary voltage	
U_{sys} (nominal value) provision for other modules	24 V DC
I_{sys} (at max. system extension, → see chapter 11, s. p. 200)	Approx. 0.5 A
U_L nominal value	24 V DC
I_{Lmax}, maximum current from field supply	8 A
Permissible range	According to EN 61131-2 (18…30 V DC)
Residual ripple	According to EN 61 131-2
Voltage anomalies	According to EN 61 131-2
I_{MB} (supply of module bus nodes)	400 mA
Connection technology	Push-in tension clamps, LSF from Weidmueller
Physical interfaces	
Field bus	Ethernet
Transmission rate	10/100 Mbps
Passive fiber-optic-adapters can be connected	Current consumption max. 100 mA
Fieldbus connection technology	2 × RJ45 female connector
Fieldbus shielding connection	Via Ethernet cable
Address setting	Via DIP-switches (2^0 …2^7)
Service interface	Ethernet
Isolation voltages	
U_{BL} (U_{sys} against service interface)	-
U_{ETH} (supply voltage against Ethernet)	500 V AC
U_{ETH} (supply voltage against Ethernet)	-
U_{ETHETH} (ETH1 against ETH2)	500 V AC

Technical data	
Ambient conditions	
Operating temperature horizontal/vertical mounting	0 …+55°C For vertical installation, the gateway can be positioned both at the top and bottom. Sufficient ventilation and heat dissipation must be ensured.
Storage temperature	- 25…+85 °C
Relative humidity according to EN 61131-2/EN 50178	5 …95 % (indoor), Level RH-2, no condensation (storage at 45 °C, no function test)
Climatic tests	according to IEC 61131-2
Vibration resistance	
10…57 Hz, constant amplitude 0.075 mm/ 0.003 inch, 1g	Yes
57 …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
Shock resistant according to IEC 68-2-27	18 shocks, sinusoidal half-wave 15 g peak value/11 ms, in each case in ± direction per space coordinate
Resistance to repetitive shock IEC 68-2-29	1 000 shocks, half-sinus 25 g peak value/6 ms, in each case in ± direction per space coordinate
Drop and topple	
Height of fall (weight < 10 kg)	1.0 m
Height of fall (weight 10 …40 kg)	0.5 m
Test runs	7
Device with packaging, electrically tested printed-circuit board.	
Electromagnetic compatibility (EMC) according to EN 50 082-2 (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 EN 61 000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61 000-4-6	10 V
Fast transients (Burst) according to EN 61 000-4-4	
Emitted interference according to EN 50 081-2 (industry)	According to EN 55 011 Class A, group 1

Approvals and tests

Designation	
Approvals	CE cULus
Tests (EN 61131-2)	
Cold	DIN IEC 68-2-1, Temperature -25 °C/185 °F, duration 96 h; device not in use
Dry heat	DIN IEC 68-2-2, Temperature +85 °C/185 °F, duration 96 h; device not in use
Damp heat, cyclic	DIN IEC 68-2-30, temperature +55 °C/131 °F, duration 2 cycles every 12 h; device in use
Pollution severity according to IEC 664 (EN 61 131-2)	2
Protection class according to IEC 529	IP20 (not evaluated by UL)
MTTF	328 years according to SN 29500 (Ed. 99) 20 °C

4.2.5 Technical data for the push-in tension clamp terminals

Designation	
Protection class	IP20 (not evaluated by UL)
Insulation stripping length	8 mm + 1 mm/0.32 inch + 0.039 inch
Max. wire range	0.14…1.5 mm^2/0.0002…0.0023 $inch^2$/26…16 AWG
Crimpable wire	
”e” solid core H 07V-U	0.14…1.5 mm^2/0.0002…0.0023 $inch^2$/26…16 AWG
”f” flexible core H 07V-K	0.5…1.5 mm^2/0.0008…0.0023 $inch^2$/25…16 AWG
”f” with ferrules according … DIN 46 228/1 (ferrules crimped gas-tight)	0.25…1.5 mm^2/0.0004…0.0023 $inch^2$/30…16 AWG

NOTE

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.

4.2.6 LED-displays

Every BL20-E-GW-EN displays the following statuses via LEDs:

- 2 LEDs for the module bus communication (module bus-LEDs): GW and IOs
- < VN 03-00:
  1 LEDs for the field bus communication: MS
  VN ≥ 03-00:
  2 LEDs for the field bus communication: ERR and BUS
- 2 LEDs for the status of the Ethernet-connection at the Ethernet-ports ETH1/ETH2:

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	Firmware not active	If LED **IOs** red, firmware-download necessary
	Green flashing, 4 Hz	Firmware active, gateway hardware error.	Replace the gateway.
	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/green flashing, 4 Hz	WINK-command active	
IOs	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 Device DTM.
	Red	Hardware error, firmware not running.	– Replace the gateway.

LED	Status	Meaning	Remedy
IOs	Red flashing, 1 Hz	Incompatible deviation of module list. The gateway reports an error. The communication to the field bus is disturbed. A trouble-free process data exchange is not assured.	– Compare the configured list of modules in your BL20-station to the current configuration. – Check the physical 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.
	Red/green flashing	behavior similar to: red flashing, 1 Hz	–
ERR	Off	No diagnostic message	–
	Red	Pending diagnostic message at the gateway or at one of the connected modules.	– Check the station for diagnostic messages.
BUS (MS)	Off	Station is not supplied.	– Check the voltage supply at the gateway.
	Green	Displays the logical connection to a Master (1. Modbus TCP- connection)	–
	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 – waiting for DHCP-/BootP-address assignment.	–
LEDs at female connectors ETH1/ETH2			
Green	Off	No Ethernet link.	
	On	Link	
	flashing	Ethernet Traffic	
yellow	On	100 Mbps	
	Off	10 Mbps	–

4.3 Connection options at the gateway

The Ethernet connection is realized via two RJ45 sockets which are connected via an integrated Ethernet switch. The supply voltage is connected via push-in tension clamps.

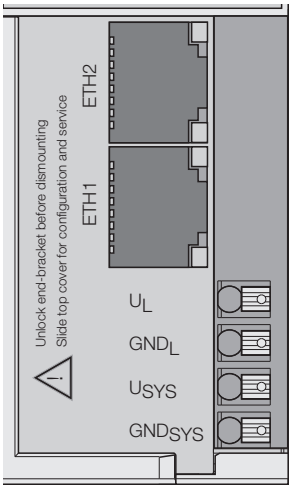


Fig. 4: Connection options at the gateway

NOTE

The minimum temperature rating of the cable to be connected to the field wiring terminals must be min. 75°C.

4.3.1 Power supply

The BL20-E-GW-EN has push-in tension clamps for:

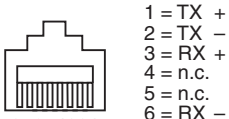
- Field supply (U_L, GND_L)

and

- system supply (U_{SYS}, GND_{SYS})

4.3.2 Field bus connection via Ethernet switch

The BL20-ECO-gateways for Ethernet provide an integrated Ethernet switch.



1 = TX +
2 = TX –
3 = RX +
4 = n.c.
5 = n.c.
6 = RX –
7 = n.c.
8 = n.c.

Fig. 5: RJ45 female connector

4.3.3 Service interface

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

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

4.4 Address assignment

NOTE

The internal module bus does not require addressing.

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.

4.4.1 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 DIP-switches 2^0 to 2^7 on the gateway to "0" followed by a power-on reset.

4.4.2 Function of DIP-switches

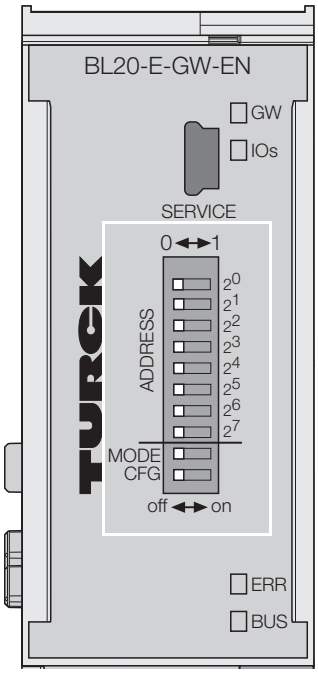
The DIP-switches for address setting, operation mode setting and for the storage of the station configuration are located under the gateway's upper label.

To set the DIP-switches, please pull the label from the gateway.

NOTE

Please observe, that the numbering of the DIP-switches under the label does not correspond to the switches' designation on the label.

Top view with label:



Top view without label:

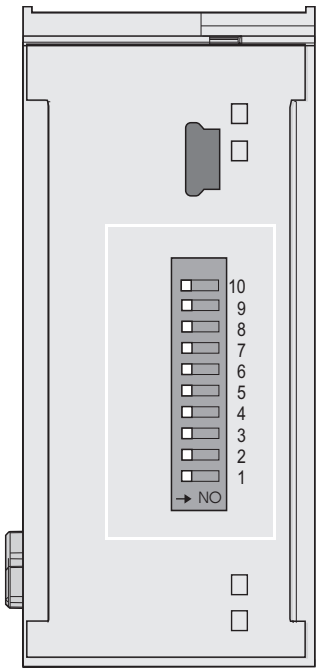


Fig. 6: DIP-switches at the gateway

Designation		Function
Label	**under label**	
2^0 - 2^7	10 - 3	Address-switch for setting the last byte of the gateway's IP-address (only, if "MODE" is Off.
MODE	2	Depending on its setting, this switch changes the function of address switches 2^0 - 2^7.
CFG	1	Switching from "Off" to "On" activates the **Synchronization of the station configuration**.

Address-switches 2^0 - 2^7 (Value)	CFG	MODE	Name	Function
0	Off	Off	RESTORE	Restoring the **Default setting of the gateway (page 17)**.
1-254	Off	Off	Address	Setting the last byte of the gateway's IP-address. See **Resetting the IP-address, switch position "RESTORE"**
1	Off	On	DHCP	**Address setting via the mode DHCP**
2	Off	On	BOOTP	**Address setting via the mode BootP**
4	Off	On	PGM	**Address setting via the mode PGM**
8	Off	On	PGM-DHCP	**Address setting via the mode PGM-DHCP (universal mode)**
16	Off	-	-	reserved
32	Off	On	F_Reset	
…	reserved			
129…199	Off	On	Assignment of the device name	In Ethernet/IP networks, the DNS name of the device is set. With Schneider Electric controllers, the IP address of the device can be assigned automatically via this mode. The devices are addressed as follows via the prefix **BL20** and the address set at the address switches: BL20_129 … BL20_199

Resetting the IP-address, switch position "RESTORE"

With this setting the DIP-switches to "0" followed by a voltage reset, the module is set to the address 192.168.1.254 for IP-based services (see **Default setting of the gateway (page 17)**).

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.

4.4.3 Address setting via DIP-switches (2^0 to 2^7)

Switch MODE has to be set to "Off".

Addresses from 1 to 254 can be set.

The addresses 0 and 255 are used for Broadcast-messages in the subnet.

NOTE

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

The gateway's field bus address results from the addition of the valences (2^0 to 2^7) of the active DIP-switches (position = 1).

NOTE

Pull the label upwards out of the housing in order to reach the DIP-switches.

Example:

Bus address 50 = 0×32 = 00110010

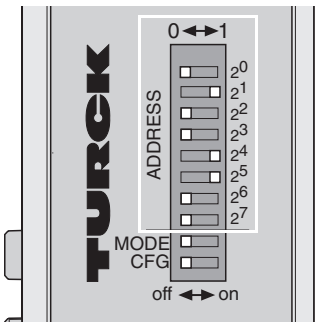


Fig. 7: Address setting

NOTE

The settings carried out via DIP-switches 2^0 to 2^7 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.

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

4.4.4 Address setting via the mode DHCP

NOTE

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

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

In order to activate the DHCP-mode, the DIP-switch MODE is set to "On", the address-switches 2^0 to 2^7 to address "1".

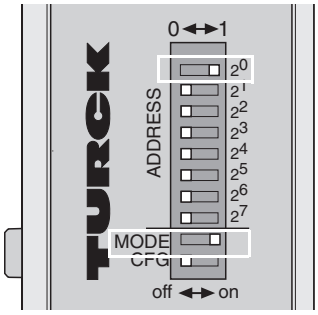


Fig. 8: DHCP mode

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 another address-mode, the settings (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.

4.4.5 Address setting via the mode BootP

NOTE

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

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 DIP-switch MODE is set to "On", the address-switches 2^0 to 2^7 to address "2".

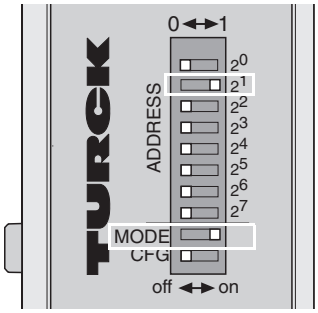


Fig. 9: BootP

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 another address--mode, the settings (IP address, subnet mask, etc) will be read from the module's EEPROM.

PROFINET

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

4.4.6 Address setting via the mode PGM

NOTE

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

The PGM-mode enables access of the software I/O-ASSISTANT (FDT/DTM) to the module's network settings (see also **Addressing via I/O-ASSISTANT 3 (FDT/DTM)**).

In order to activate the PGM-mode, the DIP-switch MODE is set to "On", the address-switches 2^0 to 2^7 to address "4".

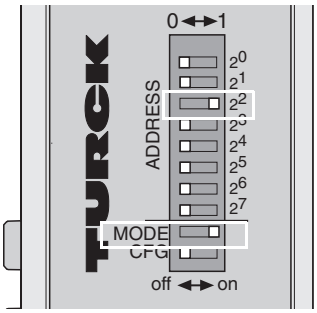


Fig. 10: PGM

NOTE

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

4.4.7 Address setting via the mode PGM-DHCP (universal mode)

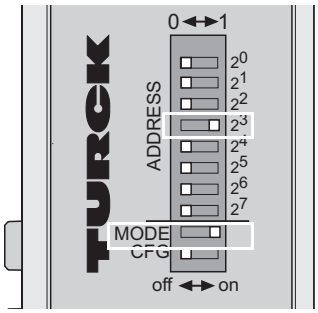


Fig. 11: PGM-DHCP

NOTE

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

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

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

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

Address assignment via PGM

The IP address is permanently stored in the EEEPROM if it is assigned via PGM (e.g. via the Turck Service Tool).

PROFINET

This mode assures a PROFINET-compliant operation of the modules and is recommended for the use of the device in PROFINET.

NOTE

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

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

4.4.8 F_Reset (Reset to factory setting)

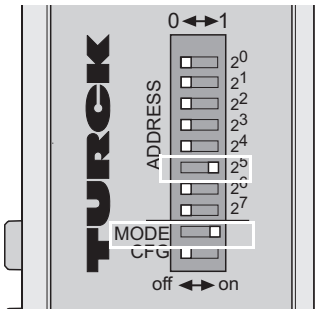


Fig. 12: F_Reset

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.

4.4.9 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 accordingt o 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).

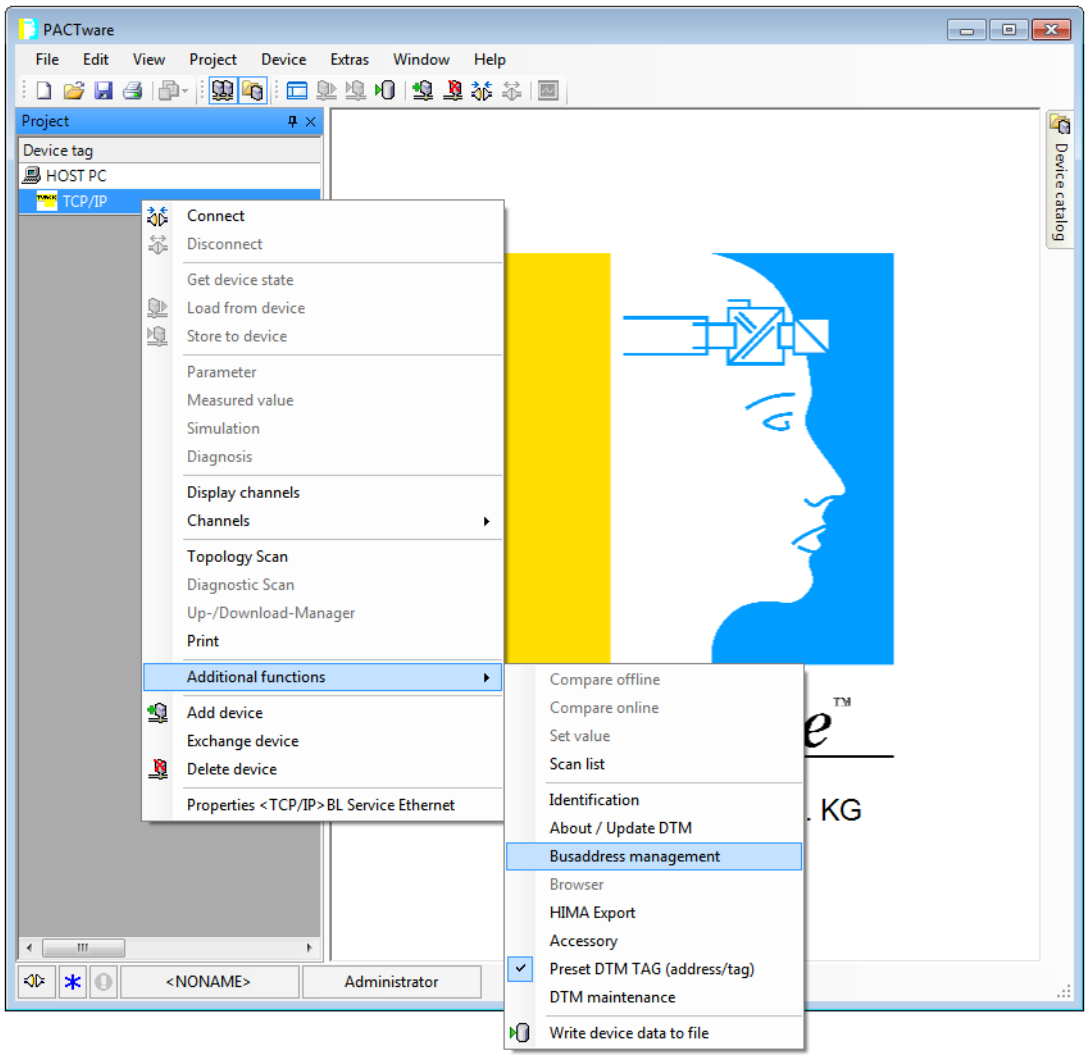


Fig. 13: Busaddress management

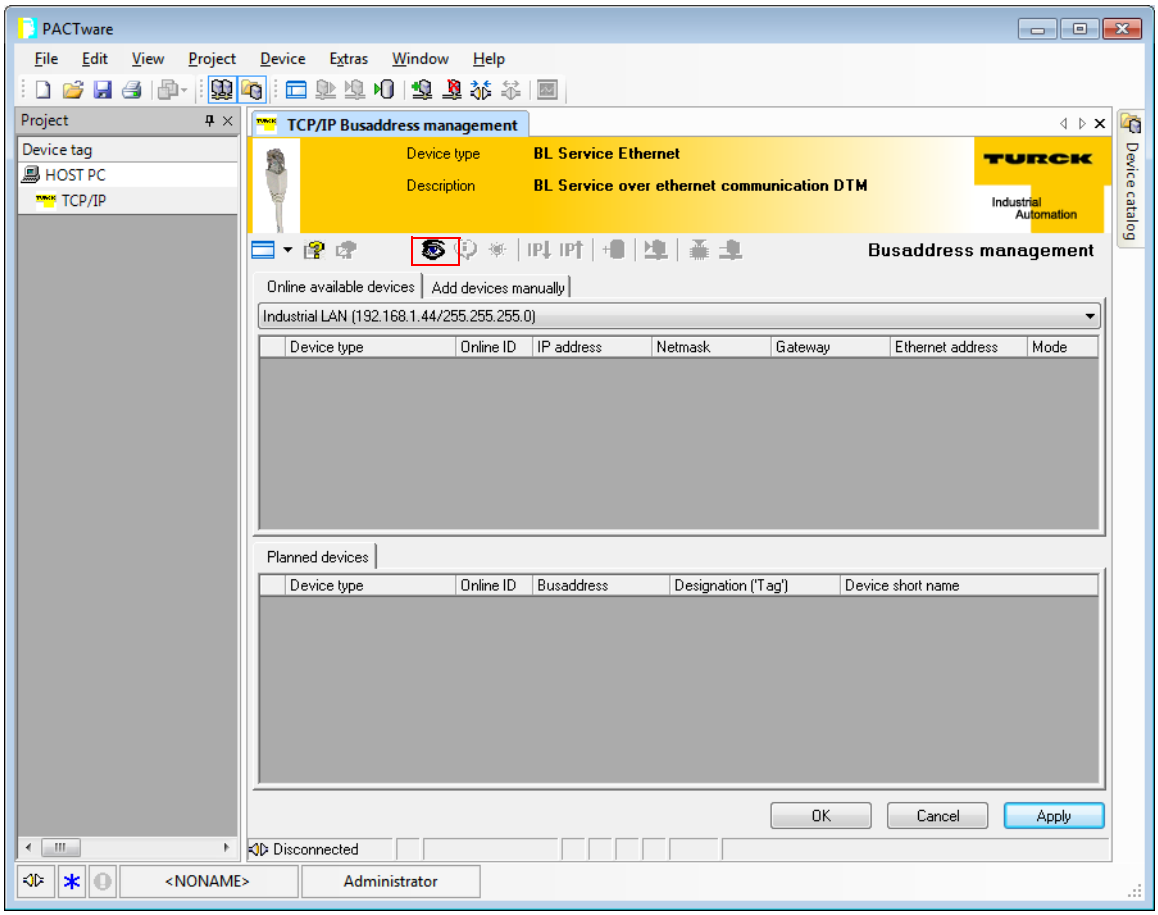


Fig. 14: Searching network-Nodes in the Busaddress management

NOTE

The access of the IO-ASSISTANT to the station is only possible, if the station already has an IP-address (see **Address assignment (page 17)**)

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

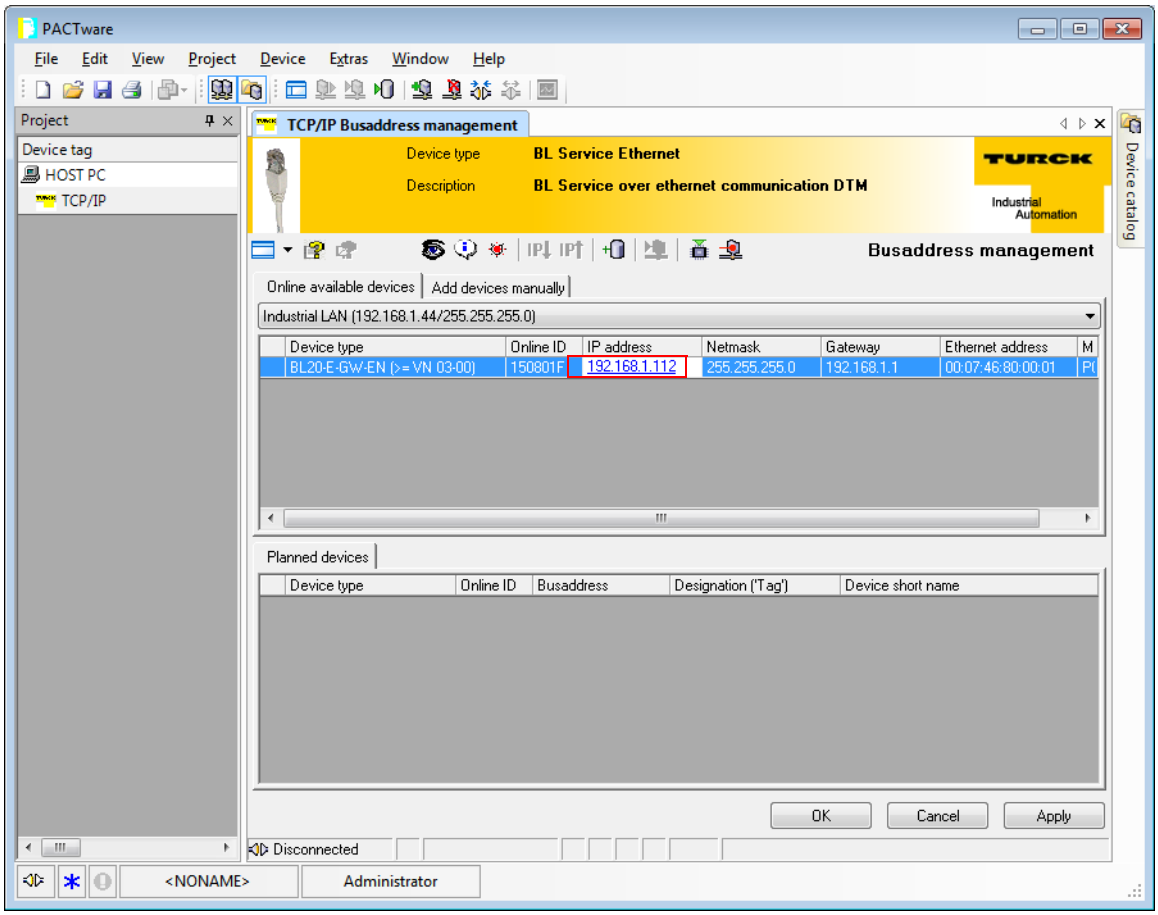


Fig. 15: IP address change

4.4.10 Addressing via Web server (Version ≥ 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 (Version ≥ ςN 03–00) (παγε 32)**.

NOTE

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

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

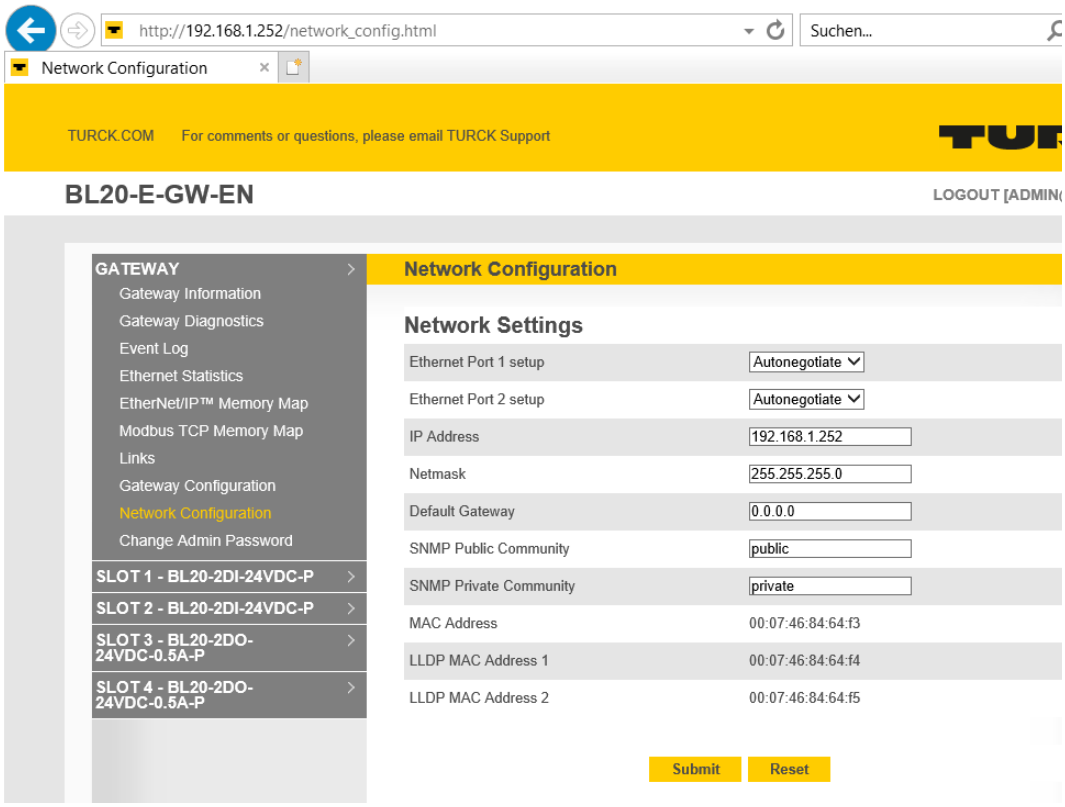


Fig. 16: Web server with Network Configuration

4.4.11 Addressing via IP Address Tool

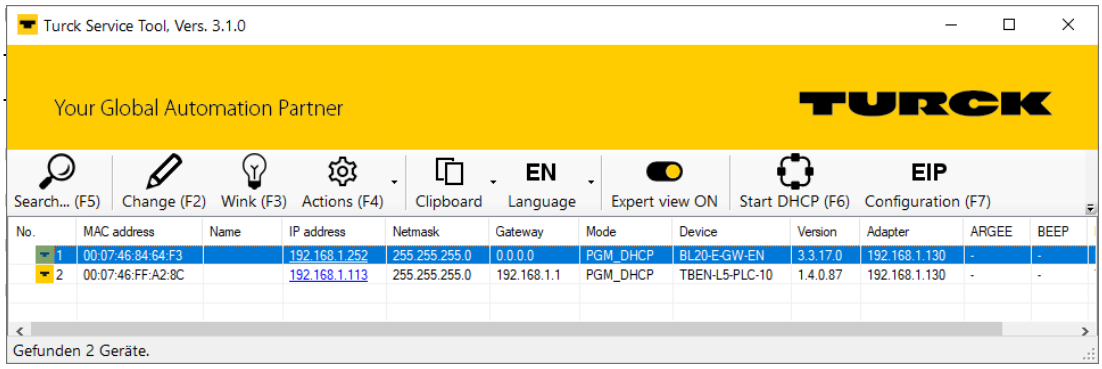


Fig. 17: IP Address Tool

4.5 Synchronization of the station configuration

4.5.1 DIP-switch CFG

The DIP-switch "CFG" at the gateway serves to take-over the Current Configuration of the BL20-station as Required Configuration to the gateway's non-volatile memory.

NOTE

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

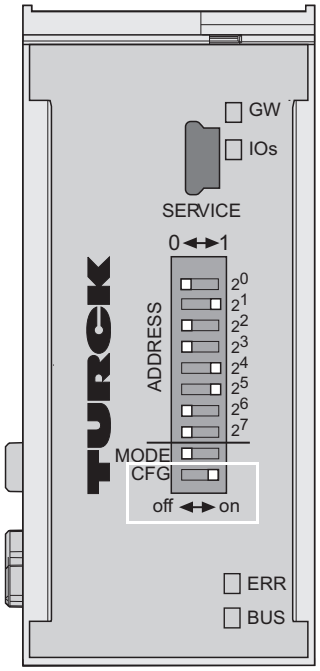


Fig. 18: DIP-switch for storing the station configuration

Switching from Off to On starts the storage of the Current Configuration as the Required Configuration (Reference configuration).

Procedure:

Switching the DIP-switch "CFG" from Off to On

→ Starting of storage process

→ LED IOs flashes green (1 Hz)

→ LED IOs shortly lits up orange

→ storage process active

→ set back the DIP-switch from On to Off

→ storage process terminated successfully, if the LEDs IOs and GW are constant green.

NOTE

If the DIP-switch is not set back, the gateway will continuously restart the storage process. Only setting the switch back from On to Off will terminate this process.

4.6 Web server - remote access/configuration (Version ≥ VN 03-00)

4.6.1 IP address

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

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

4.6.2 Access rights

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

In order to achieve administrator rights, please log-on to the web server, see **Login/password (page 33)**.

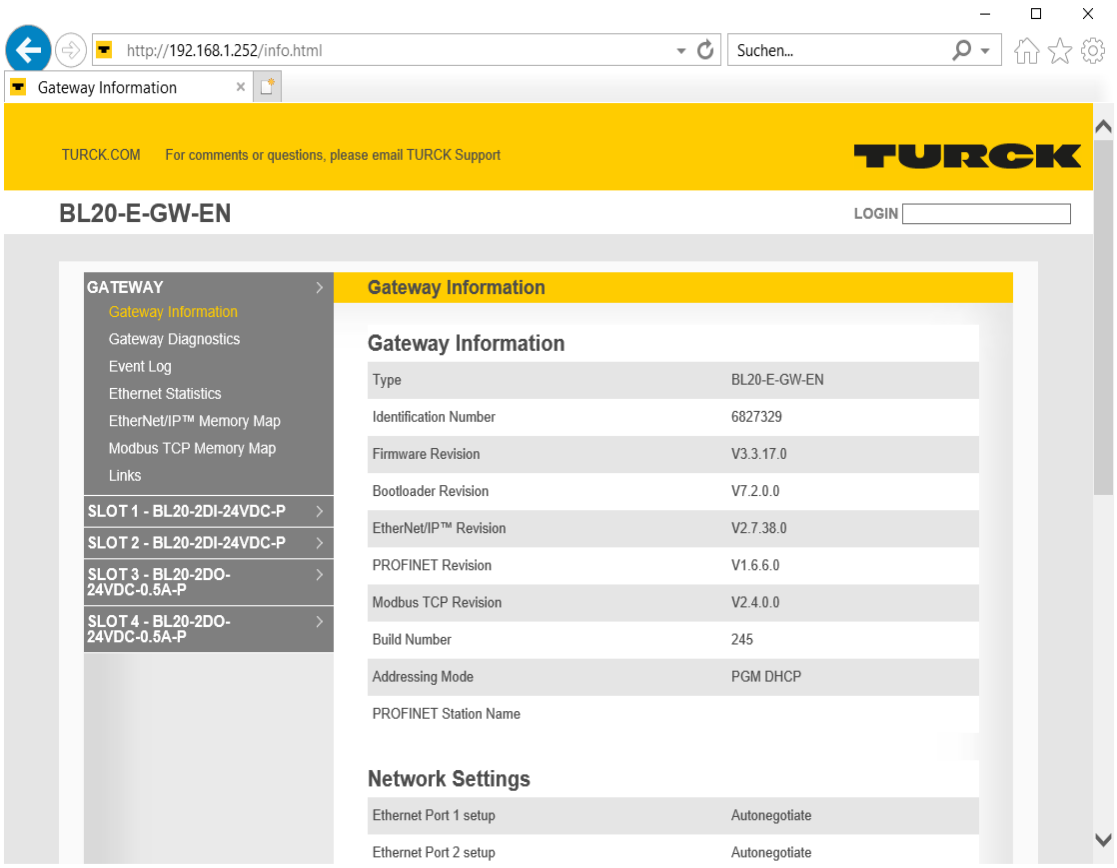


Fig. 19: Web server of the BL20-station

4.6.3 Login/password

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

The default-password can be changed by the administrator at every time under **Change Admin Password (page 39)** .

NOTE

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

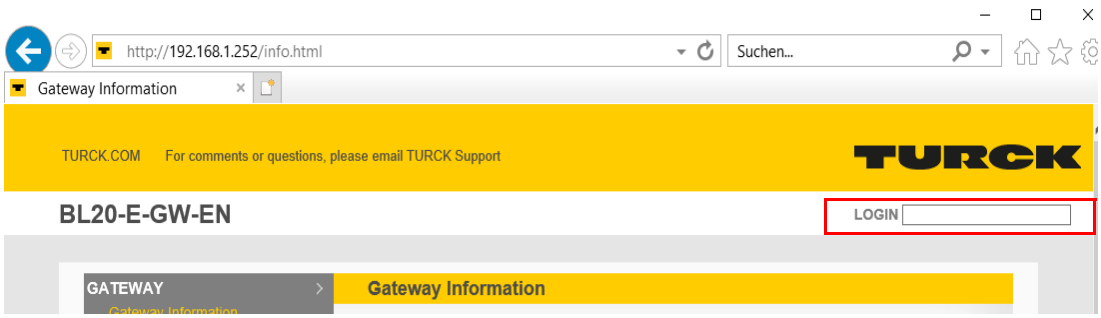


Fig. 20: Web server ”Home” screen

4.6.4 Network Configuration

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

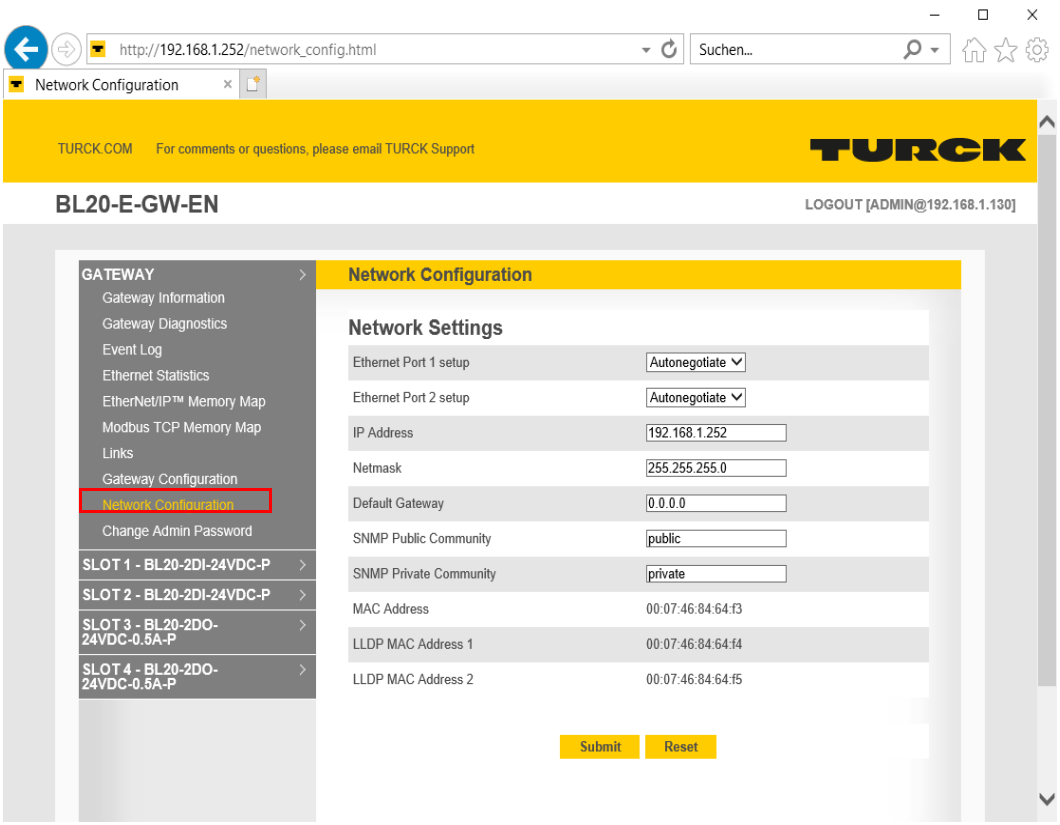


Fig. 21: Web server "Network Configuration"

4.6.5 Gateway Configuration

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

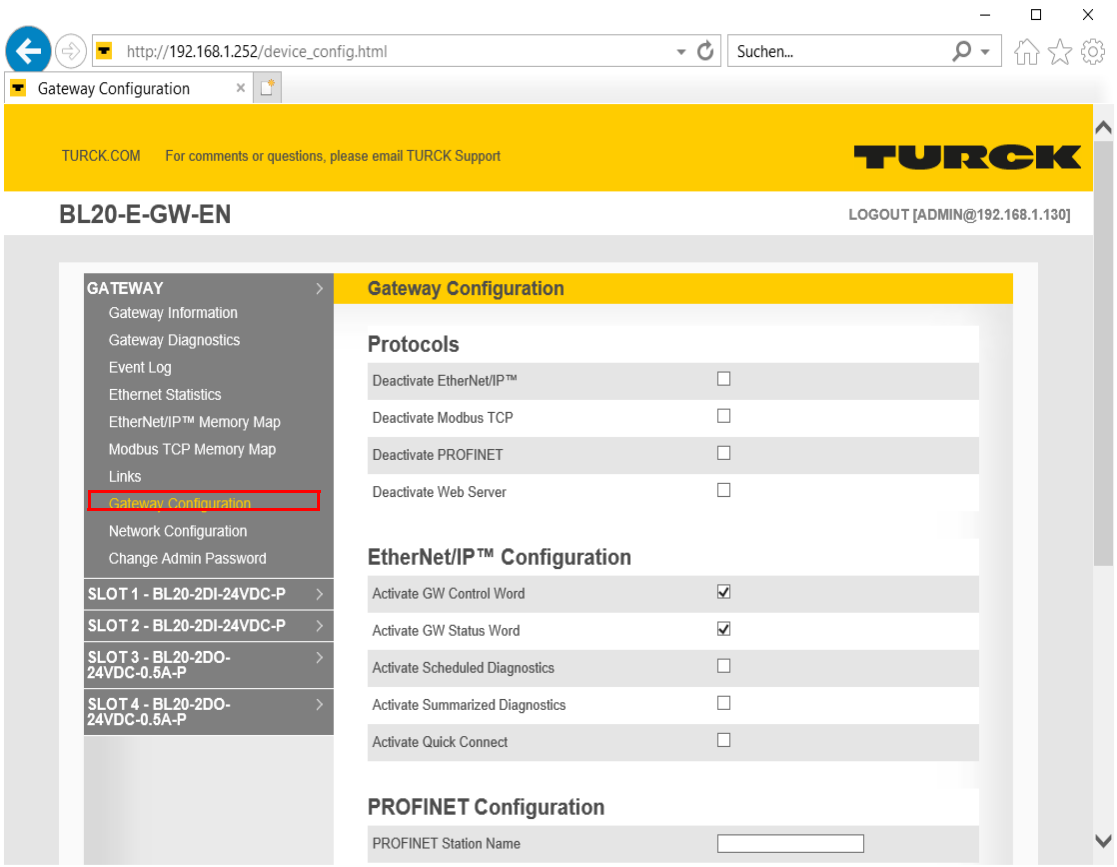


Fig. 22: Web server „Gateway Configuration"

4.6.6 Station Diagnostics

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

4.6.7 Ethernet Statistics

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

4.6.8 Links

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

4.7 The Turck IP Address Tool

4.7.1 IP address assignment with Turck IP Address Tool

In addition to web access, the IP-Address Tool provides a simple, small tool for finding a connected Turck device and changing the IP settings.

The software can be downloaded from **www.turck.de** under Downloads → Software → Service Tool".

HINWEIS

The tool works with UDP "broadcast" messages. This means that a device will be found even if the IP settings of the device and the IP settings of the PC do not match.
This makes the tool particularly useful for devices that have already been in use and whose network configuration is unknown.

Procedure:

After pressing the "Search" button, all Turck stations found in the network are displayed in a list.

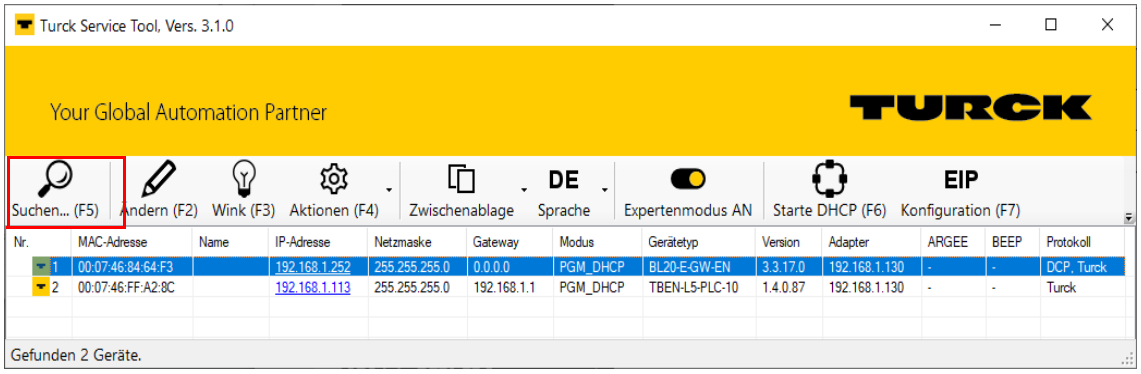


Abb. 23: IP-Address Tool, search function

The "Change" button can be used to adjust the network settings of the devices.

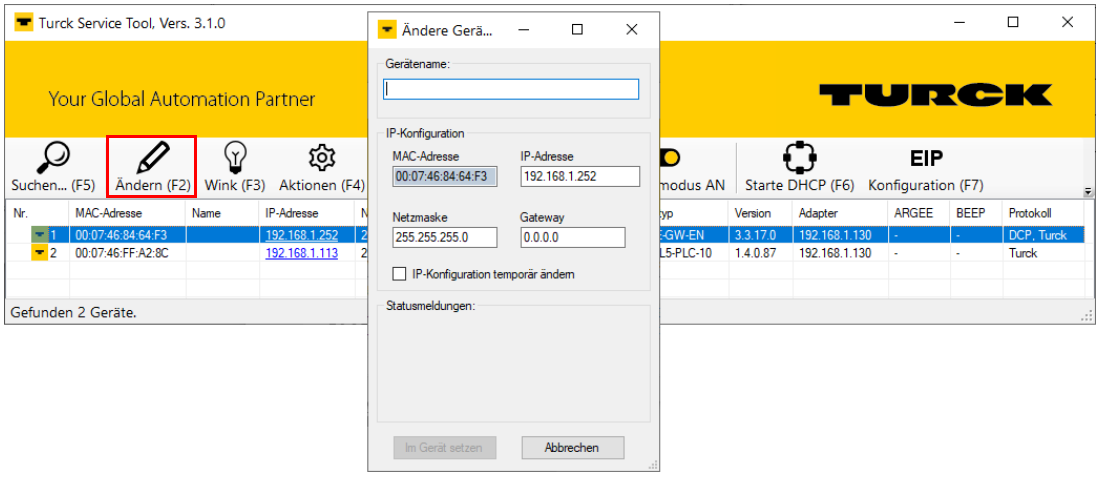


Abb. 24: IP-Address Tool, Changing IP Properties

The **Wink** function prompts an individual device to emit an LED signal. This is done to identify (localize) a device in a group of several similar devices in an existing plant or machine.

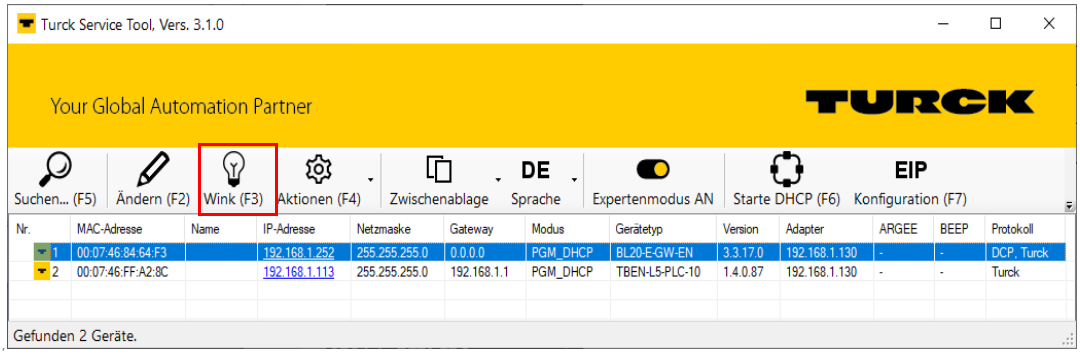


Abb. 25: IP Address Tool, Wink function

4.7.2 PROFINET name assignment with Turck IP Address Tool

The methods described above for recognition and addressing of the modules are to be regarded as general methods.

With Modbus TCP there is no standard for addressing/name assignment. Therefore the IP address assignment with web server or IP address tool is an important topic here.

When operating on PROFINET, the modules naturally support the protocols and tools for name assignment used in the PLC environment.
The Turck IP-Address Tool can be used for PROFINET name assignment. By using the PROFINET protocol DCP (Device Configuration Protocol), it should also always be possible to find connected devices and read the device information.

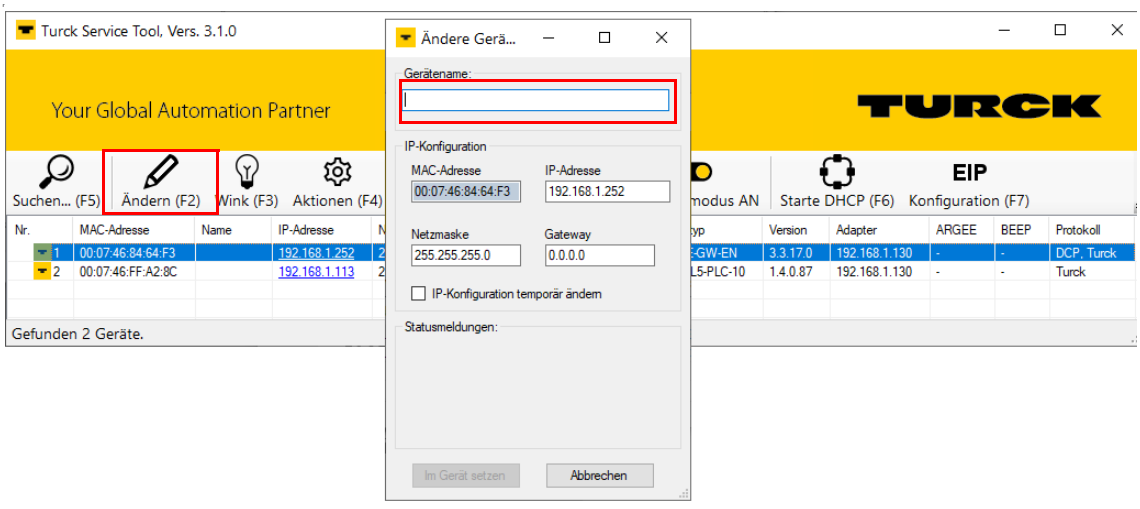


Abb. 26: IP Address Tool, PROFINET name assignment

4.7.3 “Reset to factory settings” with Turck IP Address Tool

Like the web server, the IP Address Tool, PROFINET name assignment allows you to reset the devices to their factory defaults.

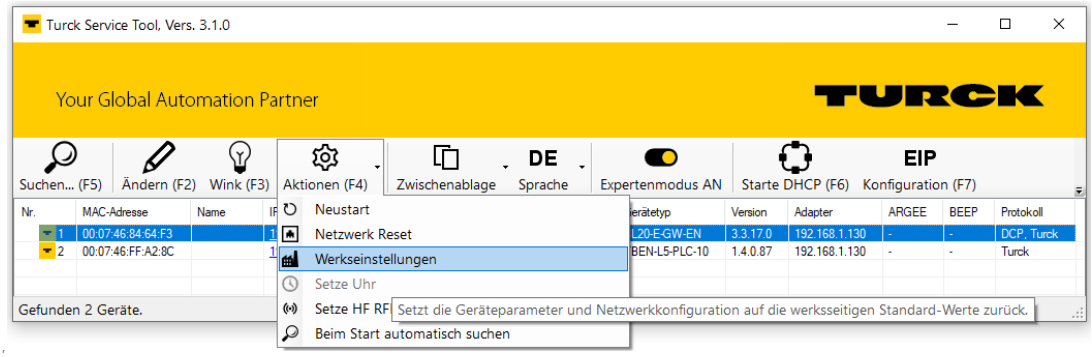


Abb. 27: IP Address Tool, reset to factory settings

4.7.4 Change Admin Password

Please define an individual password for administrator rights.

Default password. „password“

NOTE

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

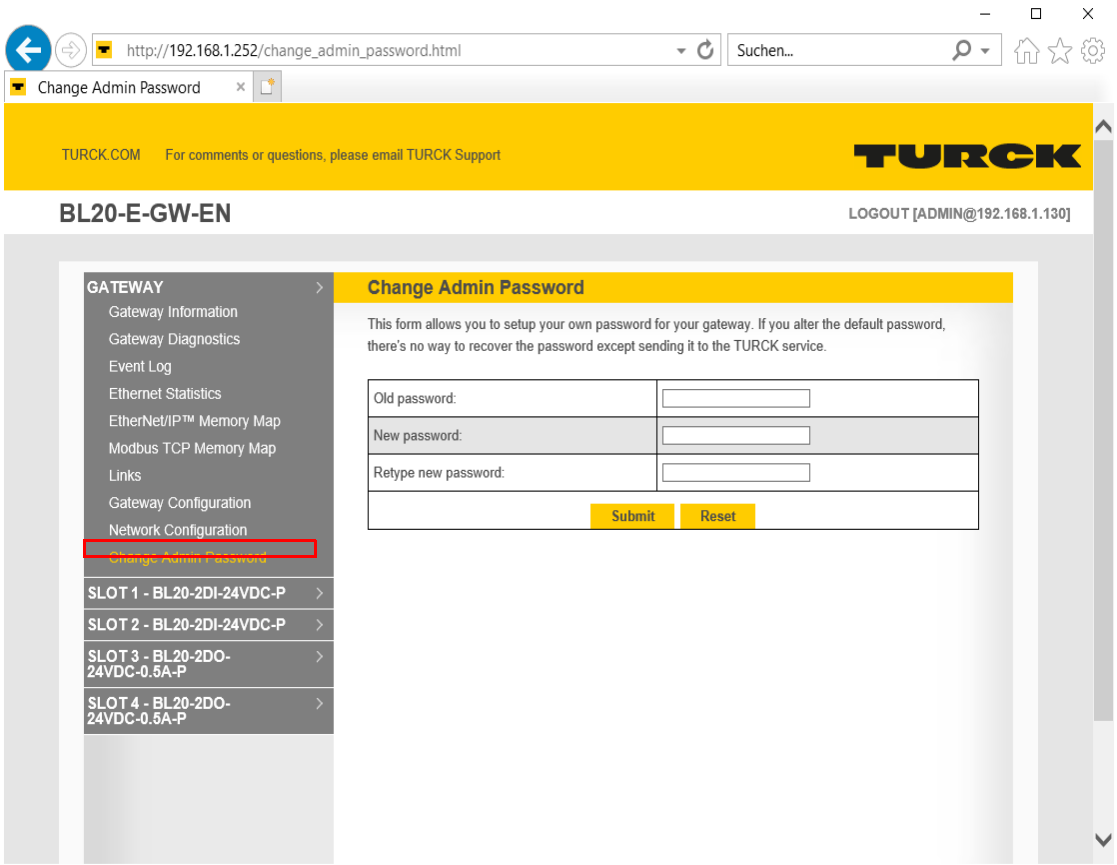


Fig. 28: Change Admin Password

4.8 Status and Control Word of the BL20-stations

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

- EtherNet/IP
  In EtherNet/IP, the mapping can be disabled (see **Gateway Class (VSC 100, 64h)**, and **GW Status Register (page 92)**).
- Modbus TCP → see **Register 0x100C: Gateway status (page 123)**
- PROFINET → see **Diagnosis in PROFINET (page 168)**

4.8.1 Status Word

	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status	**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

Meaning of the status bits

Name	Meaning
Diag Warn	Summarized diagnosis of the device. At least one I/O-module sends active diagnosis.
I/O Cfg Warn.	The station configuration has changed.
U_L low	Load voltage too low (< 18 V DC).
U_{sys} high	System supply voltage too high (> 30 V DC).
U_{sys} 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.

4.8.2 Control Word

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

4.9 Parameters of the I/O-modules

Default values are shown in **bold**.

4.9.1 Digital input modules

- BL20-4DI-NAMUR

Byte	Bit	Parameter name	Value – Meaning
0 to 3	0	input filter x	**0 = deactivate** – (input filter 0,25 ms) 1 = activate – (input filter 2,5 ms)
	1	digital input x	**0 = normal** 1 = inverted
	2	Short circuit monitoring x	**0 = deactivate** 1 = activate
	3	Short circuit diagnosis x	**0 = deactivate** 1 = activate
	4	Open circuit monitoring x	**0 = deactivate** 1 = activate
	5	Open circuit diagnosis x	**0 = deactivate** 1 = activate
	6	Input on diagnostic x	**0 = output substitute value** 1 = keep last value
	7	Substitute value on diag x	**0 = off** 1 = on

4.9.2 Analog input modules

- BL20-1AI-I(0/4…20MA)

Byte	Bit	Parameter name	Value
0	0	current mode	**0 = 0…20 mA**
			1 = 4…20 mA
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = activate**
			1 = deactivate

- BL20-2AI-I(0/4…20MA) (1 byte per channel)

Byte	Bit	Parameter name	Value
0/1	0	current mode	**0 = 0…20 mA**
			1 = 4…20 mA
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = activate**
			1 = deactivate
	3	Channel	**0 = activate**
			1 = deactivate

- BL20-1AI-U(-10/0…+10VDC)

Byte	Bit	Parameter name	Value
0	0	voltage mode	**0 = 0…10 V**
			1 = -10…+10 V
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = activate**
			1 = deactivate

- BL20-2AI-U(-10/0…+10VDC) (1 byte per channel)

Byte	Bit	Parameter name	Value
0/1	0	voltage mode	**0 = 0…10 V**
			1 = -10…+10 V
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = activate**
			1 = deactivate
	3	Channel	**0 = activate**
			1 = deactivate

- BL20-2AI-PT/NI-2/3 (2 byte per channel)

Byte	Bit	Parameter name	Value
0/2	0	Mains suppression	**0 = 50 Hz**
			0 = 60 Hz
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = release**
			1 = block
	3	Channel	**0 = activate**
			1 = deactivate
	7 to 4	element	**0000 = Pt100, -200…850 °C** 0001 = Pt100, -200…150 °C 0010 = Ni100, -60…250 °C 0011 = Ni100, -60…150 °C 0100 = Pt200, -200…850 °C 0101 = Pt200, -200…150 °C 0110 = Pt500, -200…850 °C 0111 = Pt500, -200…150 °C 1000 = Pt1000, -200…850 °C 1001 = Pt1000, -200…150 °C 1010 = Ni1000, -60…250 °C 1011 = Ni1000, -60…150 °C 1100 = resistance, 0…100 Ω 1101 = resistance, 0…200 Ω 1110 = resistance, 0…400 Ω 1111 = resistance, 0…1000 Ω
1/3	0	Measurement mode	**0 = 2 wire**
			1 = 3 wire

- BL20-2AI-THERMO-PI (2 byte parameters per channel)

Table 1:

Byte	Bit	Parameter name	Value
0/1	0	Mains suppression	**0 = 50 Hz**
			0 = 60 Hz
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = release**
			1 = block
	3	Channel	**0 = activate**
			1 = deactivate
	7 to 4	element	**0000 = Type K, -270…1370 °C** 0001 = Type B, +100…1820 °C 0010 = Type E, -270…1000 °C 0011 = Type J, -210…1200 °C 0100 = Type N, -270…1300 °C 0101 = Type R, -50…1760 °C 0110 = Type S, -50…1540 °C 0111 = Type T, -270…400 °C 1000 = ±50 mV 1001 = ±100 mV 1010 = ±500 mV 1011 = ±1000 mV … = reserved

- BL20-4AI-U/I (1 byte parameters per channel)

Table 2:

Byte	Bit	Parameter name	Value
0 to 3	0	range	**0 = 0…10 V/0…20 mA**
			1 = -10…+10 V/4…20 mA
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = release**
			1 = block
	3	Channel	**0 = activate**
			1 = deactivate
	4	Operation mode	**0 = voltage**
			1 = current

- BL20-4AI-U/I (1 byte parameters per channel)

Table 3:

Byte	Bit	Parameter name	Value
0 to 3	0	reserved	
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnosis	**0 = release**
			1 = block
	3	channel x	**0 = activate**
			1 = deactivate
	4	element Kx	**0000 = Type K, -270…1370 °C** 0001 = Type B, +100…1820 °C 0010 = Type E, -270…1000 °C 0011 = Type J, -210…1200 °C 0100 = Type N, -270…1300 °C 0101 = Type R, -50…1760 °C 0110 = Type S, -50…1540 °C 0111 = Type T, -270…400 °C 1000 = ±50 mV 1001 = ±100 mV 1010 = ±500 mV 1011 = ±1000 mV 1100 = Type K, -454…2498 °F 1101 = Type J, -346…2192 °F 1110 = Type C 0… 2315 °C 1111 = Type G 0… 2315 °C

- BL20-2AIH-I

Byte	Bit	Parameter name	Value
0 (channel 1)	0	Channel	**0 = activate**
			1 = deactivate
	1	short circuit diagnostics	0 = block
			1 = release
	2	open circuit diagnostics	0 = block
			1 = release
	3 + 4	Operation mode	0 = 0…20 mA (polling of HART-status not possible)
			1 = 4…20 mA (polling of HART-status not possible)
			2 = 4…20 mA HART active Cyclic polling of HART-status activated.
	5 + 6	reserved	
	7	HART-diagnostics	**0 = release**
			1 = block
1 (channel 1)	0 + 1	Value representation	**0 = Integer (15 bit + sign)**
			1 = NE 43
			2 = Extended Range
2 + 3 (channel 2)		similar to byte 0 + 1	
4	HART-Variable A		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

Byte	Bit	Parameter name	Value
5	HART-Variable B		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
6	HART-variable C		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
7	HART-variable D		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

- BL20-E-8AI-U/I-4PT/Ni (1 byte per channel)

Byte	Bit	Parameter name	Value	Meaning
0 to 7	0 to 5	Operation mode	000000	**voltage, -10…10 V DC Standard**
			000001	voltage …10 VDC, standard
			000010	voltage, -10…10 VDC, NE 43
			000011	voltage, 0…10 VDC, NE 43
			000100	voltage, -10…10 VDC, Extended Range
			000101	voltage, 0…10 VDC, Extended Range
			000110	reserved
			000111	reserved
			001000	current, 0…20 mA, standard
			001001	current, 4…20 mA, standard
			001010	current, 0…20 mA, NE 43
			001011	current, 4…20 mA, NE 43
			001100	current, 0…20 mA, Extended Range
			001101	current, 4…20 mA, Extended Range
			001110	reserved
			001111	reserved
			010000	Pt 100, -200°C…850 °C, 2-wire
			010001	Pt 100, -200°C…150 °C, 2-wire
			010010	Pt 200, -200°C…850 °C, 2-wire
			010011	Pt 200, -200°C…150 °C, 2-wire
			010100	Pt 500, -200°C…850 °C, 2-wire
			010101	Pt 500, -200°C…150 °C, 2-wire
			010110	Pt 1000, -200°C…850 °C, 2-wire
			010111	Pt 1000, -200°C…150 °C, 2-wire
In 3-wire measurement, only the first of the used channel has too be parameterized. The parameterization of the second channel is ignored.			011000	Pt 100, -200°C…850 °C, 3-wire
			011001	Pt 100, -200°C…150 °C, 3-wire
			011010	Pt 200, -200°C…850 °C, 3-wire
			011011	Pt 200, -200°C…150 °C, 3-wire
			011100	Pt 500, -200°C…850 °C, 3-wire
			011101	Pt 500, -200°C…150 °C, 3-wire
			011110	Pt 1000, -200°C…850 °C, 3-wire
			011111	Pt 1000, -200°C…150 °C, 3-wire
			100000	Ni 100, -60 °C…250 °C, 2-wire

Byte	Bit	Parameter name	Value	Meaning
			100001	Ni 100, -60°C…150 °C, 2-wire
			100010	Ni 1000, -60 °C…250 °C, 2-wire
			100011	Ni 1000, -60°C…150 °C, 2-wire
			100100	Ni 1000TK5000, -60 °C…250 °C, 2-wire
			100101	reserved
			100110	reserved
			100111	reserved
			101000	Ni 100, -60 °C…250 °C, 3-wire
			101001	Ni 100, -60°C…150 °C, 3-wire
			101010	Ni 1000, -60 °C…250 °C, 3-wire
			101011	Ni 1000, -60°C…150 °C, 3-wire
			101100	Ni 1000TK5000, -60 °C…250 °C, 3-wire
			101101	reserved
			101110	reserved
			101111	reserved
			110000	resistance, 0…250 Ω
			110001	resistance, 0…400 Ω
			110010	resistance, 0…800 Ω
			110011	resistance, 0…2000 Ω
			110100	resistance, 0…4000 Ω
			110101 to 111110	reserved
			111111	deactivated
	6	Value representation Kx	0	**Integer (15 bit + sign)**
			1	12 bit (left-justified)
	7	diagnostics Kx	0	**release**
			1	block

4.9.3 Analog output modules

- BL20-1AO-I(0/4…20MA)

Table 4:

Byte	Bit	Parameter name	Value
0	0	current mode	**0 = 0…20 mA**
			1 = 4…20 mA
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2 to 7	reserved	
1		Substitute value low byte	
2		Substitute value high byte	

- BL20-2AI-I(0/4…20MA) (3 byte per channel)

Table 5:

Byte	Bit	Parameter name	Value
0/3	0	current mode	**0 = 0…20 mA**
			1 = 4…20 mA
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	reserved	
	3	Channel	**0 = activate**
			1 = deactivate
	4 to 7	reserved	
1/4		Substitute value low byte	
2/5		Substitute value high byte	

- BL20-2AO-U(-10/0…+10VDC) (3 byte per channel)

Byte	Bit	Parameter name	Value
0/3	0	voltage mode	**0 = 0…10 V**
			1 = -10…+10 V
	1	Value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	reserved	
	3	Channel	**0 = activate**
			1 = deactivate
	4 to 7	reserved	
1/4		Substitute value low byte	
2/5		Substitute value high byte	

- BL20-2AOH-I

Byte	Bit	Parameter name	Value
0 (channel 1)	0	Channel	**0 = activate**
			1 = deactivate
	1	Diagnosis	**0 = block**
			1 = release
	3 + 4	Operation mode Kx	0 = 0…20 mA (polling of HART-status not possible)
			1 = 4…20 mA (polling of HART-status not possible)
			2 = 4…20 mA HART active (cyclic polling of HART-status activate)
	7	HART-diagnostics Kx	**0 = release**
			1 = block
1 (channel 1)	0+1	Value representation Kx	**0 = Integer (15 bit + sign)**
			1 = NE 43
			2 = Extended Range
	6 + 7	Behavior on module bus error Ax	
2+3 (channel 1)		substitute value Ax	
4 to 7 (channel 2)	similar to byte 0 to 3		

Byte	Bit	Parameter name	Value
8	HART-Variable A		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
9	HART-Variable B		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
10	HART-variable C		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

Byte	Bit	Parameter name	Value
11	HART-variable D		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

- BL20-E-4AO-U/I (3 byte parameters per channel)

Byte	Bit	Parameter name	Value	Meaning
0/3/6/9	0 to 3	Operation mode Kx	000000	**voltage, -10…10 V DC Standard**
			000001	voltage …10 VDC, standard
			000010	voltage, -10…10 VDC, NE 43
			000011	voltage, 0…10 VDC, NE 43
			000100	voltage, -10…10 VDC, Extended Range
			000101	voltage, 0…10 VDC, Extended Range
			000110	reserved
			000111	reserved
			001000	current, 0…20 mA, standard
			001001	current, 4…20 mA, standard
			001010	current, 0…20 mA, NE 43
			001011	current, 4…20 mA, NE 43
			001100	current, 0…20 mA, Extended Range
			001101	current, 4…20 mA, Extended Range

Byte	Bit	Parameter name	Value	Meaning
			001110	reserved
			001111	deactivated
	4	Value representation Kx	0	**Integer (15 bit + sign)**
			1	12 bit (left-justified)
	5	diagnostics Kx	0	**release**
			1	block
	6 + 7	substitute value options	00	output substitute value
			01	hold current value
			10	output min. value
			11	output max. value
1/4/7/10		substitute value Ax low byte		
2/5/8/11		substitute value Ax high byte		

4.9.4 Technology modules

- BL20-1RS232

Byte	Bit	Parameter name	Value
0	3 to 0	Data rate	0000 = 300 bps 0001 = 600 bps 0010 = 1200 bps 0100 = 2400 bps 0101 = 4800 bps **0110 = 9600 bps** 0111 = 14400 bps 1000 = 19200 bps 1001 = 28800 bps 1010 = 38400 bps 1011 = 57600 bps 1100 = 115200 bps … reserved
	5, 4	reserved	
	6	DisableReducedCtrl	Constant setting: The diagnostic messages are shown in Byte 6 of the process input data (independently from "Diagnosis"). Byte 6 of the process output data contains 2 bits, with which the receive or transmit buffer can be cleared. Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.
0	7	Diagnosis	**0 = release** – Diagnostic activated: This affects the separate fieldbus-specific diagnostic message – not the diagnosis embedded in the process input data.
			1 = block
1	0	Stop bits	**0 = 1 bit**
			1 = 2 bit
	2.1	Parity	00 = none
			01 = odd – The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
			10 = even – The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
	3	Data bits	**0 = 7** – The number of data bits is 7.
			1 = 8 – The number of data bits is 8.

Byte	Bit	Parameter name	Value
1	4 to 5	Flow control	**00 = none** – Data flow control is switched off. 01 = XON/XOFF – Software handshake (XON/XOFF) is switched on. 10 = RTS/CTS – Hardware handshake (RTS/CTS) is switched on.
	7.6	reserved	
2		XON character	0 – 255 (**17**) XON character: This character is used to start the transmission of data from the data terminal device if the software handshake is active.
3		XOFF character	0 – 255 (**19**) XOFF character This character is used to start the transmission of data from the data terminal device if the software handshake is active.

- BL20-1RS485/422

Byte	Bit	Parameter name	Value
0	3 to 0	Data rate	0000 = 300 bps 0001 = 600 bps 0010 = 1200 bps 0100 = 2400 bps 0101 = 4800 bps **0110 = 9600 bps** 0111 = 14400 bps 1000 = 19200 bps 1001 = 28800 bps 1010 = 38400 bps 1011 = 57600 bps 1100 = 115200 bps … reserved
	4	Select RS485	0 = parameterization of the module as RS422
			1 = parameterization of the module as RS485
	5	reserved	
	6	DisableReducedCtrl	Constant setting: The diagnostic messages are shown in Byte 6 of the process input data (independently from “Diagnosis”). Byte 6 of the process output data contains 2 bits, with which the receive or transmit buffer can be cleared. Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.
0	7	Diagnosis	**0 = release**
			1 = block

Byte	Bit	Parameter name	Value
1	0	Stop bits	**0 = 1 bit**
			1 = 2 bit
	2.1	Parity	00 = none
			01 = odd The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
			10 = even The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
	3	Data bits	**0 = 7** The number of data bits is 7.
			0 = 8 The number of data bits is 8.
2		XON character	0 – 255 (**17**) only in the RS422-mode: XON character: This character is used to start the transmission of data from the data terminal device if the software handshake is active.
3		XOFF character	0 – 255 (**19**) only in the RS422-mode: XOFF character: This character is used to start the transmission of data from the data terminal device if the software handshake is active.

- BL20-1SSI

Byte	Bit	Parameter name	Value – Meaning
0	4 to 0	reserved	
	5	Sensor idle data cable test	**0 = activate** ZERO test of data cable.
			1 = deactivate After the last valid bit, a ZERO test of the data cable is not carried out.
	7.6	reserved	
1	3 to 0	Number of invalid bits (LSB)	0000 to 1111: Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN -INVALID_BITS_MSB-INVALID_BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. (Default 0 bit = 0×0). INVALID_BITS_MSB +INVALID_BITS_LSB must always be less than SSI_FRAME_LEN.
1	6 to 4	Number of invalid bits (MSB)	000 to 111 Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. INVALID_BITS_MSB +INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0hex
	7	reserved	
2	3 to 0	Data rate	0000 = 1000000 bps **0001 = 500000 bps** 0010 = 250000 bps 0011 = 125000 bps 0100 = 100000 bps 0101 = 83000 bps 0110 = 71000 bps 0111 = 62500 bps … reserved
	7 to 4	reserved	

Byte	Bit	Parameter name	Value – Meaning
3	5 to 0	Number of data frame bits	00000 to 100000 Number of bits of the SSI data frame. SSI_-FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19hex
	6	reserved	
	7	Data type	**binary coded** SSI encoder sends data in binary code
			GRAY coded SSI encoder sends data in GRAY code

- BL20-E-1SWIRE

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	reserved	free	free	MC	MNA	configura-tion	Disable Cfg	free
Byte 2	free	U_{AUXERR}	TYP_{ERR}	TYP_{INFO}	PKZ_{ERR}	PKZ_{INFO}	SD_{ERR}	SD_{INFO}
Byte 3	reserved							
Byte 4	reserved (life guarding time until version VN 01-03)							
Byte 5	$SC_{DIAG}S8$	$SC_{DIAG}S7$	$SC_{DIAG}S6$	$SC_{DIAG}S5$	$SC_{DIAG}S4$	$SC_{DIAG}S3$	$SC_{DIAG}S2$	$SC_{DIAG}S1$
Byte 6	$SC_{DIAG}S16$	$SC_{DIAG}S15$	$SC_{DIAG}S14$	$SC_{DIAG}S13$	$SC_{DIAG}S12$	$SC_{DIAG}S11$	$SC_{DIAG}S10$	$SC_{DIAG}S9$
Byte 7	reserved							
Byte 8	reserved							
Byte 9 - 24	Type designation slave 1 - 16							

The following table shows the meaning of the parameter bits:

Parameter name	Value	
Byte 1		
Disable Cfg	If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE on power up (SW LED flashing), the physical structure of the SWIRE bus must be stored in the BL20-E-1SWIRE.	
	0 = inactive	Manual SWIRE configuration: To store the physical structure of the SWIRE bus in the BL20-E-1SWIRE, the CFG button of the BL20-E-1SWIRE must be pressed manually (only functions if the SW LED is flashing).
	1 = active	Automatic SWIRE configuration: If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE on power up, the physical structure is stored automatically in the BL20-E-1SWIRE.
configura-tion	PLC configuration check If the PLC configuration check is activated, the configuration stored in the BL20-E-1SWIRE is compared with the SET configuration stored in the PLC.	
	0 = active	The configuration stored in BL20-E-1SWIRE is compared with the SET configuration stored in the PLC. Only SWIRE slaves in the SWIRE bus are accepted that have a device ID completely matching the SET configuration.
	1 = inactive	All slaves are mapped in 4Bit INPUT/4Bit OUTPUT without checking the device ID.

Parameter name	Value	
Byte 1		
MNA active/passive	Configuration check Bus or slave-oriented configuration check (without function if MC = 1)	
	0 = Bus based	If the PLC configuration check is activated, data exchange is only started if the configuration stored in the BL20-E-1SWIRE fully matches the SET configuration stored in the PLC. Modifying the bus during operation causes the system to be aborted.
	1 = Slave based	If the PLC configuration check is activated, data exchange is started with all SWIRE slaves that match the SET configuration stored in the PLC. The SWIRE slaves that do not match the SET configuration stored in the PLC do not perform any data exchange.
MC	Moeller conformance (from version VN 01-04) Behavior of the BL20-E-1SWIRE in accordance with SWIRE Conformance criteria.	
	0 = inactive	Default behavior
	1 = active	The BL20-E-1SWIRE master responds according to the Moeller SWIRE Conformance criteria (see manual for the IO-modules D300717).
SD_{INFO}	Slave error field Activate slave diagnostics info field SD_{ERR}Sx. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	0 = active	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated
Byte 2		
SD_{ERR}	Group error - slave error Activate slave diagnostics SD_{ERR}Sx. Activate slave diagnostics SDERRSx. As soon as only one slave on the bus sets its error bit, this is indicated as a group error depending on the parameter setting.	
	0 = active	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated
PKZ_{INFO}	PKZ error field Activate slave diagnostics info field PKZ_{ERR}Sx. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	0 = active	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated
Byte 2		
PKZ_{ERR}	Group PKZ error field Activate slave diagnostics PKZ_{ERR}. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	0 = active	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated

Parameter name	Value	
TYP_{INFO}	Configuration error field As soon as a slave on the bus does not match the set configuration and therefore cannot be started, this is indicated as an individual error depending on the parameter set.	
	0 = active	Single diagnostics is activated
	1 = inactive	Single diagnostics is not activated
TYP_{ERR}	Group configuration error field Activate slave diagnostics TYP_{ERR}Sx. As soon as only one slave on the bus is incorrectly configured, this is indicated as an error depending on the parameter setting.	
	0 = active	Group diagnostics is activated
	1 = inactive	Group diagnostics is not activated
Byte 2		
U_{AUXERR}	Error message Voltage U_{AUX} - Activate system diagnostics U_{AUXERR}. U_{AUXERR} will generate an error message as soon as the power supply goes below a level at which the function of the relays is not guaranteed.	
	0 = active	Error message U_{AUXERR} activated
	1 = inactive	Error message U_{AUXERR} not activated
Byte 3	reserved	
Byte 4		
reserved (Lifeguarding time only up to version VN01-03)	Was up to version VN 01-03: Lifeguarding time of the SWIRE slaves. Lifeguarding time of the SWIRE slaves	
	0x02-0xFF **0x64**	Lifeguarding time of the SWIRE slaves Setting of lifeguarding time of SWIRE slaves, timeout time up to automatic reset of the slaves in the event of communication failure. (n * 10ms) (Default 1s) 0xFF: 0xFF: Lifeguarding off
Byte 5 - 6		
SD_{DIAG}Sx	Input bit communication error, slave x Slave diagnostics message from Byte 1/Bit 7 is accepted in the feedback interface as Bit 4	
	0 = active	SD_{DIAG}Sx is accepted
	1 = inactive	SD_{DIAG}Sx is not accepted
Byte 7 - 8	reserved	
Byte 9 to 24		
Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus	
	0x20	SWIRE-DIL-MTB (: 0xFF)
	0xFF	Basic setting (no slave)

- BL20-E-2CNT-2PWM (see separate manual for the module, **D301224**, „BL20 – I/O-MODULES BL20-E-2CNT-2PWM“, chapter 2)
- BL20-2RFID-S (see RFID-documentation **www.turck.de**)

4.10 Diagnostic messages of the modules

4.10.1 Power distribution modules

- BL20-BR-24VDC-D

Diagnostic byte	Bit	Diagnosis
n	0	Module bus voltage warning
	1	reserved
	2	Undervoltage field supply
	3	reserved

- BL20-PF-24VDC

Diagnostic byte	Bit	Diagnosis
n	0	reserved
	1	reserved
	2	Undervoltage field supply
		reserved

- BL20-PF-120/230VAC-D

Diagnostic byte	Bit	Diagnosis
n	0	reserved
	1	reserved
	2	Undervoltage field supply
		reserved

4.10.2 Digital input modules

- BL20-4DI-NAMUR

Diagnostic byte	Bit	Diagnosis
n	0	short circuit sensor 1
	1	open circuit sensor 1
	2	short circuit sensor 2
	3	open circuit sensor 2
	4	short circuit sensor 3
	5	open circuit sensor 3
	6	short circuit sensor 4
	7	open circuit sensor 4

4.10.3 Analog input modules

- BL20-1AI-I(0/4…20MA)

Diagnostic byte	Bit	Diagnosis
n (channel 1)	0	measurement value range error Only in the measurement range 4 to 20 mA
	1	Open circuit

- BL20-2AI-I(0/4…20MA)

Diagnostic byte	Bit	Diagnosis
n (channel 1)	0	measurement value range error Only in the measurement range 4 to 20 mA
	1	Open circuit
n + 1 (channel 2)	0	measurement value range error Only in the measurement range 4 to 20 mA
	1	Open circuit

- BL20-1AI-U(-10/0…+10VDC)

Diagnostic byte	Bit	Diagnosis
n (channel 1)	0	Measurement value range error

- BL20-2AI-U(-10/0…+10VDC)

Diagnostic byte	Bit	Diagnosis
n (channel 1)	0	Measurement value range error
n (channel 2)	0	Measurement value range error

- BL20-2AI-PT/NI-2/3

Diagnostic byte	Bit	Diagnosis
n (channel 1)	0	measurement value range error (Underflow diagnostics in temperature measurement ranges only) threshold: 1 % of the positive measurement range end value
	1	Open circuit
	2	Short circuit (in temperature measurement ranges only) threshold: 5 Ω (loop resistance)
	3 to 7	

- BL20-2AI-THERMO-PI

Diagnostic byte	Bit	Diagnosis
n	0	measurement value range error threshold: 1 % of the positive measurement range end value
	1	Open circuit (in temperature measurement ranges only)
	2 to 7	reserved

- BL20-2AIH-I

Diagnostic byte	Bit	Diagnosis
n	0	overflow The measurement value exceeds the value ranges and the device is not able to capture these values.
	1	Open circuit Displays an open circuit in the signal line.
	2	Short circuit Displays a short circuit in the signal line.
	3	undervoltage The measurement value is below the value ranges and the device is not able to capture these values.
	4	HART status-error The connected HART-device set a bit in the HART status-information (”status - polling”).
	5	HART communication error The channel does not allow communication with the HART-device.
	6	Invalid parameter
	7	Hardware error Shows common errors of the module hardware. The return analog value in case of an error is ”0”.

- BL20-4AI-U/I

Diagnostic byte	Bit	Diagnosis
n (channel 0) to n + 3 (channel 3)	0	measurement value range error threshold: 1% of the positive measurement range end value, underflow diagnostics only in value range 4…20 mA
	1	open circuit threshold: 3 mA (only in value range 4…20 mA)
	2 to 7	reserved

- BL20-E-8AI-U/I-4AI-PT/NI

Diagnostic byte	Bit	Diagnosis	
n (channel 0) to n + 7 (channel 7)	0	Measurement value range error (OoR)	thresholds: value representation of the module in manual D300716
	1	Wire break (WB)	
	2	Short circuit (SC)	
	3	Overflow/underflow (OUFL)	
	4 to 6	reserved	
	7	Hardware error	

4.10.4 Digital output modules

- BL20-2DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnosis
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-2DO-24VDC-0.5A-N

Diagnostic byte	Bit	Diagnosis
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-2DO-24VDC-2A-P

Diagnostic byte	Bit	Diagnosis
n	0	overcurrent (short-circuit channel 1)
	1	overcurrent (short-circuit channel 2)

- BL20-4DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnosis
n	0	overcurrent /short-circuit (1 ch. min)

- BL20-16DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnosis
n	0	Overcurrent (short-circuit channel 1-4)
	1	Overcurrent (short-circuit channel 5-8)
	2	Overcurrent (short-circuit channel 9-12)
	3	Overcurrent (short-circuit channel 13-16)

- BL20-32DO-24VDC-0.5A-P

Diagnostic byte	Bit	Diagnosis
n	0	Overcurrent (short-circuit channel 1-4)
	1	Overcurrent (short-circuit channel 5-8)
	2	Overcurrent (short-circuit channel 9-12)
	3	Overcurrent (short-circuit channel 13-16)
	4	Overcurrent (short-circuit channel 17-20)
	5	Overcurrent (short-circuit channel 21-24)
	6	Overcurrent (short-circuit channel 25-28)
	7	Overcurrent (short-circuit channel 29-32)

4.10.5 Analog output modules

- BL20-2AOH-I

Diagnostic byte	Bit	Diagnosis
n	0	Value above upper limit Display of a measurement range exceeding→ limit values according to parameterization
	1	Open circuit Displays an open circuit in the signal line.
	2	invalid value The output value exceeds the values which the module is able to interpret.
	3	value below lower limit Display of a measurement range underflow → limit values according to parameterization
	4	HART status error The connected HART-device set a bit in the HART status-information (”status - polling”).
	5	HART communication error The channel does not allow communication with the HART-device.
	6	Invalid parameter
	7	Hardware error Shows common errors of the module hardware. The return analog value in case of an error is ”0”.

- BL20-E-4AO-U/I

Diagnostic byte	Bit	Diagnosis	
n (channel 0) to n + 3 (channel 3)	0	Measurement value range error (OoR)	thresholds: value representation of the module in manual D300716
	1	Reserved	
	2	Reserved	
	3	Overflow/underflow (OUFL)	
	4 to 6	Reserved	
	7	Hardware error	

4.10.6 Technology modules

- BL20-1CNT-24VDC

Diagnostic byte	Bit	Diagnosis
n if bit 7=0 (counter mode)	0	Short-circuit/open circuit DO → ERR_DO
	1	Short-circuit in sensor power supply, 24 V DC → ERR-24VDC
	2	End of counter range wrong
	3	Start of counter range wrong
	4	Invert-DI+latch-retr. not perm. It is not permitted to invert the level of the digital input when using the latch-retrigger-function
	5	Main count direction wrong
	6	Operating mode wrong
	7	Measurement mode Bit = 0 Counter mode active
n If bit 7 = 0 (measure-ment mode)	0	Short-circuit/open circuit DO → ERR_DO
	1	Short-circuit in sensor power supply, 24 V DC → ERR-24VDC
	2	Sensor pulse wrong
	3	Integration time wrong
	4	Upper limit wrong
	5	Lower limit wrong
	6	Operating mode wrong
	7	Measurement mode Bit = 1 measurement operation is active

- BL20-1RS232

Diagnostic byte	Bit	Diagnosis
n	0	parameterization error
	1	Hardware failure
	2	Data flow control error
	3	frame error
	4	buffer overflow

- BL20-1RS485/422

Diagnostic byte	Bit	Diagnosis
n	0	Parameterization error
	1	Hardware failure
	2	Data flow control error (only in the RS422-mode)
	3	Frame error
	4	Buffer overflow

- BL20-1SSI

Diagnostic byte	Bit	Diagnosis
n	0	SSI group diagnostics
	1	Open circuit
	2	Sensor value overflow
	3	Sensor value underflow
	4	Parameterization error

- BL20-E-1SWIRE

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte n	GENE-RAL$_{ERR}$	U$_{SWERR}$	free	COM$_{ERR}$	free	RDY$_{ERR}$	free	SW$_{ERR}$
Byte n+1	free	U$_{AUXERR}$	TYP$_{ERR}$	free	PKZ$_{ERR}$	free	SD$_{ERR}$	free
TYP$_{ERR}$ field								
Byte n+2	TYP$_{ERR}$S8	TYP$_{ERR}$S7	TYP$_{ERR}$S6	TYP$_{ERR}$S5	TYP$_{ERR}$S4	TYP$_{ERR}$S3	TYP$_{ERR}$S2	TYP$_{ERR}$S1
Byte n+3	TYP$_{ERR}$S 16	TYP$_{ERR}$ S15	TYP$_{ERR}$ S14	TYP$_{ERR}$ S13	TYP$_{ERR}$ S12	TYP$_{ERR}$ S11	TYP$_{ERR}$ S10	TYP$_{ERR}$S9
Slave diagnosis								
Byte n+4	SD$_{ERR}$S8	SD$_{ERR}$S7	SD$_{ERR}$S6	SD$_{ERR}$S5	SD$_{ERR}$S4	SD$_{ERR}$S3	SD$_{ERR}$S2	SD$_{ERR}$S1
Byte n+5	SD$_{ERR}$S16	SD$_{ERR}$S15	SD$_{ERR}$S14	SD$_{ERR}$S13	SD$_{ERR}$S12	SD$_{ERR}$S11	SD$_{ERR}$S10	SD$_{ERR}$S9
PKZ field								
Byte n+6	PKZ$_{ERR}$S8	PKZ$_{ERR}$S7	PKZ$_{ERR}$S6	PKZ$_{ERR}$S5	PKZ$_{ERR}$S4	PKZ$_{ERR}$S3	PKZ$_{ERR}$S2	PKZ$_{ERR}$S1
Byte n+7	PKZ$_{ERR}$S1 6	PKZ$_{ERR}$S1 5	PKZ$_{ERR}$S1 4	PKZ$_{ERR}$S1 3	PKZ$_{ERR}$S1 2	PKZ$_{ERR}$S1 1	PKZ$_{ERR}$S1 0	PKZ$_{ERR}$S9

The following table shows the meaning of the diagnostic bits:

Designation	Value	Meaning	
Byte 1			
SW_{ERR}	SWIRE MASTER		
	If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE, this bit indicates an error.		
	0	Data exchange	The physical structure of the SWIRE bus was accepted and the SWIRE bus is in operation.
	1	Offline	The physical structure was not accepted, the SWIRE bus does not start operation (SW LED flashing).
RDY_{ERR}	SPS SLAVE		
	This bit indicates an error if the configuration stored in the BL20-E-1SWIRE does not match the SET configuration stored in the PLC.		
	0	Data exchange	No error present. The SWIRE bus is ready for data exchange.
	1	Offline	The configuration stored in the BL20-E-1SWIRE was not accepted. The data exchange is prevented (RDY LED flashing).
COM_{ERR}	Communication SWIRE		
	A communication error is present, such as a slave is no longer reached, its internal timeout has elapsed or communication is faulty. The master cannot carry out data exchange with at least one slave.		
	0	OK	No error present.
	1	faulty	An error is present.
U_{SWERR}	Voltage U_{SW}		
	Voltage fault in U_{SW}, voltage (17 VDC) for supplying the SWIRE slaves		
	0	OK	No error present.
	1	under voltage	An error is present.
$GENERAL_{ERR}$	Error message		
	The creation of a function block shows that systems/function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.		
	0	none	No diagnostics message present
	1	present	One/several diagnostics messages present
Byte 2			
SD_{ERR}	Communication SWIRE slave		
	If the parameter SD_{ERR}A is set for group diagnostics, this bit indicates an error as soon as only one slave on the bus sets its SD_{ERR}.		
	0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1	faulty	An error is present.

Designation	Value	Meaning	
PKZ_{ERR}	Overcurrent protective circuit-breaker		
	If the parameter PKZ_{ERR}A is set for group diagnostics, this bit indicates an error as soon as only one PKZ of a slave has tripped.		
	0	OK	No PKZ error is present or diagnostics function has been deactivated via the parameter setting.
	1	Tripping	At least one PKZ has tripped.
TYP_{ERR}	configuration		
	If the TYP_{ERR} parameter is set with group diagnostics in the parameter setting, this bitindicates an error as soon as a PLC configuration check detects differing slave numbers,types or position of an SWIRE slave.		
	0	OK	The PLC configuration check was positive (the configuration stored in the BL20-E-1SWIRE matches the SET configuration stored in the PLC) or the diagnostics function is deactivated via the parameter setting.
	1	faulty	A mismatch was determined in the PLC configuration check.
U_{AUXERR}	Voltage U_{AUX}		
	If the U_{AUXERR}A parameter is activated, $_{AUXERR}$ will generate an error message as soon as the power supply goes below the level at which the function of the relays is not guaranteed.		
	0	OK	Contactor supply voltage is o.k. (> 20 VDC) or diagnostics function has been deactivated via this parameter.
	1	under voltage	Contactor supply voltage is not o.k. (< 18 VDC).
Byte 3.4			
TYP_{ERR}Sx	Device configuration, slave x		
	Info field for the individual indication of a configuration error as error message. Info field for the individual indication of a configuration error as error message. If theTYP_{INFO} parameter is set with individual diagnostics, the error is indicated in this bit fieldas soon as a PLC configuration check detects differing slave numbers, types or positionof an SWIRE slave.		
	0	OK	No configuration error is present and the slave is in data exchange mode or diagnostics function has been deactivated via the parameter setting.
	1	incorrect	Configuration error present and the slave is NOT in data exchange mode.
Byte 5.6			
SD_{ERR}Sx	Communication, slave x		
	Info field for the individual indication of the release of the slave diagnostics as error message. If the SD_{INFO}A is set for single diagnostics, this bit field indicates the error as soon as the slave diagnostic message of the slave Sx is triggered.		
	0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1	Offline	A diagnostics message is present.
Byte 7.8			

Designation	Value	Meaning	
$PKZ_{ERR}Sx$	Overcurrent protective circuit-breaker, slave x		
	Info field for the individual indication of the tripping a motor-protective circuit-breaker (PKZ) as error message. If the $PKZ_{INFO}A$ is set for single diagnostics, this bit field indicates the error as soon as the PKZ of the slave Sx has tripped.		
	0	OK	The PKZ of the slave has not tripped or diagnostics function has been deactivated via the parameter setting.
	1	tripped	The PKZ of the slave has tripped

NOTE

The error messages U_{AUXERR}, TYP_{ERR}, $TYP_{ERR}Sx$, PKZ_{ERR}, $PKZ_{ERR}Sx$, SD_{ERR} and $SD_{ERR}Sx$ can be deactivated by a respective parameterization.

- BL20-E-2CNT-2PWM (see separate manual for this module **D301224**)
- BL20-2RFID-S (see RFID-documentation **www.turck.de**)

5 Implementation of EtherNet/IP

5.1 The EtherNet/IP Communications Profile

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

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

I/O Messages

I/O Messages serve to exchange high priority process and application data over the network.

Communication between the slaves in the EtherNet/IP network is carried out according to the Server/Client Model,

which means a producing application transmits data to another or a number of consuming applications. It is quite possible that information is passed to a number of Application Objects in a single device.

Explicit Messages

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

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.

5.1.1 Communications Profile for BL20

BL20 behaves as an EtherNet/IP Server in the network; the scanner of the higher-level controller operates as a EtherNet/IP Client.

The following EtherNet/IP communications types are supported:

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

Unicast

A point-to-point connection that exists between two nodes only.

Multicast

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

COS I/O Connection

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

Cyclic I/O Connection

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

UCMM

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

UCMM-based explicit messaging is normally used for random, non-periodic requests.

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

Connected Explicit Messaging

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

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

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

5.2 Device Level Ring (DLR)

The BL20-E-GW-EN (FW-Version ≥ V 3.2.8.0) supports DLR.

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.

5.3 Diagnostic messages via the process data

Besides the evaluation of diagnostic data via Explicit Messages, BL20 with EtherNet/IP offers the possibility of mapping diagnostic data into the process data (see also the stations' process data mappings (s. p. 83 ff.).

2 different forms of diagnostic data handling are provided:

- summarized diagnostics
- Scheduled Diagnostics

5.3.1 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 s. p. 83).

Bit „I/O Diag Warn"

0 = OK, no diagnostics present

at least one module sends diagnostics (acc. to VSC 100, Gateway Class, Attr. 116, s. p. 91)

5.3.2 Scheduled Diagnostics

If scheduled diagnostics is activated (Process Data Class (VSC102, 66h) (page 93)), the manufacturer specific diagnostic bits are mapped into the station's process data(s. p. 77 ff.).

The scheduled diagnostic data is placed at the end of the input data and after the summarized diagnostic data (see s. p. 83).

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 tothe gateway.

Word	Byte	Data
0	0	slot-no. of the module which sends an emergency-frame.
	1	Status process release: bit 5 = 1: diagnostic active bit 6 = 1: wrong module bit 7 = 1 Module pulled (acc. to VSC 100, Gateway Class, Attr. 116, s. p. 91)
n		Module diagnostics from the module actually referenced by the roundrobin mechanism.

5.4 Classes and Instances of the EtherNet/IP-stations

5.4.1 EtherNet/IP Standard Classes

The BL20-stations support the following EtherNet/IP Standard Classes in accordance with the CIP specification.

Class Code	Object name
01 (0x01)	Identity Object (0x01)
04 (0x04)	Assembly Object (0x04)
06 (0x06)	Connection Manager Object (0x06)
245 (0xF5)	TCP/IP Interface Object (0xF5)
246 (0xF6)	Ethernet Link Object (0xF6)

5.4.2 Identity Object (0x01)

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 BL20.

Class Attributes

Attr. No.	Attribute name	Get/Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
6 (0x06)	MAX CLASS ATTRIBUTE	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	7

Object-instance 1 - instance attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	VENDOR	G	UINT	Contains the vendor ID. Turck = 48
2 (0x02)	PRODUCT TYPE	G	UINT	Indicates the general type of product. Communications Adapter 12_{dez} = 0x0C
3 (0x03)	PRODUCT CODE	G	UINT	Identifies a particular product within a device type. Default: 27247_{dec} = 6A6F
4 (0x04)	REVISION Major Minor	G	STRUCT OF: USINT USINT	Revision of the item the Identity Object is representing. 0x01 0x06
5 (0x05)	DEVICE STATUS	G	WORD	
6 (0x06)	SERIAL NUMBER	G	UDINT	Contains the ident-no. of the product (3 last bytes of the MAC-ID).
7 (0x07)	PRODUCT NAME LENGTH NAME	G	STRUCT OF: USINT STRING [13]	

Device Status

Bit	Name	Definition
0 …1	reserved	Default = 0
2	Configured	TRUE = 1 → The application of the device has been configured (≠ default-settings).
3	reserved	Default = 0
4 …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 …15	reserved	Default = 0

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All Returns a predefined list of the object's attributes.
05 (0x05)	no	yes	Reset Starts the reset service for the device.
14 (0x0E)	yes	yes	Get_Attribute_Single Returns the contents of a specified attribute.
16 (0x10)	no	no	Set_Attribute_Single Modifies a single attribute.

5.4.3 Assembly Object (0x04)

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 BL20.

Class Attributes

Attr. No.	Attribute name	Get/Set	Type	Value
1 (0x01)	REVISION	G	UINT	2
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	104

Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
3 (0x03)	DATA	S	ARRAY OF BYTE	
4 (0x04)	SIZE	G	UINT	UINT Number of bytes in attr. 3 256 or variable

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	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 s. p. 32)

+ process data

Instance 102

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

2 Bytes Control data (mapped, but not defined)

+ process data

Instance 103 und Instance 104

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

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

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

Mapping of process data

The process data image of the BL20-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 precedingword, follows on from another output module16-bit input data is reached and further input modules follow

Produced Data (word no.)	**Input data**
0	Status Word of the gateway Mapping can be disabled using attr. 138 in VSC100, object instance 2, s. p. 91)
1 …n	Input data of modules An example mapping can be found in chapter 6.3, I/O data mapping (page 104).
n + x	Summarized diagnostic data (s. p. 77) of individual length (1 bit per module which sends diagnostics). Can be enabled/disabled using VSC102, Object instance 3, attr. 104, s. p. 93 ff. (x = the no. of following bytes depending on the no. of slices within the station)
n + y	Scheduled diagnostic data (s. p. 77).. Can be enabled/disabled using VSC102, Object instance 3, attr. 105, s. p. 93 ff. (y = data length for the scheduled diagnostics set according to the properties of the modules attached to the gateway)
Consumed Data (word no.)	**Output data**
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 s. p. 92).
1- n	Output data of modules An example mapping can be found in chapter 6.3, I/O data mapping (page 104).

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.

5.4.4 Connection Manager Object (0x06)

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

The following description of the Ethernet Link Object is taken from the CIP specification, Vol. 2, Rev. 2.1 by ODVA & ControlNet International Ltd. and adapted to BL20.

Common Services

Service code	Class	Instance	Service name
84 (0x54)	no	yes	FWD_OPEN_CMD (Opens a connection)
78 (0x4E)	no	yes	FWD_CLOSE_CMD (Closes a connection)
82 (0x52)	no	yes	UNCONNECTED_SEND_CMD

5.4.5 TCP/IP Interface Object (0xF5)

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 BL20.

Class Attributes

Attr. No.	Attribute name	Get/Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0x03)	NUMBER OF INSTANCES	G	UINT	1
6 (0x06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Object instance 1: instance attribute

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	STATUS	G	DWORD	Interface status
2 (0x02)	CONFIGURATION CAPABILITY	G	DWORD	Interface Capability Flag
3 (0x03)	CONFIGURATION CONTROL	G/S	DWORD	Interface Control Flag
4 (0x04)	PHYSICAL LINK OBJECT	G	STRUCT	
	Path size		UINT	Number of 16bit words: 0x02
	path		Padded EPATH	0x20, 0xF6, 0x24, 0x01
5 (0x05)	INTERFACE CONFIG-URATION	G	Structure of:	TCP/IP Network Interface Configuration (
	IP address	G	UDINT	Current IP address
	NETWORK MASK	G	UDINT	Current network mask
	GATEWAY ADDR.	G	UDINT	Current default gateway
	NAME SERVER	G	UDINT	0 = no name server address configured
	NAME SERVER 2		UDINT	0 = no secondary name server address config-ured
	DOMAIN NAME	G	UDINT	0 = no Domain Name configured
6 (0x06)	HOST NAME	G	STRING	0 = no Host Name configured
12 (0x0C)	Quick Connect	G/S	BOOL	0 = deactivate 1 = activate

Common Services

Service code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
02 (0x02)	no	no	Set_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
16 (0x10)	no	yes	Set_Attribute_Single

- **Interface Status**
  The Status attribute indicates the status of the TCP/IP network interface.
  Refer to the state diagram **TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1) (page 87)** for a description of object states as they relate to the Status attribute.

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.

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.

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

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

- **Host Name**
  The Host Name attribute contains the device's host name.
  The host name attribute is used when the device supports the DHCP-DNS Update capability and has been configured to use DHCP upon start up.
  The mechanism allows the DHCP client to transmit its host name to the DHCP server. The DHCP server then updates the DNS records on behalf of the client.

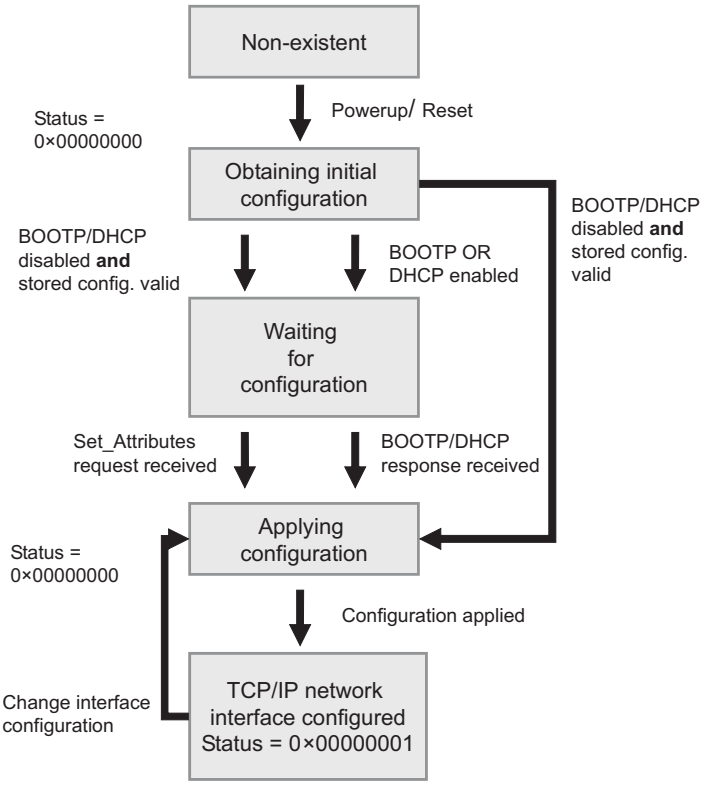


Fig. 29: TCP/IP object state diagram (acc. to CIP Spec., Vol.2, Rev. 1.1)

5.4.6 Ethernet Link Object (0xF6)

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 BL20.

Class Attributes

Attr. No.	Attribute name	Get/Set	Type	Value
1 (0x01)	REVISION	G	UINT	1
2 (0x02)	MAX OBJECT INSTANCE	G	UINT	1
3 (0x03)	NUMBER OF INSTANCES	G	UINT	1
6 (0x06)	MAX CLASS IDENTIFIER	G	UINT	7
7 (0x07)	MAX INSTANCE ATTRIBUTE	G	UINT	6

Instance Attributes

Attr. No.	Attribute name	Get/ Set	Type	Description
1 (0x01)	INTERFACE SPEED	G	UDINT	Speed in megabits per second (e.g., 10, 100, 1000, etc.)
2 (0x02)	INTERFACE FLAGS	G	DWORD	
3 (0x03)	PHYSICAL ADDRESS	G	ARRAY OF USINT	Contains the interface's MAC address (Turck: 00:07:46:xx:xx:xx)
6 (0x06)	INTERFACE CONTROL		2 WORD	Allows port-wise changes of the Ethernet-settings
7 (0x07)	INTERFACE TYPE			
10 (0x0A)	INTERFACE LABEL			

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

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

Common Services

Service-Code	Class	Instance	Service name
01 (0x01)	yes	yes	Get_Attribute_All
14 (0x0E)	yes	yes	Get_Attribute_Single
76 (0x4C)	no	yes	Enetlink_Get_and_Clear

5.5 VSC-Vendor Specific Classes

In addition to supporting the above named CIP Standard Classes, the BL20-stations support the vendor specific classes described in the following.

Class Code dec. (hex.)	Name	Description
100 (64h)	Gateway Class, s. p. 91	Contains data and settings concerning the fieldbus-specific part of the BL20-stations.
102 (66h)	Process Data Class, s. p. 93	Contains process data
126 (1Ah)	Miscellaneous Parameters Class, s. p. 95	Describes the EtherNet/IP-Port properties

5.5.1 Class Instance of the VSCs

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.

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.

5.5.2 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 VSCs (page 90) for the description of the class instance for the VSC.

Object Instance 1, Boot instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
100 (64h)	Max object attribute	G	USINT	Contains the number of the last object attribute to be implemented.
101 (65h)	Hardware revision	G	STRUCT	Contains the hardware revision number of the station (USINT Maj./USINT Min.)
102 (66h)	Firmware revision	G	STRUCT	Contains the 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, gateway instance

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
109 (6Dh)	Status register 2	G	STRUCT	The Status Word contains general station status information: **Station** – Bit 15: reserved – Bit 14: "Force Mode Active Error" The Force Mode is activated. – Bit 13: reserved – Bit 12: reserved **Internal bus** – Bit 11: "I/O Cfg Modified Error" The configuration has been changed in an incompatible way. – Bit 10: "I/O Communication Lost Error" Communication on the internal module bus disturbed. **Voltage errors** – Bit 09: "U_{sys} too low" System voltage too low (< 18 VDC). – Bit 08: "U_{sys} too high" System supply voltage too high (> 30 VDC). – Bit 07: "U_L too low" Load voltage too low (< 18 VDC). – Bit 06: 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 (0x8A)	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)
139 (0x8B)	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)

Attr. No. dec. (hex.)	Attribute name	Get/ Set	Type	Description
140 (0x8C)	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

5.5.3 Process Data Class (VSC102, 66h)

This class contains the process-relevant information.

Class instance

NOTE

Please refer to paragraph **Class Instance of the VSCs**, s. **p. 90** for the description of the class instance for the VSC.

Object instance 1, standard input process data (compressed)

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

Object instance 2, standard output process data (compressed)

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

Object Instance 3, diagnostic instance

Attr. No. dec. (hex.)	Attribute name	Get/Set	Type	Description
104 (68h)	GW summarized diagnostics	G/S	BOOL	0 = disabled 1 = active 1 bit of diagnosis mapped at the end of the input data image (s. p. 77). Changes become valid after a start-up.
105 (69h)	GW manufacturer specific diagnostics (scheduled diagnostics)	G/S	BOOL	0 = disabled 1 = active The channel-specific diagnostic bits are mapped into the process input data (s. p. 77). Changes become valid after a start-up.
106 (6Ah)	reserved			-

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

5.5.4 Miscellaneous Parameters Class (VSC 126)

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

Attr. No. dec. (hex.)	Attribute name	Get/Set	Type	Description
109 (6Dh)	Ethernet port Parameters	G/S	DWORD	**0 = Autonegotiate, AutoMDIX** 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.

6 BL20-E-GW-EN with EtherNet/IP (Allen Bradley)

6.1 General

The following example shows detailed information about the connection of a BL20-station for EtherNet/IP to an Allen Bradley PLC.

6.1.1 Used hard-/software

Hardware

Hardware used in this example:

- Allen Bradley PLC 1769-L30-ER/A Compact Logix5330ER Controller
- BL20-E-GW-EN (> VN 03-00, IP: 192.168.1.16)
  - Slot 1: BL20-2DI-24VDC-P
  - Slot 2: BL20-4DI-24VDC-P
  - Slot 3: BL20-1AI-U(-10/0…+10VDC)
  - Slot 4: BL20-2AI-THERMO-PI
  - Slot 5: BL20-2DO-24VDC-0.5A-P
  - Slot 6: BL20-E-8DO-24VDC-0.5A-P

Software

Software used in this example:

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

6.2 Network configuration

BL20-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 BL20-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 4.4, Address assignment (page 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 215)**.

6.2.1 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.

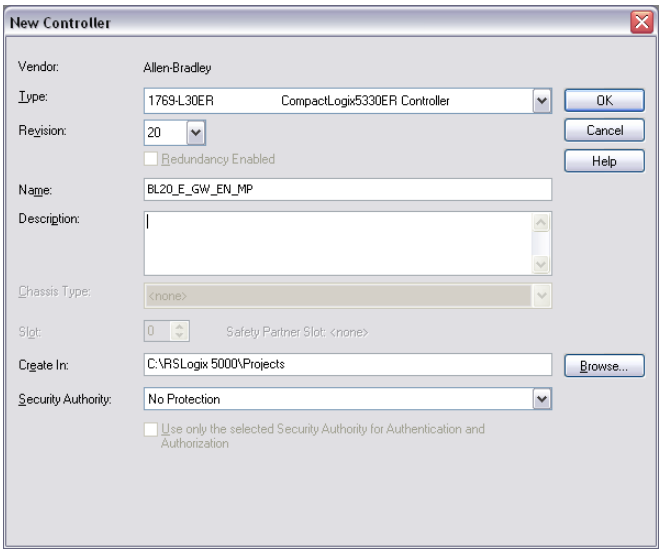


Fig. 30: Configuration of the controller

2 Your project will be opened offline.

3 Open the context menu by right-clicking "Ethernet" and select "New Module" in order to add the BL20-station to the network.

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

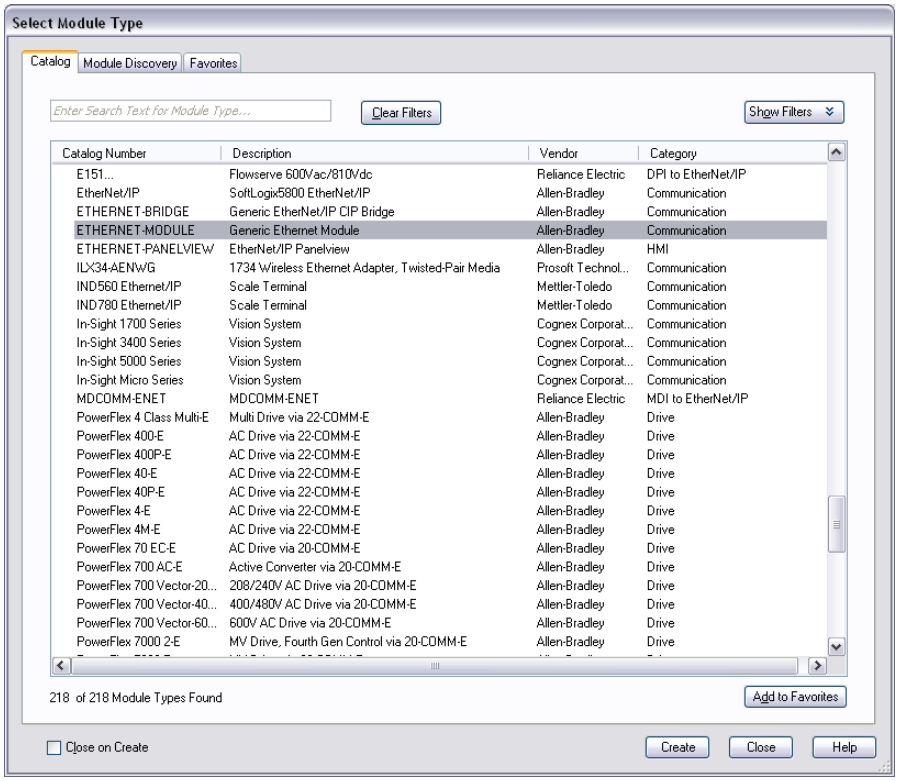


Fig. 31: Add generic Ethernet module

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

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

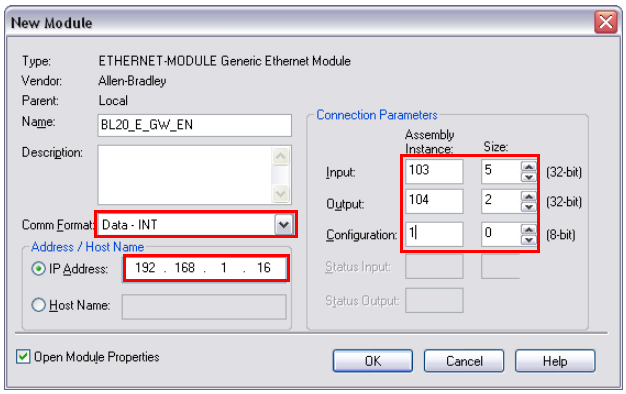


Fig. 32: Configuring the BL20-station

NOTE

If the variable Assembly Instances 103 and 104 are used, the Connection Parameters have to be set according to the actual station configuration.
That 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.

OR

Read out the correct size of in- and output data via Assembly Class (0×04), Instance 0×67, Attr. 0x04 and Assembly Class (0x04), Instance 0x68, Attr. 0x04.

1. EtherNet/IP report

1.1. Station description

Station address: 192.168.1.112

Adr./Slot	Name	TAG	Descr.	Data Size In	Data Size Out
Slot 0*	BL20-E-GW-EN (>= VN 03-00)	192.168.1.112/BL20-E-GW-EN (>= VN 03-00)	Term0A	16 bit	16 bit
Slot 1	BL20-2DI-24VDC-P	01/BL20-2DI-24VDC-P	Term0B	2 bit	0 bit
Slot 2	BL20-4DI-24VDC-P	02/BL20-4DI-24VDC-P	Term0C	4 bit	0 bit
Slot 3	BL20-1AI-U(-10/0...+10VDC)	03/BL20-1AI-U(-10/0...+10VDC)	Term0D	16 bit	0 bit
Slot 4	BL20-2AI-THERMO-PI	04/BL20-2AI-THERMO-PI	Term0E	32 bit	0 bit
Slot 5	BL20-2DO-24VDC-0.5A-P	05/BL20-2DO-24VDC-0.5A-P	Term0F	0 bit	2 bit
Slot 6	BL20-E-8DO-24VDC-0.5A-P	06/BL20-E-8DO-24VDC-0.5A-P	Term0G	0 bit	8 bit
	Local I/O data incl. status/control			5 Words	2 Words
Total size for in/out data rounded on full words				**5 Words**	**2 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-ASSISTANT mapping results have thus to be converted into the respective data format.

PLC-configuration:
Values for Assembly Instance 103 (input data): 5 Words
Values for Assembly Instance 104 (output data): 2 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).

Fig. 33: EtherNet/IP-report (PLC-configuration)

A Data to enter into assembly instances in RS Logix

7 In the "Connection" tab set the "Requested Packet Interval" (RPI) to 10 ms, which normally should be the default setting. For BL20, the RPI should be set to 5 ms or higher.

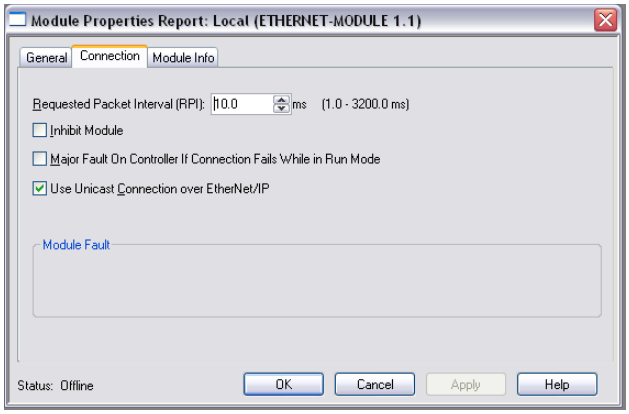


Fig. 34: Set connection options for the gateway

8 The station is now added to the project tree.

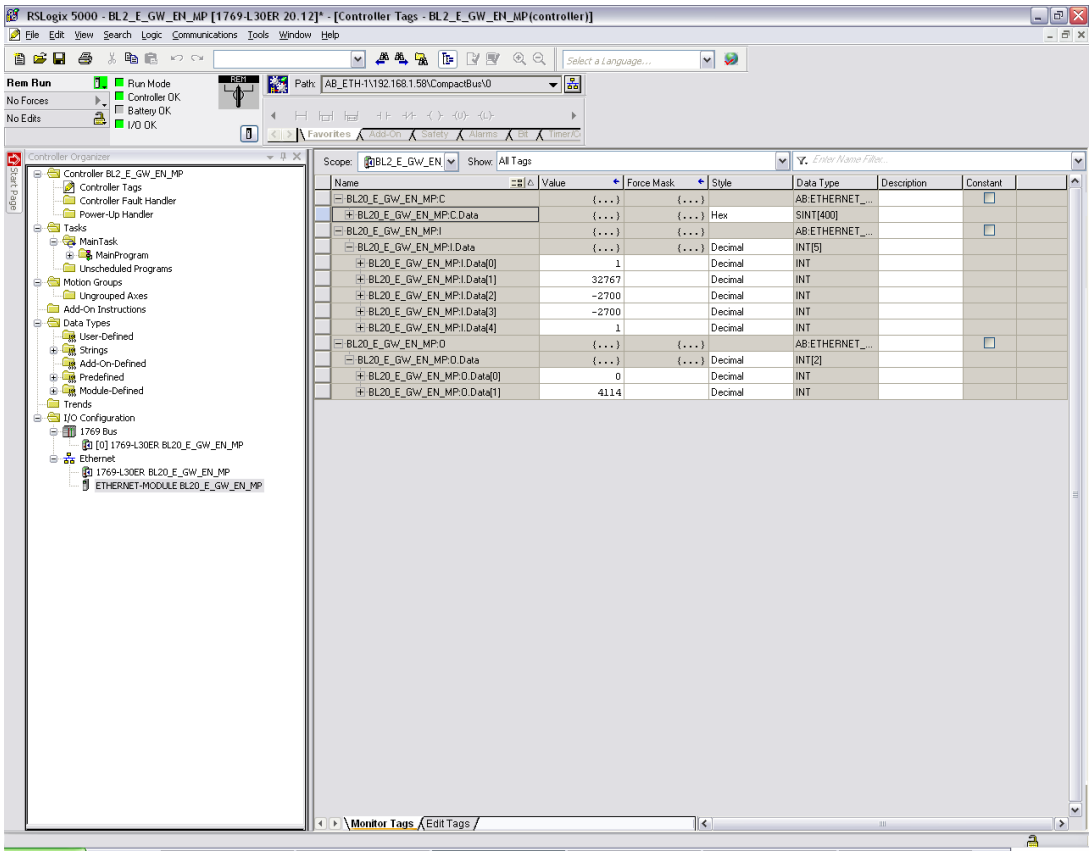


Fig. 35: Project tree with stations

6.2.2 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.

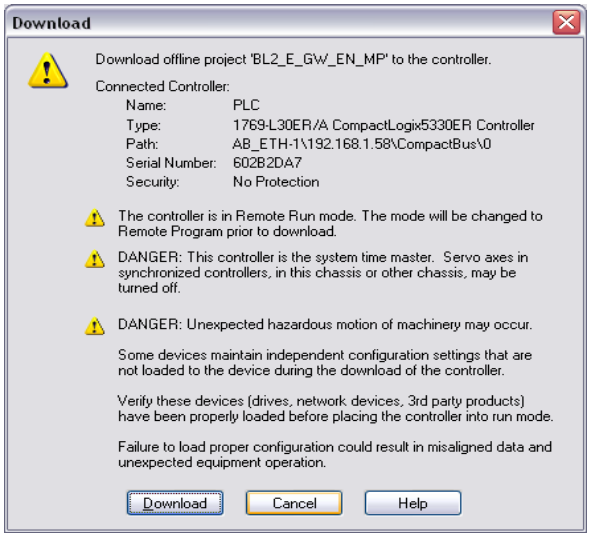


Fig. 36: Download of the configuration

3 If an error message is generated, warning, that the communication path can not be found, please open the "Path" menu, select your controller and press "Set Project Path".

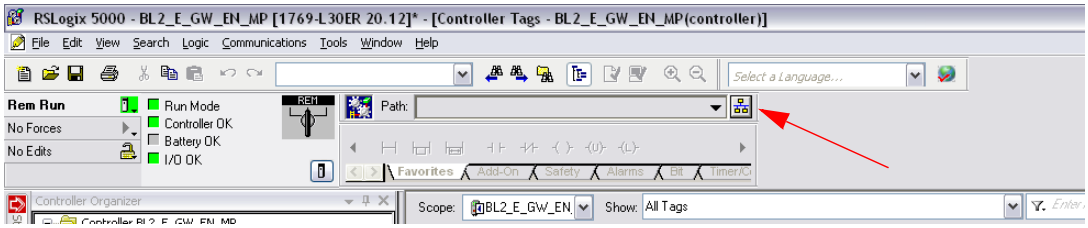


Fig. 37: Communication path

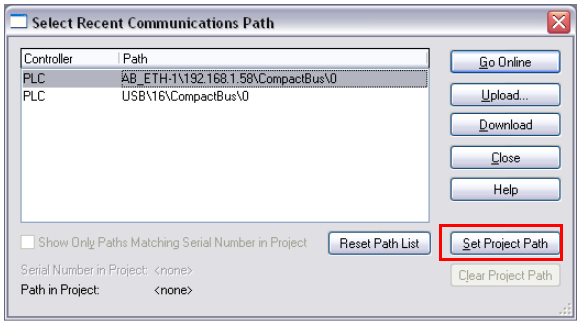


Fig. 38: Set project path

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

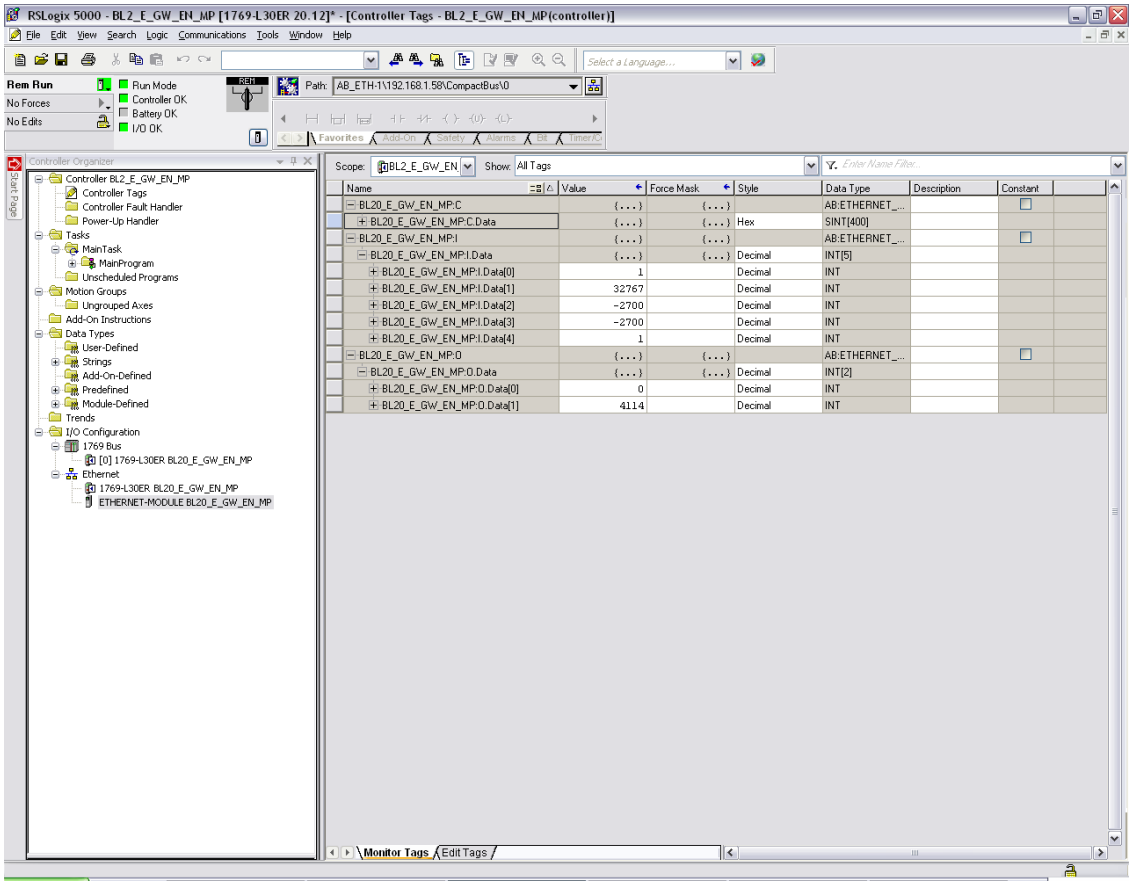


Fig. 39: Controller Tags

The controller tags are divided into:

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

6.3 I/O data mapping

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

The data mapping depends on process data mappings of the configured modules.

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

1. EtherNet/IP report

1.1. Station description

Station address: 192.168.1.112

Adr./Slot	Name	TAG	Descr.	Data Size In	Data Size Out
Slot 0*	BL20-E-GW-EN (>= VN 03-00)	192.168.1.112/BL20-E-GW-EN (>= VN 03-00)	Term0A	16 bit	16 bit
Slot 1	BL20-2DI-24VDC-P	01/BL20-2DI-24VDC-P	Term0B	2 bit	0 bit
Slot 2	BL20-4DI-24VDC-P	02/BL20-4DI-24VDC-P	Term0C	4 bit	0 bit
Slot 3	BL20-1AI-U(-10/0...+10VDC)	03/BL20-1AI-U(-10/0...+10VDC)	Term0D	16 bit	0 bit
Slot 4	BL20-2AI-THERMO-PI	04/BL20-2AI-THERMO-PI	Term0E	32 bit	0 bit
Slot 5	BL20-2DO-24VDC-0.5A-P	05/BL20-2DO-24VDC-0.5A-P	Term0F	0 bit	2 bit
Slot 6	BL20-E-8DO-24VDC-0.5A-P	06/BL20-E-8DO-24VDC-0.5A-P	Term0G	0 bit	8 bit
	Local I/O data incl. status/control			5 Words	2 Words
Total size for in/out data rounded on full words				**5 Words**	**2 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-ASSISTANT mapping results have thus to be converted into the respective data format.

PLC-configuration:
Values for Assembly Instance 103 (input data): 5 Words
Values for Assembly Instance 104 (output data): 2 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.3	0C.2	0C.1	0C.0	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	0E.15	0E.14	0E.13	0E.12	0E.11	0E.10	0E.9	0E.8	0E.7	0E.6	0E.5	0E.4	0E.3	0E.2	0E.1	0E.0
Word4	0E.31	0E.30	0E.29	0E.28	0E.27	0E.26	0E.25	0E.24	0E.23	0E.22	0E.21	0E.20	0E.19	0E.18	0E.17	0E.16

*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: 5 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	-	-	-	-	-	-	0G.7	0G.6	0G.5	0G.4	0G.3	0G.2	0G.1	0G.0	0F.1	0F.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: 2 Words

Fig. 40: EtherNet/IP-report with data mapping

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

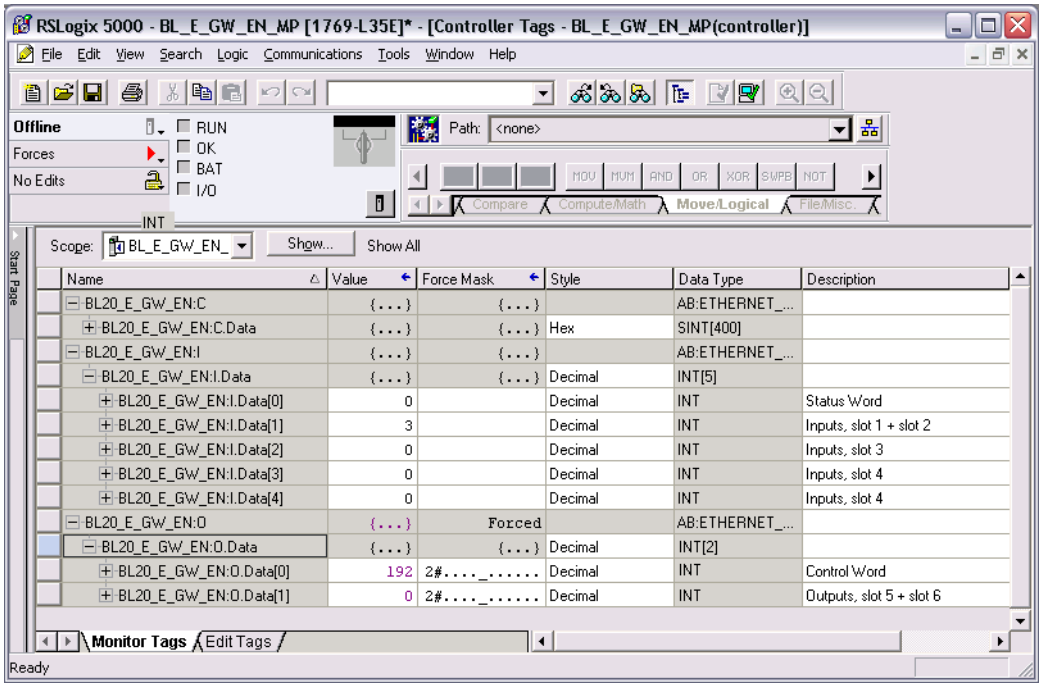


Fig. 41: Mapping of the BL20-station

6.4 Process data access

6.4.1 Setting outputs

Example:

In order to set outputs "0" and "1" at slot 5 of the station (BL20-2DO-24VDC-0.5A-P, see example station), bit 0 and bit 1 in data word 1 (BL20_E_GW_EN:I.Data [1]) have to be set (see above **I/O data mapping (page 104)**).

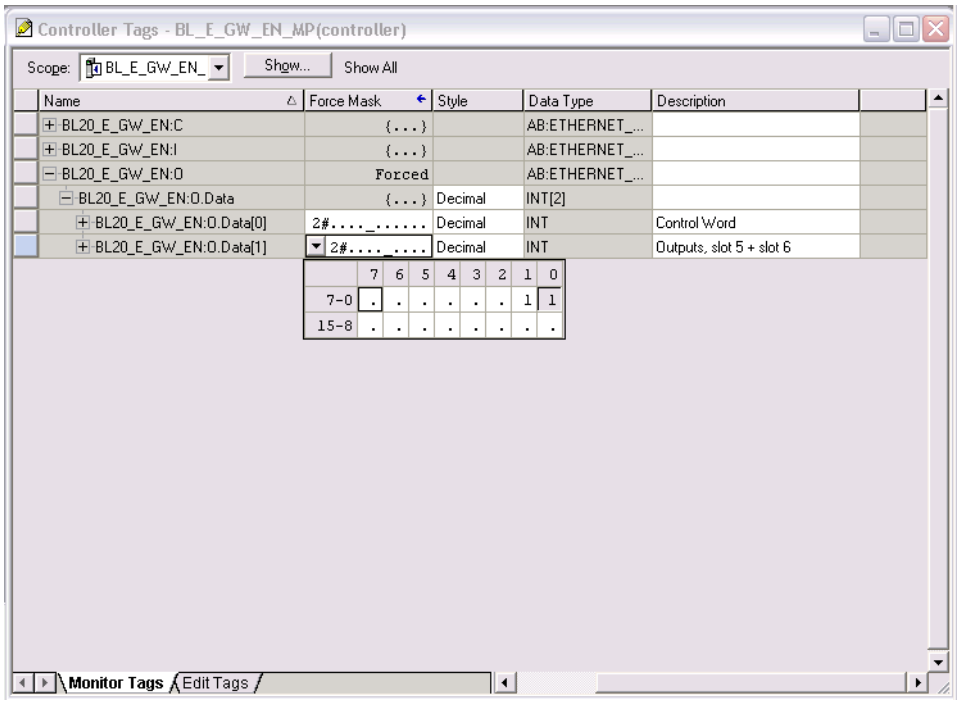


Fig. 42: Setting outputs at BL20-2DO-24VDC-0.5A-P

6.4.2 Example program

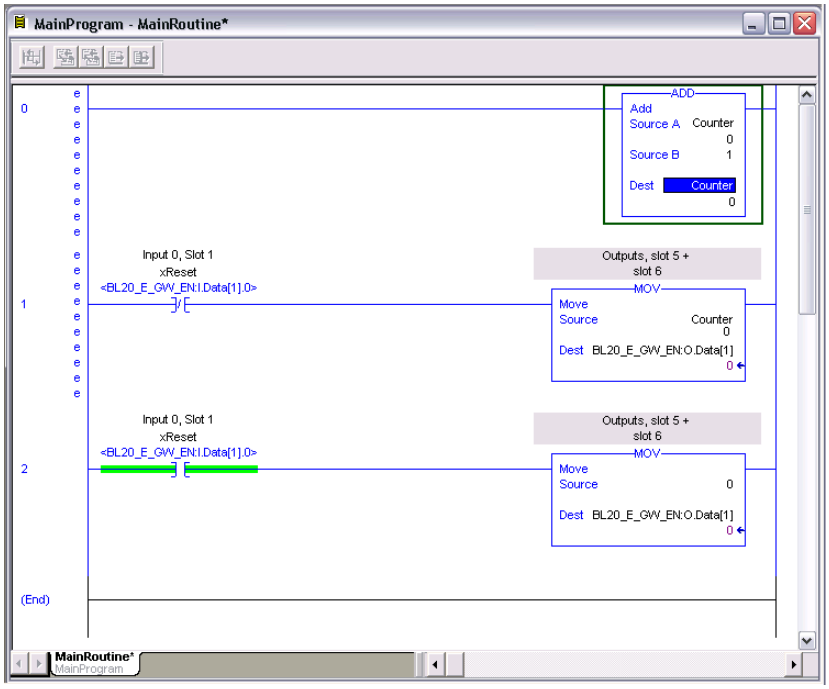


Fig. 43: Example program

1 The counter counts upwards.

2 The counter value is mapped to the outputs of the two digital output modules in the station (slot 5 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 BL20_E_GW_EN:I.Data[1].0 by building an Alias in the Main Program.

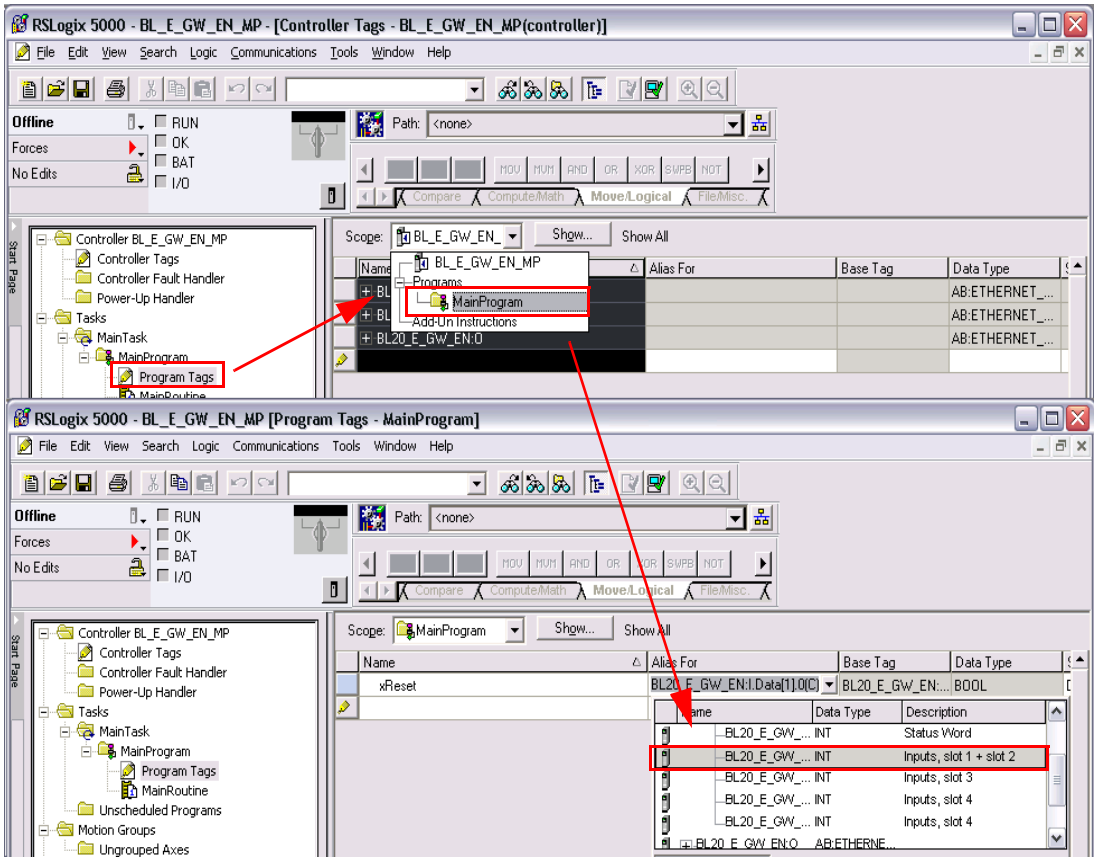


Fig. 44: Definition and mapping of xReset

7 Implementation of Modbus TCP

7.1 Common Modbus description

NOTE

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

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

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

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

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

It is currently implemented using:

- TCP/IP over Ethernet. (that is used for the BLxx-gateways for Modbus TCP 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):

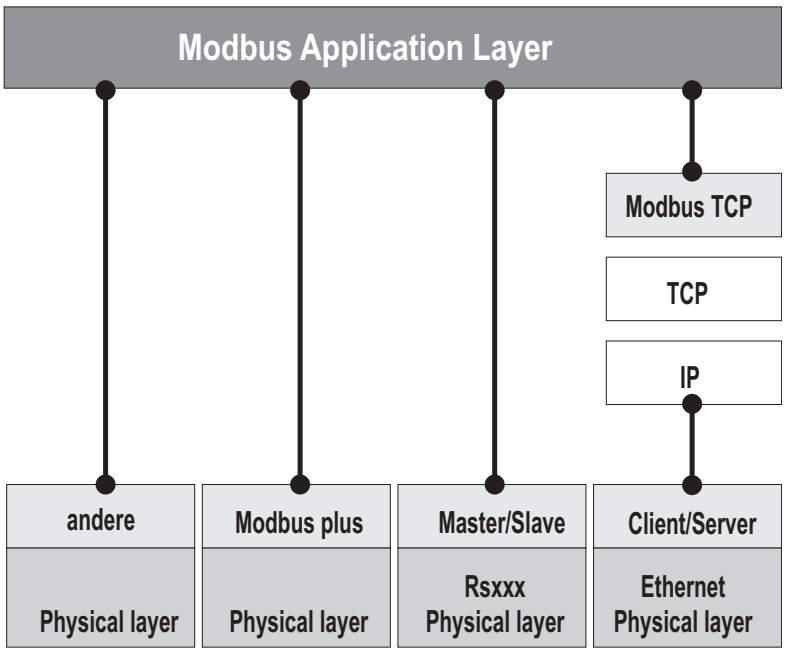


Fig. 45: Schematic representation of the Modbus Communication Stack

7.1.1 Protocol description

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

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

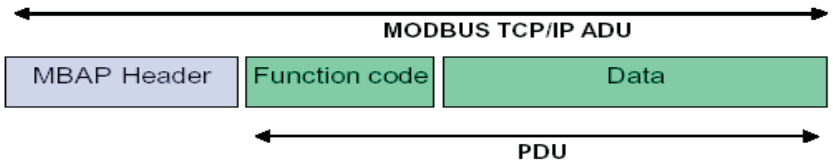


Fig. 46: Modbus telegram acc. to Modbus-IDA

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

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

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

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

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

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

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

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

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

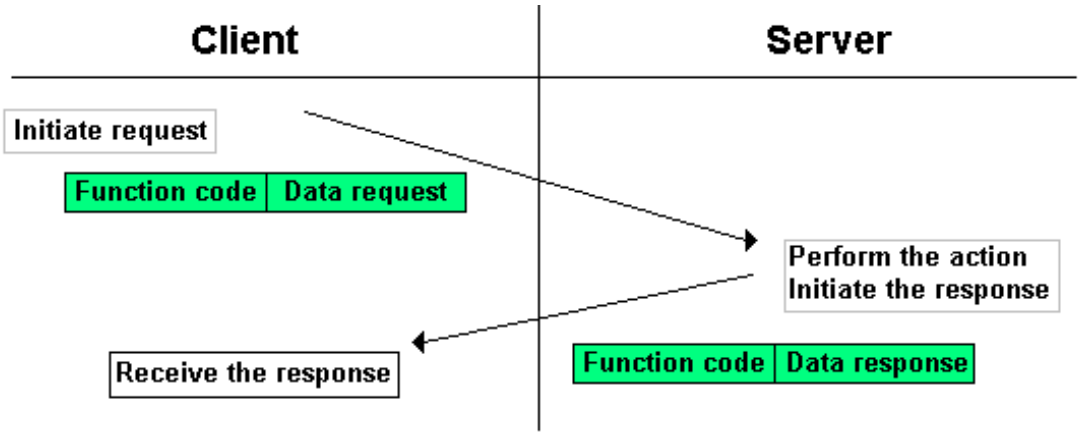


Fig. 47: Modbus data transmission (acc. to Modbus-IDA)

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

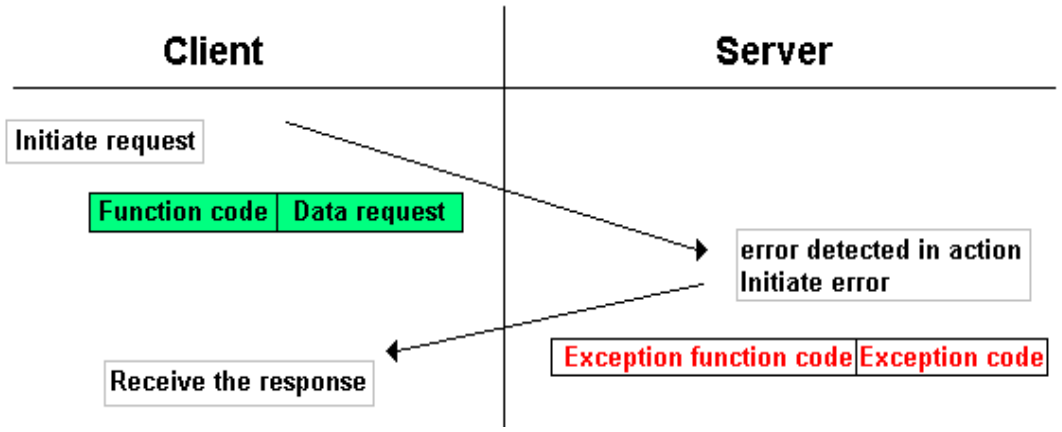


Fig. 48: Modbus data transmission (acc. to Modbus-IDA)

7.1.2 Data model

The data model distinguishes 4 basic data types:

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

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

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

Access to these data is done via defined access-addresses (see **Modbus registers**, s. **p. 114**).

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

BL20 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.

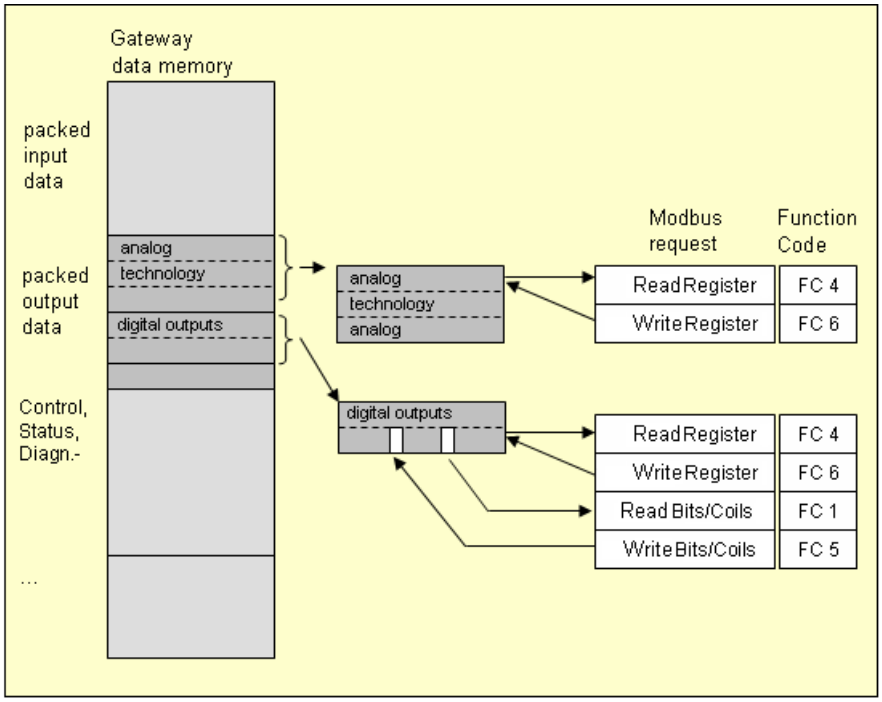


Fig. 49: Picture of the data memory of the BL20 modules

7.2 Implemented Modbus functions

The BL20-gateways for Modbus TCP support the following functions for accessing process data, parameters, diagnostics and other services.

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.

7.3 Modbus registers

Address (hex.)	Access ro = read only rw = read/write	Description
0x0000 to 0x01FF	ro	packed process data of inputs (process data length of the modules
0x0800 to 0x09FF	rw	packed process data of outputs (process data length of the modules
0x1000 to 0x1006	ro	gateway identifier
0x100C	ro	Gateway status (see **Register 0x100C: Gateway status (page 123)**)
0x1010	ro	process image length in bit for the intelligent output modules
0x1011	ro	process image length in bit for the intelligent input modules
0x1012	ro	process image length in bit for the intelligent output modules
0x1013	ro	process image length in bit for the intelligent input modules
0x1017	ro	Register-mapping-revision (always 1, if not, mapping is incompatible with this description)
0x1018 to 0x101A	ro	group diagnostics of I/O-modules 0 to 32 (1 bit per I/O module)
0x1020	ro	watchdog, actual time [ms]
0x1120	rw	watchdog predefined time [ms] (default: 0), see also **Error behavior of outputs (watchdog) (page 129)**)
0x1121	rw	Watchdog reset register
0x1130	rw	Modbus connection mode register, s. **p. 124**
0x1131	rw	Modbus connection timeout in sec. (Def.: 0 = never), s. **p. 124**
0x113C to 0x113D	rw	Modbus parameter restore, s. **p. 124** (reset of parameters to default values)
0x113E to 0x113F	rw	Modbus parameter save, s. **p. 125** (permanent storing of parameters)
0x1140 (VN 03-00 and higher)	rw	Disable Protocol, s. **p. 125**
0x1141 (VN 03-00 and higher)	ro	Active Protocol, s. **p. 125**
0x2000 to 0x207F	rw	service-object, request-area, s. **p. 126**
0x2080 to 0x20FF	ro	service-object, response-area, s. **p. 126**
0x2400	ro	System voltage U_{SYS} [mV]
0x2401	ro	Load voltage U_L [mV]

Address (hex.)	Access ro = read only rw = read/write	Description
0x2405	ro	load current I_L [A]
0x27FE	ro	no. of entries in actual module list
0x27FF	rw	no. of entries in reference module list
0x2800 to 0x283F	rw	Reference module list (max. 32 modules per station × 2 registers for module-ID)
0x2A00 to 0x2A3F	ro	Actual module list (max. 32 modules per station × 2 registers for module-ID)
0x8000 to 0x8400	ro	process data inputs (max. 32 modules per station × 32 registers for module-ID)
0x9000 to 0x9400	rw	process data outputs (max. 32 modules per station × 32 registers for module-ID)
0xA000 to 0xA400	ro	Diagnosis (max. 32 modules per station × 32 registers for module-ID)
0xB000 to 0xB400	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

Description	Hex	Decimal	5-digit	Modicon
packed input data	0x0000 to 0x01FF	0 to 511	40001 to 40512	400001 to 400512
packed output data	0x0800 to 0x09FF	2048 to 2549	42049 to 42560	402049 to 402560
gateway identifier	0x1000 to 0x1006	4096 to 4102	44097 to 44103	404097 to 404103
Gateway status	0x100C	4108	44109	404109
process image length in bit for the intelligent output modules	0x1010	4112	44113	404113
process image length in bit for the intelligent input modules	0x1011	4113	44114	404114
process image length in bit for the digital output modules	0x1012	4114	44115	404115
process image length in bit for the digital input modules	0x1013	4115	44116	404116
Register-mapping-revision	0x1017	4119	44120	404120
group diagnostics of I/O-modules 1 to 32 (1 bit per I/O module)	0x1018 to 0x1019	4120 to 4121	44121 to 44122	404121 to 404122
watchdog, actual time	0x1020	4128	44129	404129
watchdog, predefined time	0x1120	4384	44385	404385
Watchdog reset register	0x1121	4385	44386	404386
Modbus connection mode register	0x1130	4400	44401	404401
Modbus connection timeout in sec.	0x1131	4401	44402	404402
Modbus parameter restore	0x113C to 0x113D	4412 to 4413	44413 to 44414	404413 to 404414
Modbus parameter save	0x113E to 0x113F	4414 to 4415	44415 to 44416	404415 to 404416
service-object, request-area,	0x2000 to 0x207F	8192 to 8319	48193 to 48320	408193 to 408320
Disable protocol (VN 03-00 and higher)	0x1140	4416	44417	404417
Active protocol (VN 03-00 and higher)	0x1141	4417	44418	404418
service-object, response-area,	0x2080 to 0x20FF	8320 to 8447	48321 to 48448	408321 to 408448
System voltage U_{SYS} [mV]	0x2400	9216	49217	409217

Description	Hex	Decimal	5-digit	Modicon
Load voltage U_L [mV]	0x2401	9217	49218	409218
load current I_L [A]	0x2405	9221	49222	409222
no. of entries in actual module list	0x27FE	10238	-	410239
no. of entries in reference module list	0x27FF	10239	-	410240
Reference module list (max. 32 modules per station × 2 registers for module-ID)	0x2800 to 0x283F	10240 to 10303	-	410241 to 410304
Actual module list (max. 32 modules per station × 2 registers for module-ID)	0x2A00 to 0x2A3F	10752 to 10815	-	410753 to 410816
Slot-related address assignment				
Process data inputs (max. 32 modules per station × 32 registers for module-ID)	0x8000 to 0x8400			
slot 1	0x8000	32768	-	432769
slot 2	0x8020	32800	-	432801
slot 3	0x8040	32832	-	432833
…	…	…	…	…
slot 32	0x83E0	33760		433761
Process data outputs (max. 32 modules per station × 32 registers for module-ID)	0x9000 to 0x9400			
slot 1	0x9000	36864	-	436865
slot 2	0x9020	36896	-	436897
slot 3	0x9040	36928	-	436929
…	…	…	…	…
slot 32	0x93E0	37856	-	437857

Description	Hex	Decimal	5-digit	Modicon
Diagnostics (max. 32 modules per station × 32 registers for module-ID)	0xA000 to 0xA400			
slot 1	0xA000	40960	-	440961
slot 2	0xA020	40991	-	440992
slot 3	0xA040	41023	-	441024
…	…	…	…	…
slot 32	0xA3E0	41983	-	441984
Parameters (max. 32 modules per station × 32 registers for module-ID)	0xB000 to 0xB400			
slot 1	0xB000	45056	-	445057
slot 2	0xB020	45088	-	445089
slot 3	0xB040	45120	-	445121
…	…	…	…	…
slot 32	0xB3E0	46048	-	446049

7.3.1 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).

NOTE

For the data mapping, the BL20-1SWIRE-modules are not considered as intelligent modules. Their process data is mapped into the register area for the digital in- and output modules

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 structure-daccording 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 digitalmodules and on the other hand that the data of one digital module can be distributed over multipleregisters. Bit 0 of a digital module is thus not necessarily located on a word limit.

NOTE

An example in chapter 8 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: **0x0000** to **0x01FF**

0x0000			**0x01FF**
intelligent modules, input data	digital Input modules	status/ diagnosis	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 + 0x0000**		**n + 0x0008**
Gateway status (reg. 100Ch)	group diagnosis I/O-modules 0...127 (register 0x1018 to 0x101F)	

Packed output process data

- output register area: **0x0800** to **0x09FF**

0x0800			**0x09FF**
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 BL20-I/O-modules within the modbus register area and the type of data alignment.

Module	Process input	Process output	Alignment
– **Digital inputs**			
BL20-2DI-x	2 Bit	-	bit by bit
BL20-4DI-x	4 Bit	-	bit by bit
BL20-E-8DI-x	8 Bit	-	bit by bit
BL20-16DI-x	16 Bit	-	bit by bit
BL20-E-16DI-x	16 Bit	-	bit by bit
BL20-32DI-x	32 Bit	-	bit by bit
– **Digital outputs**			
BL20-2DO-x	-	2 Bit	bit by bit
BL20-4DO-x	-	4 Bit	bit by bit
BL20-E-8DO-x	-	8 Bit	bit by bit
BL20-16DO-x	-	16 Bit	bit by bit
BL20-E-16DO-x	-	16 Bit	bit by bit
BL20-32DO-x	-	32 Bit	bit by bit
– **Analog input modules**			
BL20-1AI-x	1 word		word by word
BL20-2AI-x	2 word		word by word
BL20-2AIH-I	12 word		word by word
BL20-4AI-x	4 word		word by word
BL20-E-4AI-TC	4 word		word by word
BL20-E-8AI-U/I-4AI-PT/NI	8 word		word by word
– **Analog outputs**			
BL20-1AO-x		1 word	word by word
BL20-2AO-x		2 word	word by word
BL20-2AOH-I	8 word	2 word	word by word
BL20-E-4AO-U/I		4 word	word by word
– **Technology modules**			
BL20-1RS×××	4 word	4 word	word by word
BL20-1SSI	4 word	4 word	word by word
BL20-E-2CNT-2PWM	12 word	12 word	word by word
BL20-E-SWIRE **A**	4 word	4 word	word by word

Module	Process input	Process output	Alignment
BL20-2RFID-S	12 word	12 word	word by word
– **Power distribution modules**			
BL20-BR-×	-		
BL20-PF-×	-		

7.3.2 Register 0x100C: Gateway status

This register contains a general gateway/station status.

Bit	Name	Description
Gateway		
15	reserved	-
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	U_{sys} too low	System supply voltage too low (< 18 V DC).
8	U_{sys} too high	System supply voltage too high (> 30 V DC).
7	U_L too low	Load voltage too low (< 18 V DC).
6	reserved	-
5	reserved	-
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.

7.3.3 Register 0x1130h: Modbus-Connection-Mode

This register defines the behavior of the Modbus connections:

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.

7.3.4 Register 0x1131: Modbus-Connection-Timeout

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

7.3.5 Register 0x113C and 0x113D: Restore Modbus-connection parameters

Register 0x113C and 0x113D are used to reset the parameter registers 0x1120 and 0x1130 to 0x113B to default.

For this purpose, write 0x6C6F 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.

7.3.6 Register 0x113E and 0x113F: „Save Modbus-Connection-Parameters“

Registers 0x113E and 0x113F are used for permanent storing the parameters in registers 0x1120 and 0x1130 to 0x113B.

For this purpose, write 0x7361 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.

7.3.7 Register 0x1140: Disable protocol

NOTE

This register is only valid for BL20-E-GW-EN with multiprotocol-functionality, meaning, for gateways with **VN 03-00** and higher.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	PROF-INET deacti-vate	reserved	EtherNet/IP deactivate
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Web-Server deacti-vate	-	-	-	-	-	-	-

7.3.8 Register 0x1141: Active protocol

NOTE

This register is only valid for BL20-E-GW-EN with multiprotocol-functionality, meaning, for gateways with **VN 03-00** and higher.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	PROF-INET active	Modbus TCP active	EtherNet/IP active
Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Web-Server active	-	-	-	-	-	-	-

7.3.9 Register 0x2000 bis 0x207F: 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.

0x2000	0x2080	0x20FF
service request area	service response area	

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

- service request area

0x2000	0x2001	0x2002	0x2003	0x2004	0x2005	0x207F
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

0x2080	0x2081	0x2082	0x2083	0x2084	0x2085	0x20FF
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:

Service-Code	Meaning
0x0000	no function
0x0003	indirect reading of registers
0x0010	indirect writing of registers

A service request may have the following results:

Service-Code	Meaning
0x0000	error free execution of service
0xFFFE	service parameters incorrect/inconsistent
0xFFFF	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...122 (Count) Modbus-registers are read starting with address x (Addr).

- service-request

0x2000	**0x2001**	**0x2002**	**0x2003**	**0x2004**	**0x2005**	**0x207F**
Service-number	0x0000	0x0003	Addr	Count	no meaning	

- service response

0x2080	**0x2081**	**0x2082**	**0x2083**	**0x2084**	**0x2085**	**0x20FF**
Service-number	result	0x0003	Addr	Count	register contents	

Indirect writing of registers

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

- service-request

0x2000	0x2001	0x2002	0x2003	0x2004	0x2005	0x207F
Service-number	0x0000	0x0010	Addr	Count	register contents	

- service response

0x2080	0x2081	0x2082	0x2083	0x2084	0x2085	0x20FF
Service-number	result	0x0010	Addr	Count	no meaning	

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

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

NOTE

In the packed process data, the digital I/O data are stored following the variable in- and output data area of the intelligent 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 Mapping: input-discrete-area
  All digital inputs are stored in this area (offset ”0”).
- Mapping Mapping: Coil-area
  All digital outputs are stored in this area (offset ”0”).

7.5 Error behavior of outputs (watchdog)

In case of a failure of the Modbus communication, the outputs' behavior is as follows, depending on the defined time for the Watchdog (register 0x1120 (page 114)):

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

NOTE

Please observe that changes in the watchdog time have to be saved per save-command (see Register 0x113E and 0x113F: „Save Modbus-Connection-Parameters“ (page 125)).

NOTE

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

Behavior of the gateway on loss of Modbus communication

If Modbus is the active protocol and all Modbus connections are closed, then the watchdog switches all outputs to ”0” after the watchdog time has expired, as long as no other protocol (PROFINET, EtherNet/IP) has been activated in the meantime.

8 BL20-E-GW-EN for Modbus TCP (CODESYS Win V3)

8.1 Used hard-/software

8.1.1 Hardware

- BL20-E-GW-EN, VN 03-00 (IP-address 192.168.1.16)
  - BL20-2DI-24VDC-P
  - BL20-4DI-24VDC-P
  - BL20-1AI-U(-10/0…+10VDC)
  - BL20-2AI-THERMO-PI
  - BL20-2DO-24VDC-0.5A-P
  - BL20-E-8DO-24VDC-0.5A-P

8.1.2 Software

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

8.2 Network configuration

BL20-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 BL20-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 4.4, Address assignment**.

  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 215)**.

8.3 Programming with CODESYS

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

8.3.1 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.

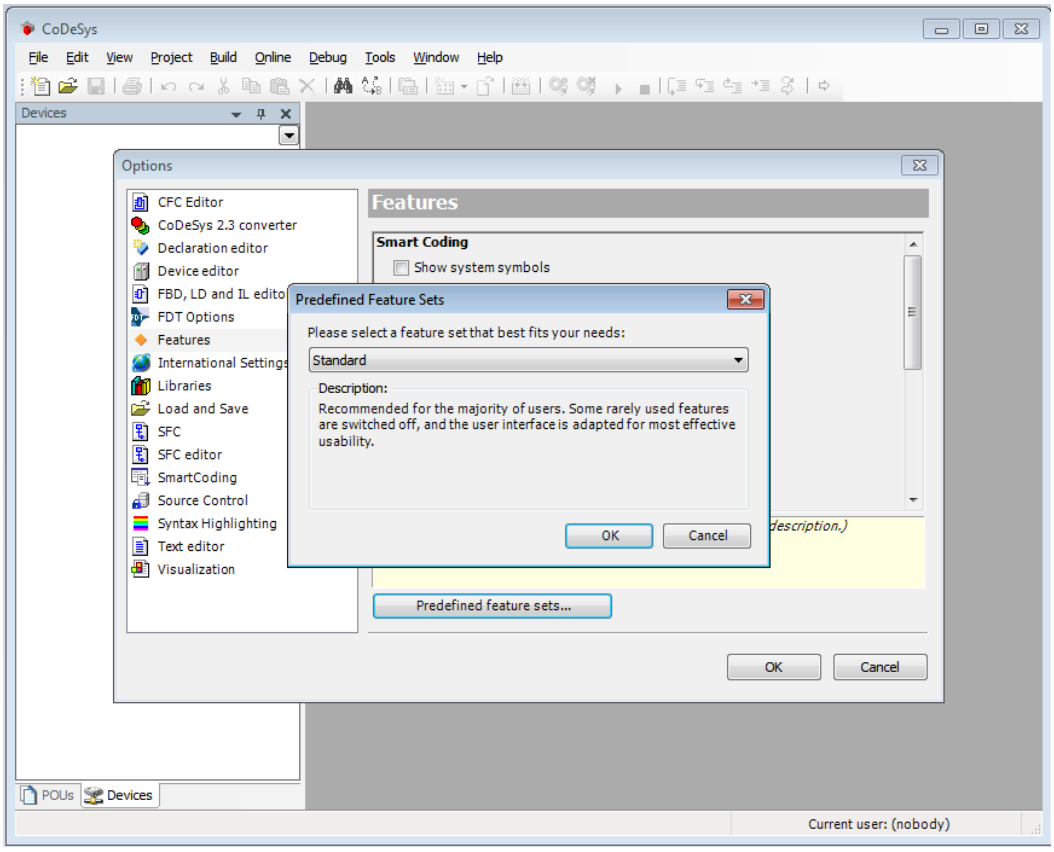


Fig. 50: Predefined feature sets

8.3.2 Creating a new project

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

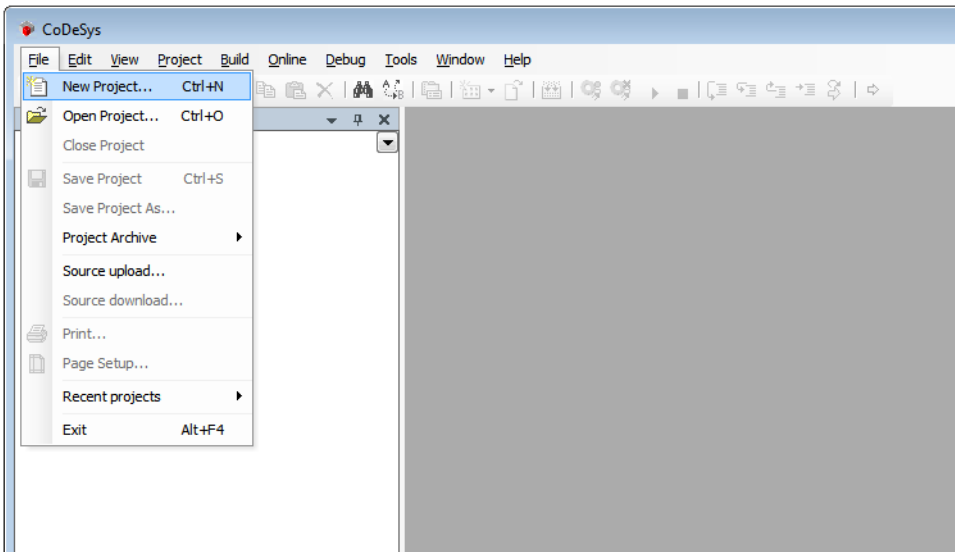


Fig. 51: New project

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

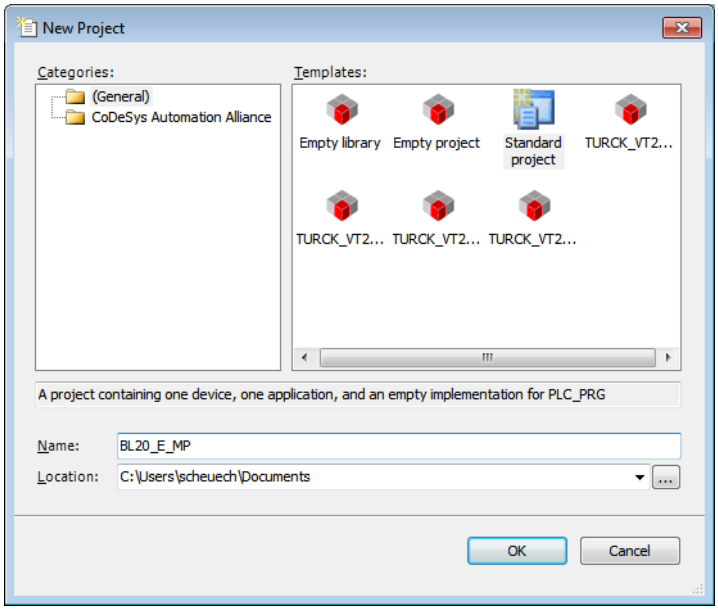


Fig. 52: Standard project

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.

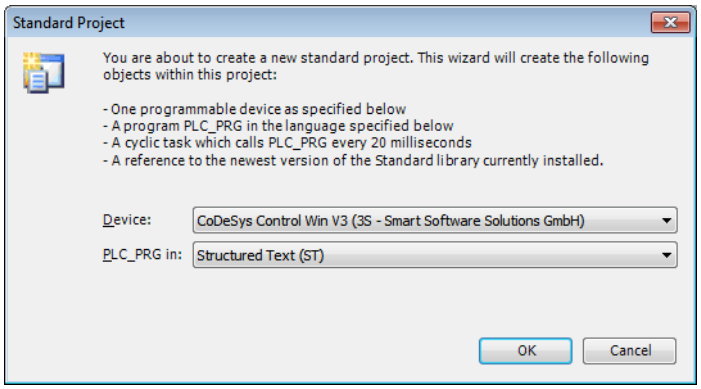


Fig. 53: Selection of CODESYS Control Win V3

5 The new project is created.

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

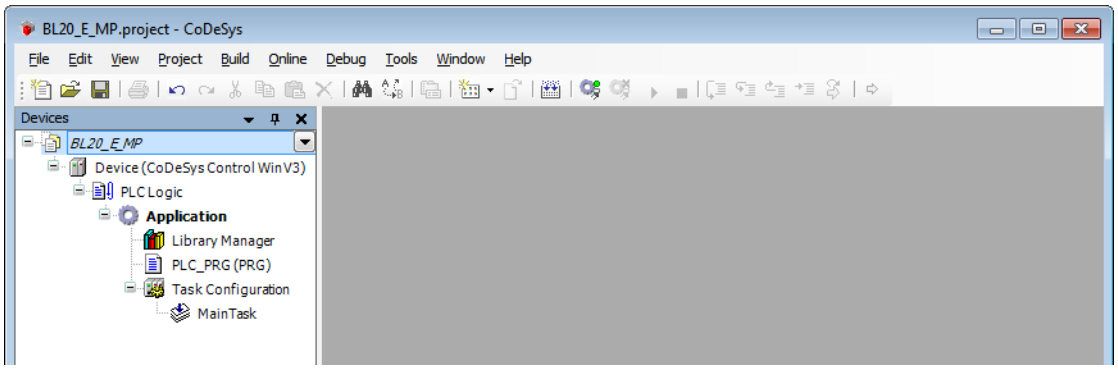


Fig. 54: Project tree

NOTE

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

8.3.3 Defining the communication settings

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

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

Gateway definition

1 Use the "Add gateway"-button to open the dialog box "Gateway" and, where necessary, assign a new gateway name.

2 Keep the setting "localhost" or define an IP-address for the gateway instead.
When using the setting "localhost", the CODESYS-communication-gateway of the PC, on which this CODESYS-installation is running, is used as programming interface.

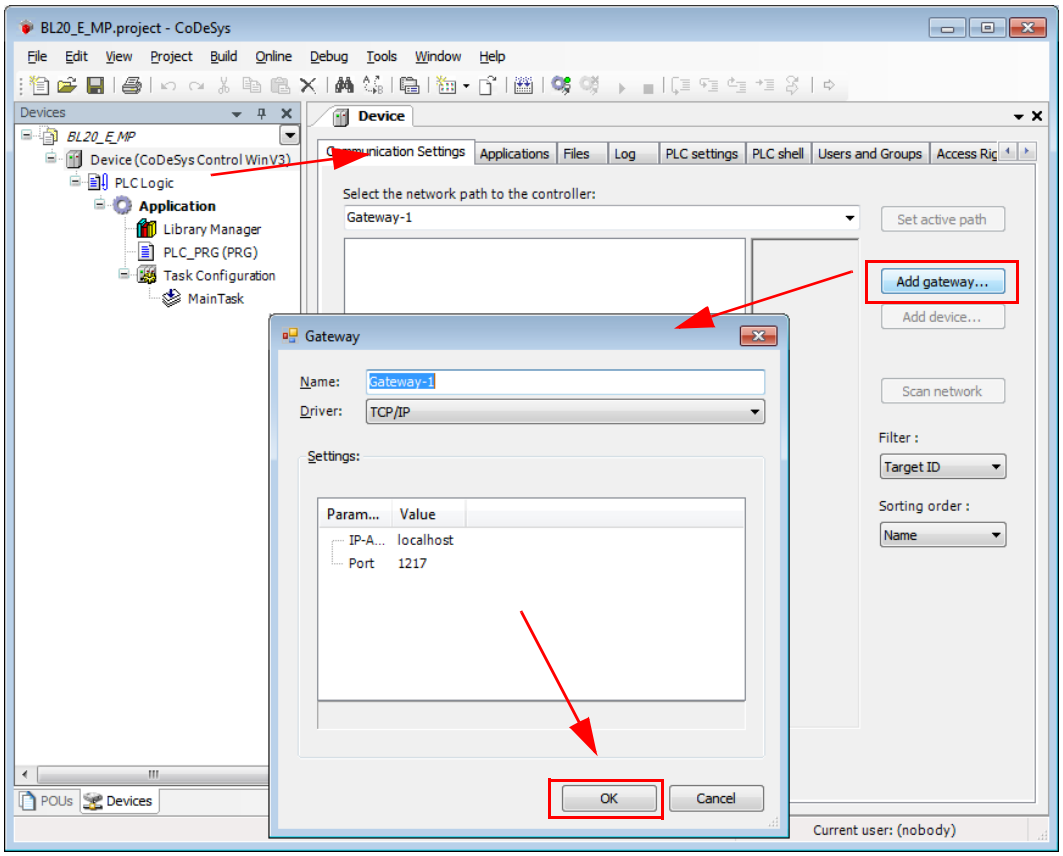


Fig. 55: Communication settings

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.

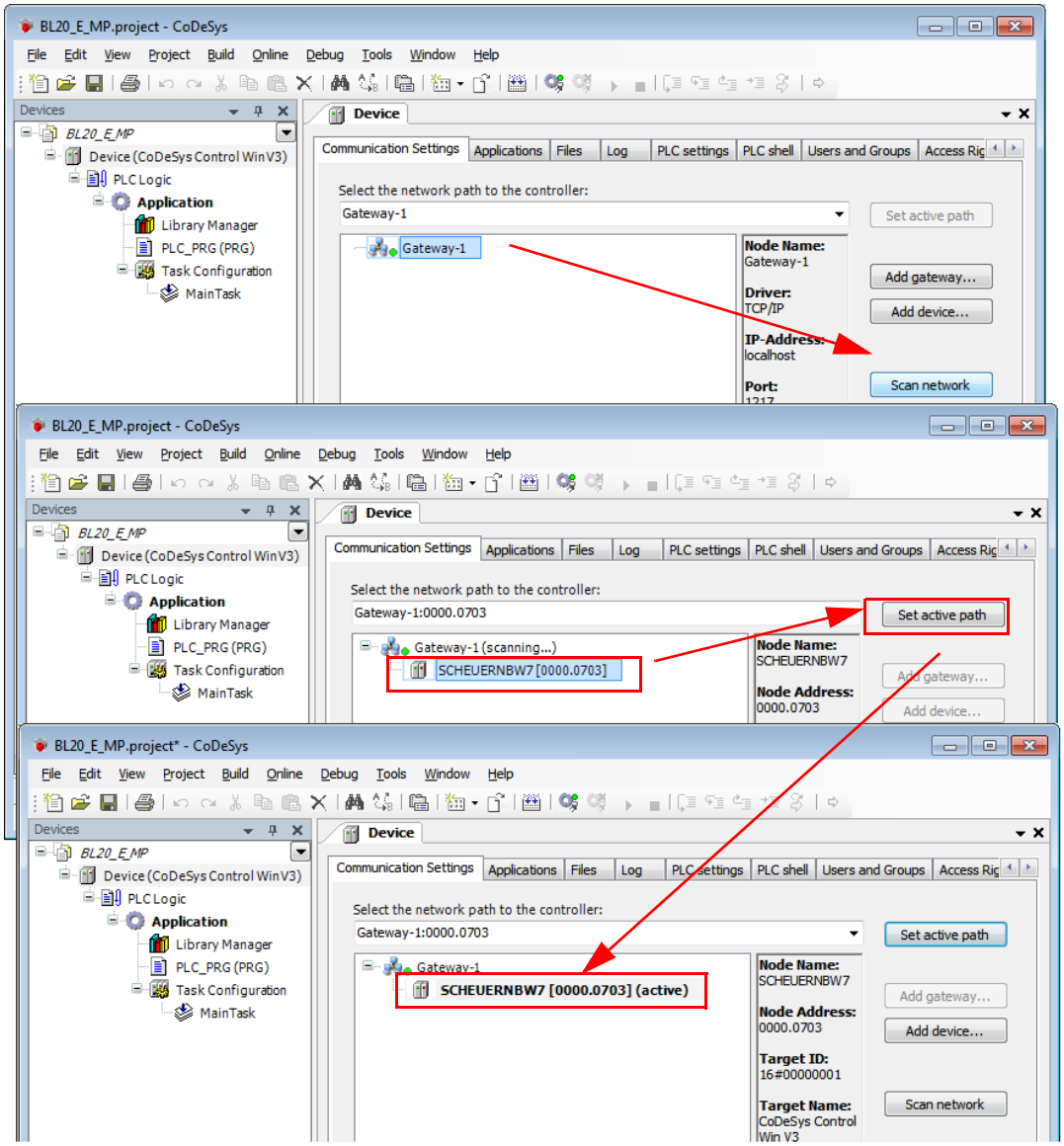


Fig. 56: Setting the communication path

8.3.4 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.

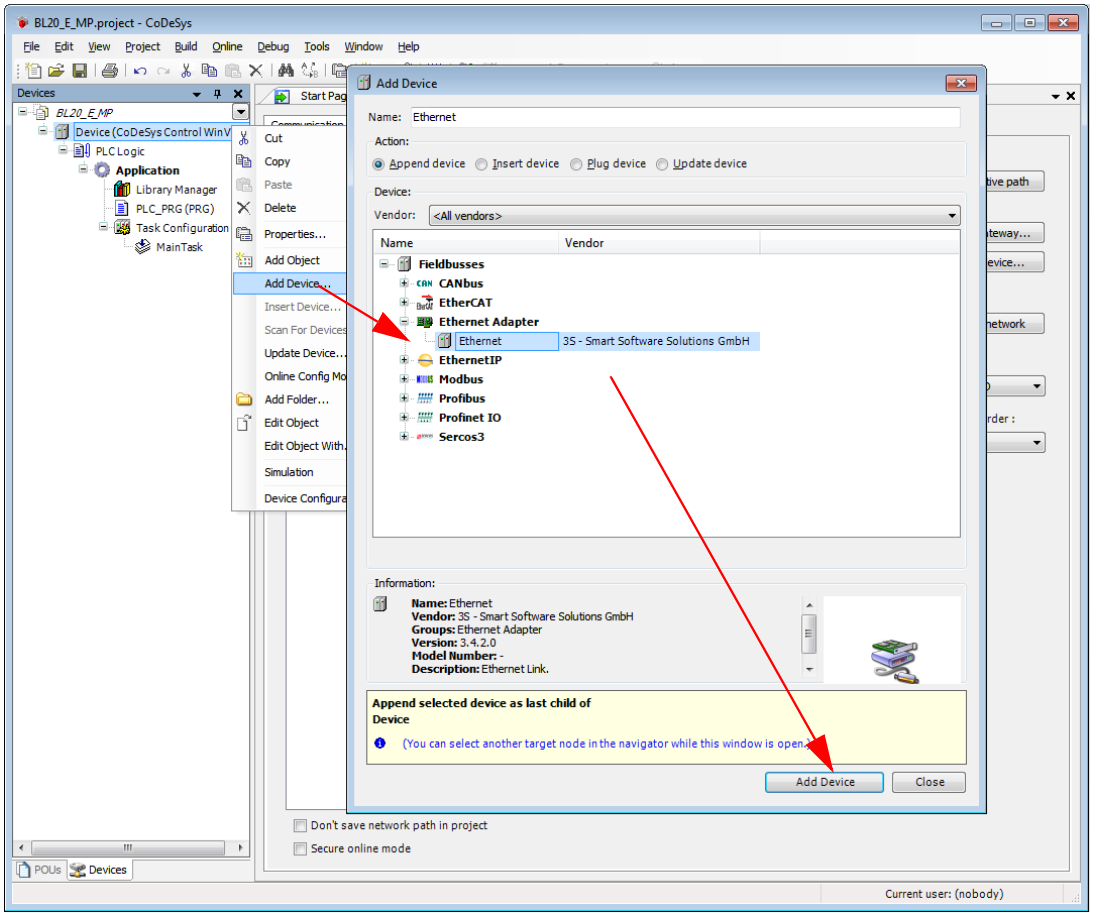


Fig. 57: Adding the Ethernet Adapter as device

8.3.5 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.

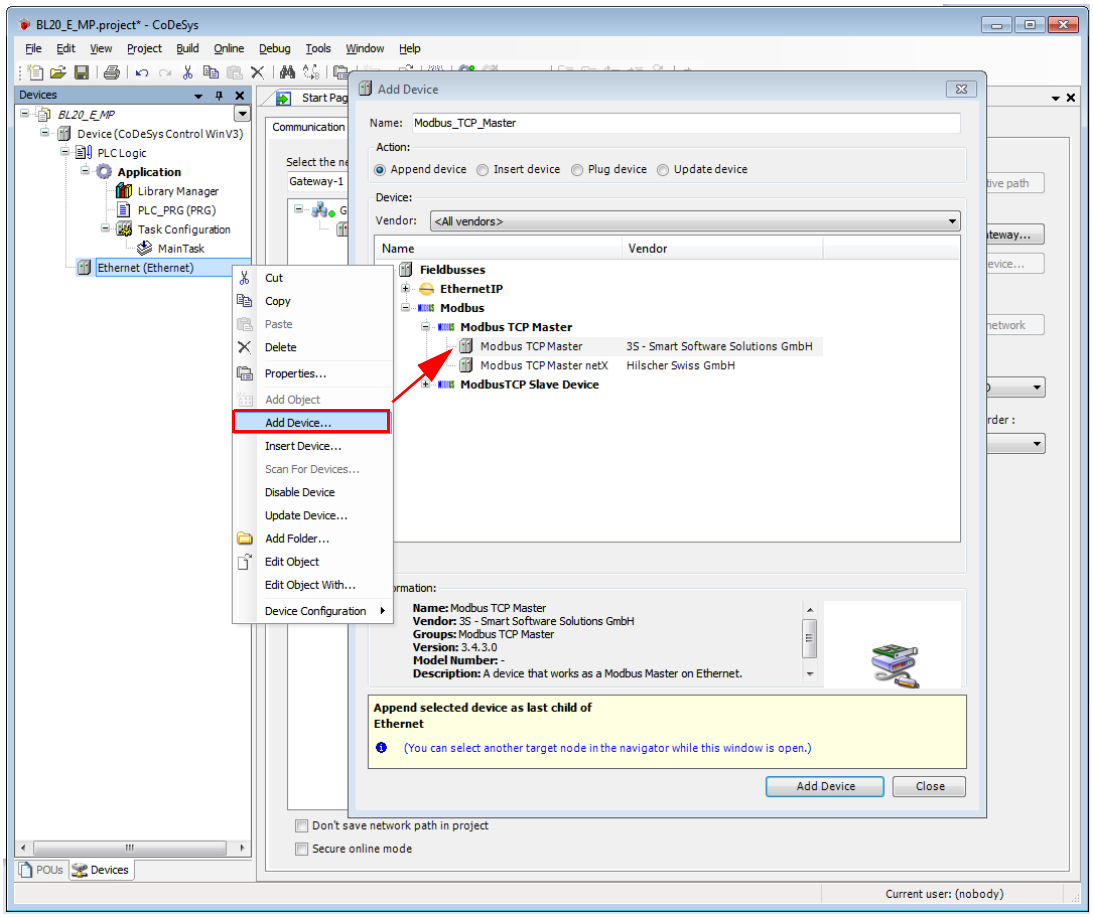


Fig. 58: Adding the Modbus master

Auto-reconnect

➤ Activate the function "auto-reconnect" at the Master.

CODESYS automatically confirms communication errors and tries to continue with executing Modbus commands instead of interrupting the Modbus communication. Otherwise the error has to be reset using a slave function block.

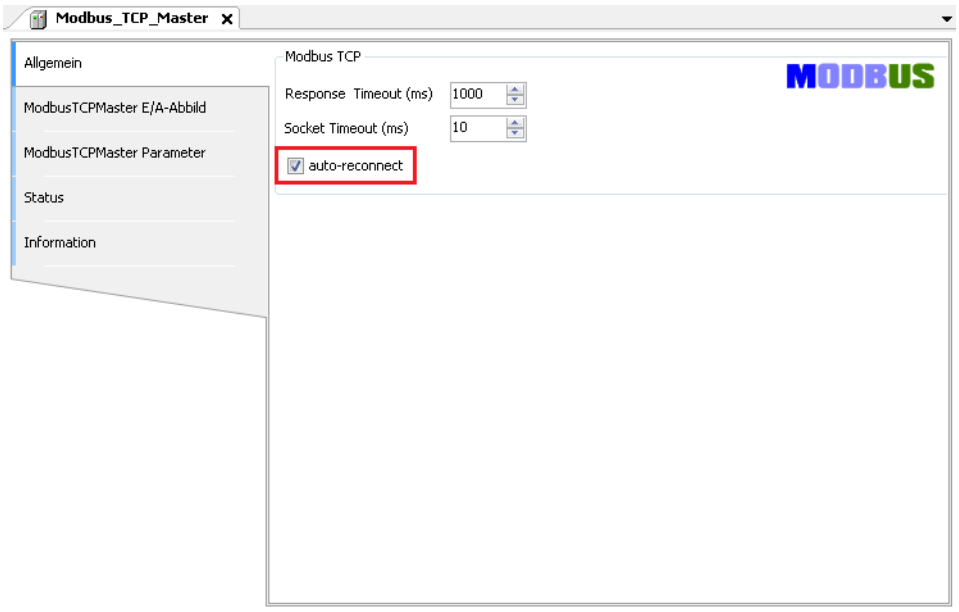


Fig. 59: Parameterization of the Modbus TCP-Master

8.3.6 Adding a Modbus TCP slave

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

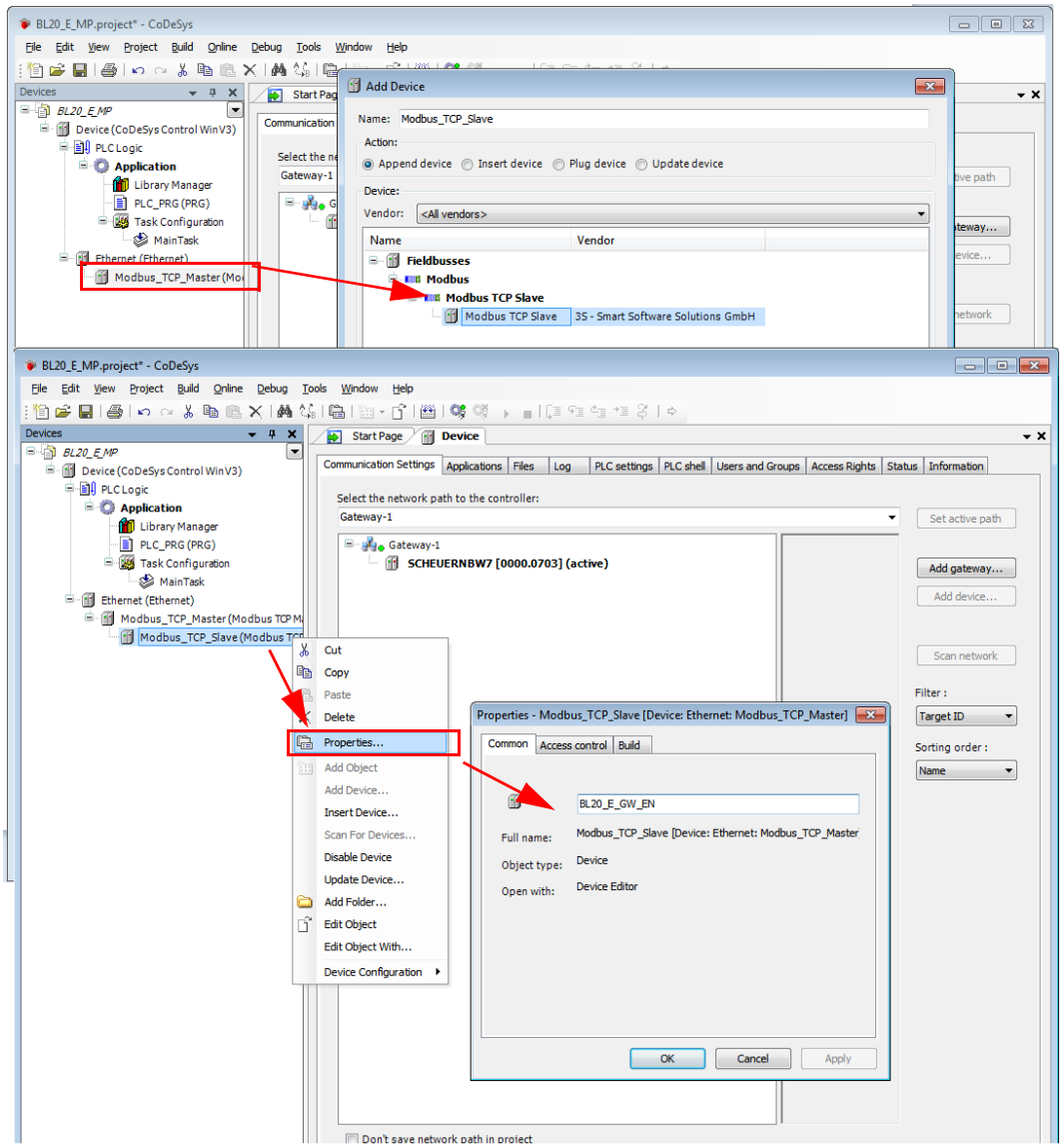
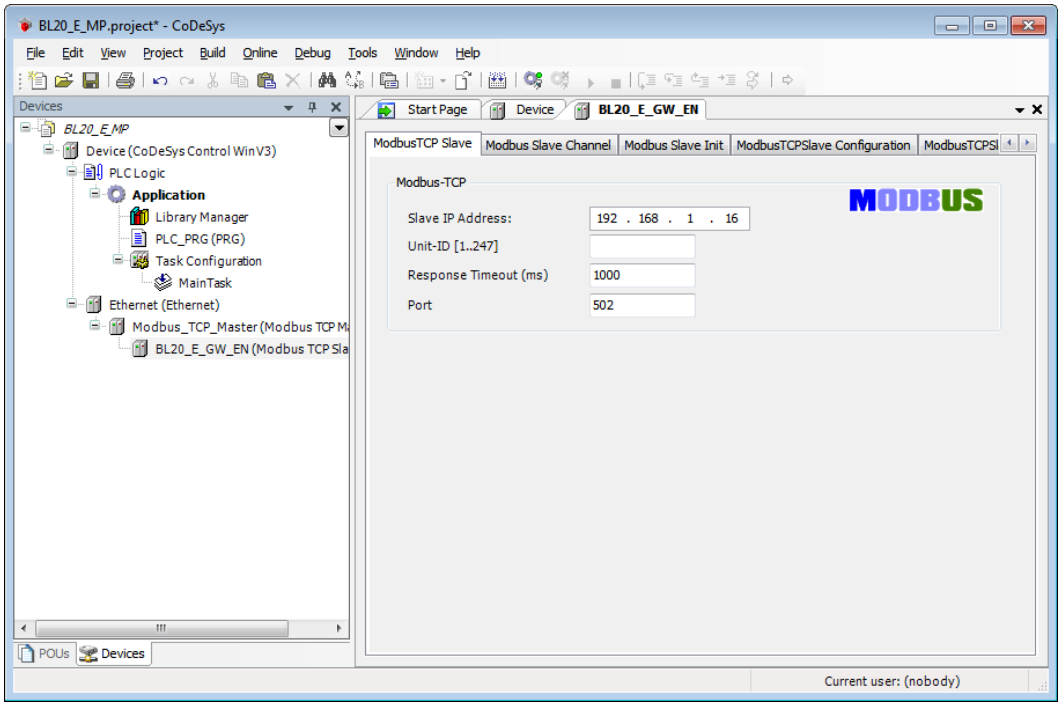


Fig. 60: Selecting a slave

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.



Setting the IP address at the slave

8.3.7 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 133)**.

Small example program

1. The counter counts
2. Counter-reset via setting the variable "xReset" (BOOL) to "1".
   "xReset" has been defined in the global variables (see also page s. **p. 143**)

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**, s. **p. 158**) is enabled.

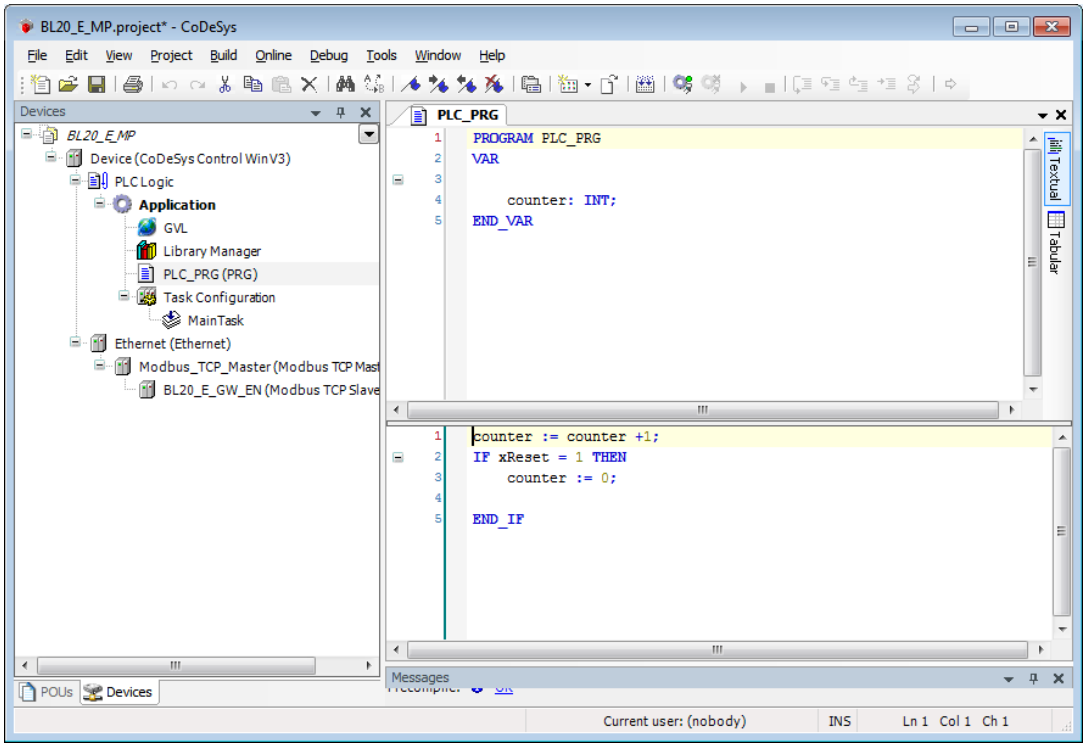


Fig. 61: Example program

8.3.8 CODESYS: Global variables

Global variables are defined either in the Global Variable List (see s. p. 143) or directly in the I/O Mappings of the single stations.

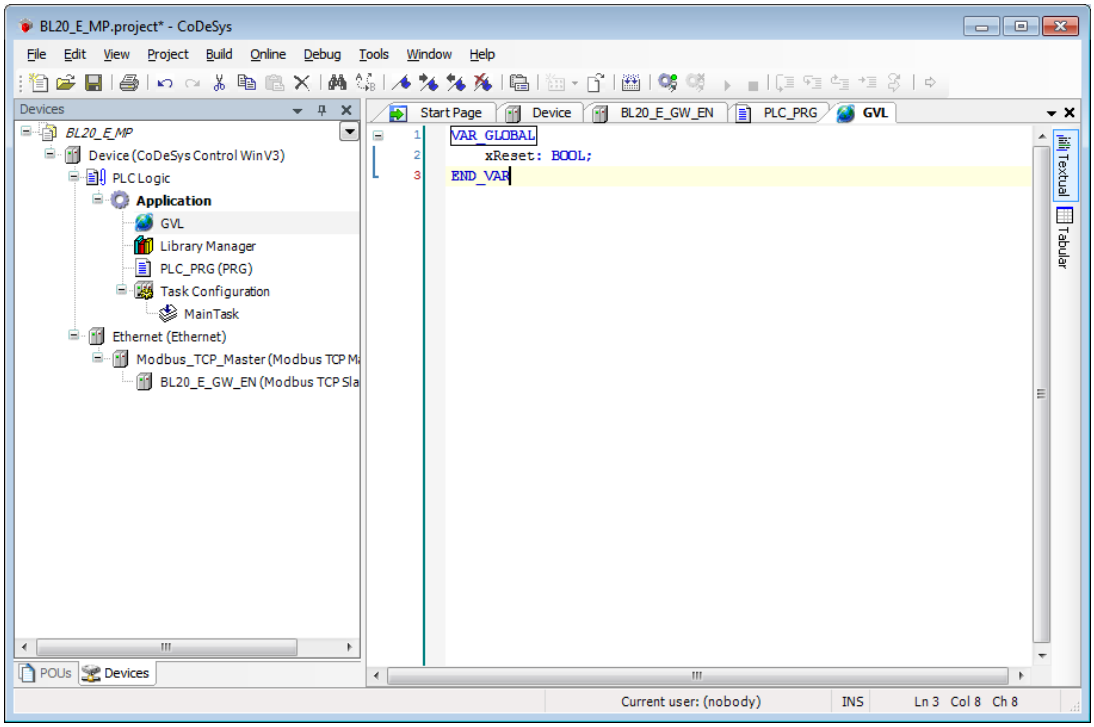


Fig. 62: Example for the definition of a global variable

Global variable list

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

Define the global variables The global variables are also automatically exported when building the project, if they have been chosen for export in the symbol configuration. (see also **Predefined feature sets (page 132)**).

8.3.9 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 8.3.11, Reading out the process data, s. p. 158)

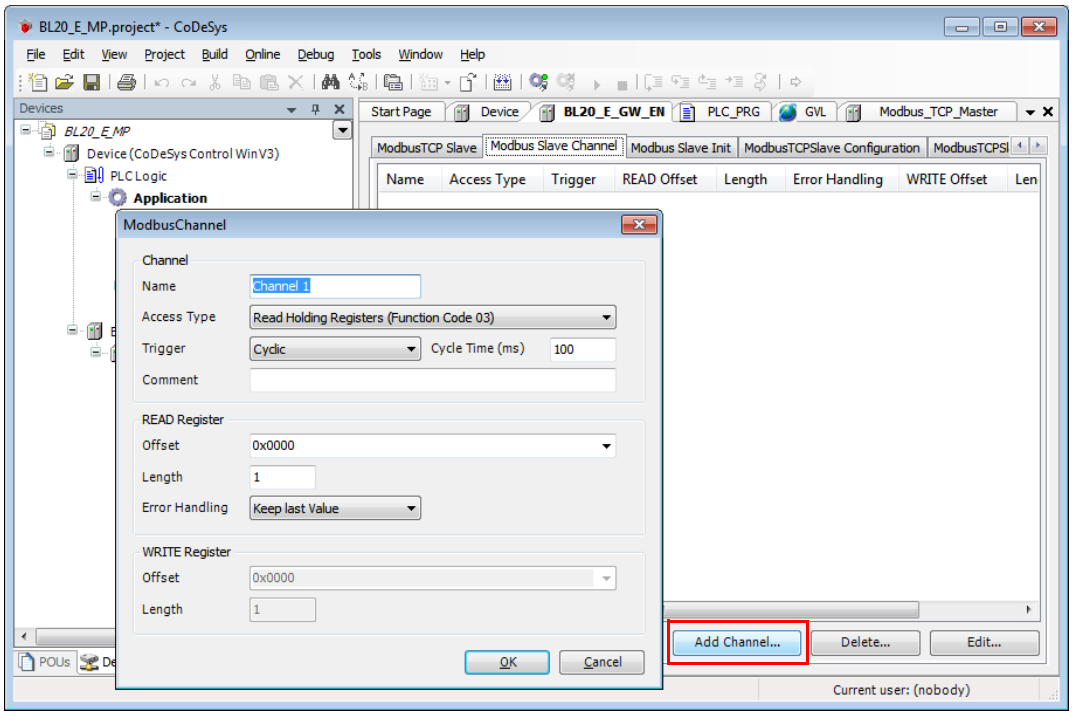


Fig. 63: Setting the Modbus channels, examples

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!

The mapping for the input and output data of a BL20-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)

2. Modbus report

2.1. Station description

Station address: 192.168.1.112

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-EN (>= VN 03-00)	192.168.1.112/BL20-E-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL20-2DI-24VDC-P	01/BL20-2DI-24VDC-P	2 bit	0 bit
2	BL20-4DI-24VDC-P	02/BL20-4DI-24VDC-P	4 bit	0 bit
3	BL20-1AI-U(-10/0...+10VDC)	03/BL20-1AI-U(-10/0...+10VDC)	16 bit	0 bit
4	BL20-2AI-THERMO-PI	04/BL20-2AI-THERMO-PI	32 bit	0 bit
5	BL20-2DO-24VDC-0.5A-P	05/BL20-2DO-24VDC-0.5A-P	0 bit	2 bit
6	BL20-E-8DO-24VDC-0.5A-P	06/BL20-E-8DO-24VDC-0.5A-P	0 bit	8 bit
	Local I/O data incl. status/control		4 Words	1 Word
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**6 Words**	**1 Word**

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

2.2. I/O map for input data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	0000	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
0x0001	0001	04.15	04.14	04.13	04.12	04.11	04.10	04.09	04.08	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00
0x0002	0002	04.31	04.30	04.29	04.28	04.27	04.26	04.25	04.24	04.23	04.22	04.21	04.20	04.19	04.18	04.17	04.16
0x0003	0003	-	-	-	-	-	-	-	-	-	-	02.03	02.02	02.01	02.00	01.01	01.00
*0x0004	0004	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
**0x0005	0005	-	-	-	-	-	-	-	-	-	-	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: 6 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	-	-	-	-	-	-	06.07	06.06	06.05	06.04	06.03	06.02	06.01	06.00	05.01	05.00

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

Process output data: 1 Word

Fig. 64: Modbus report - Mapping of in- and output data

2.4. Map for parameter data

Station report

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
B040	0	1	3	BL20-1AI-U(-10/0...+10VDC)	voltage mode	0 : 0..10V 1 : -10..+10V
B040	1	1	3	BL20-1AI-U(-10/0...+10VDC)	value representation	0 : Integer (15Bit + sign) 1 : 12Bit (left-justified)
B040	2	1	3	BL20-1AI-U(-10/0...+10VDC)	diagnostics	0 : release 1 : block
B040	3	1	3	BL20-1AI-U(-10/0...+10VDC)	channel	0 : activate 1 : deactivate
B060	0	1	4	BL20-2AI-THERMO-PI	mains suppression	0 : 50Hz 1 : 60Hz
B060	1	1	4	BL20-2AI-THERMO-PI	value representation	0 : Integer (15Bit + sign) 1 : 12Bit (left-justified)
B060	2	1	4	BL20-2AI-THERMO-PI	diagnostic	0 : release 1 : block
B060	3	1	4	BL20-2AI-THERMO-PI	channel	0 : activate 1 : deactivate
B060	4	4	4	BL20-2AI-THERMO-PI	element	0 : Type K, -270..1370°C 1 : Type B, +100..1820°C 2 : Type E, -270..1000°C 3 : Type J, -210..1200°C 4 : Type N, -270..1300°C 5 : Type R, -50..1760°C 6 : Type S, -50..1540°C 7 : Type T, -270..400°C 8 : +/-50mV 9 : +/-100mV 10 : +/-500mV 11 : +/-1000mV
B060	8	1	4	BL20-2AI-THERMO-PI	mains suppression	0 : 50Hz 1 : 60Hz
B060	9	1	4	BL20-2AI-THERMO-PI	value representation	0 : Integer (15Bit + sign) 1 : 12Bit (left-justified)
B060	10	1	4	BL20-2AI-THERMO-PI	diagnostic	0 : release 1 : block
B060	11	1	4	BL20-2AI-THERMO-PI	channel	0 : activate 1 : deactivate
B060	12	4	4	BL20-2AI-THERMO-PI	element	0 : Type K, -270..1370°C 1 : Type B, +100..1820°C 2 : Type E, -270..1000°C 3 : Type J, -210..1200°C 4 : Type N, -270..1300°C 5 : Type R, -50..1760°C 6 : Type S, -50..1540°C 7 : Type T, -270..400°C 8 : +/-50mV 9 : +/-100mV 10 : +/-500mV 11 : +/-1000mV

2.5. Map for diagnostic data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
A040	0	1	3	BL20-1AI-U(-10/0...+10VDC)	overflow/underrun channel x	0 : 1 : activate
A060	0	1	4	BL20-2AI-THERMO-PI	measurement value range error channel x	0 : - 1 : activate
A060	1	1	4	BL20-2AI-THERMO-PI	open circuit channel x	0 : - 1 : activate
A060	2	1	4	BL20-2AI-THERMO-PI	no PT1000 sensor(cold j. comp) channel x	0 : - 1 : activate
A060	8	1	4	BL20-2AI-THERMO-PI	measurement value range error channel x	0 : - 1 : activate
A060	9	1	4	BL20-2AI-THERMO-PI	open circuit channel x	0 : - 1 : activate
A060	10	1	4	BL20-2AI-THERMO-PI	no PT1000 sensor(cold j. comp) channel x	0 : - 1 : activate
A080	0	1	5	BL20-2DO-24VDC-0.5A-P	short circuit channel x	0 : - 1 : activate
A080	1	1	5	BL20-2DO-24VDC-0.5A-P	short circuit channel x	0 : - 1 : activate

Fig. 65: Modbus report - Mapping of parameter and diagnostic data

NOTE

Detailed information about the modbus registers of the BL20-stations can be found in the descriptions in chapter 7.3.

1 Writing of **%QW0** and mapping of the counter value (VAR "Counter", see PLC_PRG, s. p. 142) to the output byte of the station (%QW0).

1.1 Write: %QW0

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

– Write Register, Offset:
0x0800 (see below)
The process output data of the station can be found in register 0×0800.

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	-	-	-	-	-	-	06.07	06.06	06.05	06.04	06.03	06.02	06.01	06.00	05.01	05.00

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

Process output data: 1 Word

Fig. 66: Mapping of output data acc. to Modbus-report

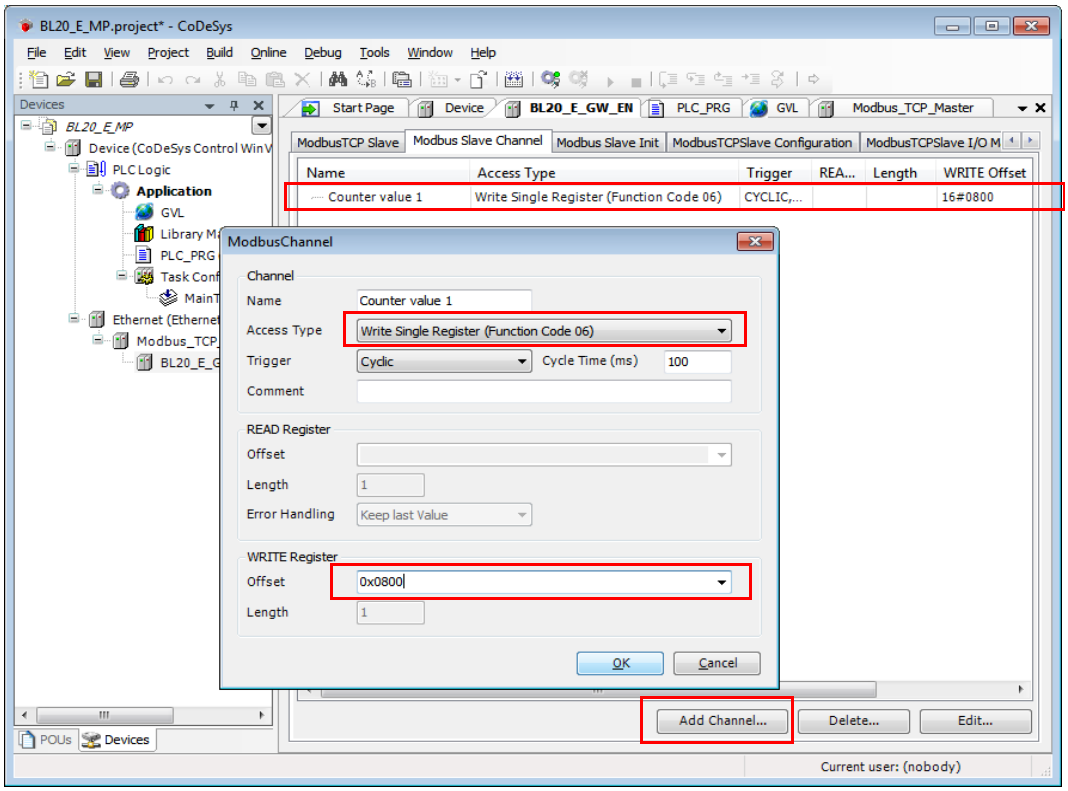


Fig. 67: Modbus channel, counter value, FC06

1.2 Mapping: counter value to %QW0

– The mapping of the counter value (VAR "Counter") to the station 's output register is done the 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) (page 142)**, it can be found there.

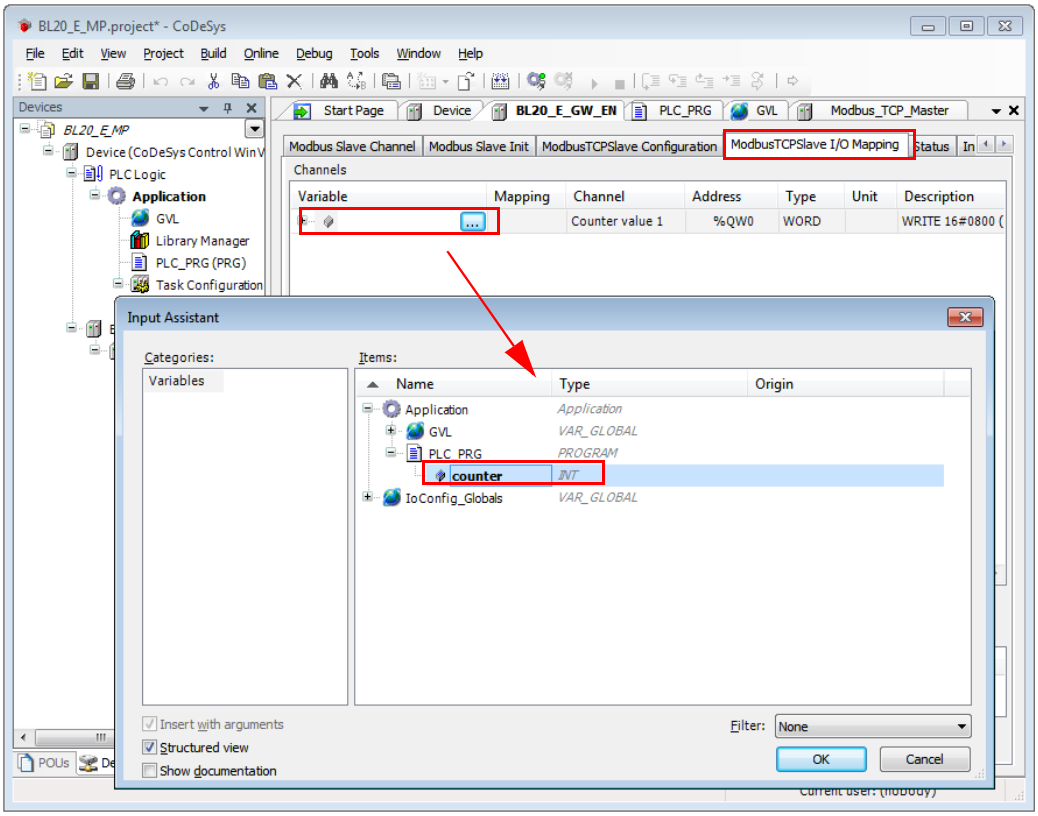


Fig. 68: Mapping of the counter value to %QW0

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

2 Read:

Bit 0 in register 0x0003 has to be read out
(→ reset the counter (with „xReset“ = 1)

1.3 Read: %IW0

- Access Type:
  Read Holding Registers (function code **03**)
- Read Register, Offset:
  0x0003 (see below)

2. Modbus report

2.1. Station description

Station address: 192.168.1.112

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-EN (>= VN 03-00)	192.168.1.112/BL20-E-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL20-2DI-24VDC-P	01/BL20-2DI-24VDC-P	2 bit	0 bit
2	BL20-4DI-24VDC-P	02/BL20-4DI-24VDC-P	4 bit	0 bit
3	BL20-1AI-U(-10/0...+10VDC)	03/BL20-1AI-U(-10/0...+10VDC)	16 bit	0 bit
4	BL20-2AI-THERMO-PI	04/BL20-2AI-THERMO-PI	32 bit	0 bit
5	BL20-2DO-24VDC-0.5A-P	05/BL20-2DO-24VDC-0.5A-P	0 bit	2 bit
6	BL20-E-8DO-24VDC-0.5A-P	06/BL20-E-8DO-24VDC-0.5A-P	0 bit	8 bit
	Local I/O data incl. status/control		4 Words	1 Word
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**6 Words**	**1 Word**

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

2.2. I/O map for input data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	0000	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
0x0001	0001	04.15	04.14	04.13	04.12	04.11	04.10	04.09	04.08	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00
0x0002	0002	04.31	04.30	04.29	04.28	04.27	04.26	04.25	04.24	04.23	04.22	04.21	04.20	04.19	04.18	04.17	04.16
0x0003	0003	-	-	-	-	-	-	-	-	-	-	02.03	02.02	02.01	02.00	01.01	01.00
*0x0004	0004	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
**0x0005	0005	-	-	-	-	-	-	-	-	-	-	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: 6 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	-	-	-	-	-	-	06.07	06.06	06.05	06.04	06.03	06.02	06.01	06.00	05.01	05.00

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

Process output data: 1 Word

Fig. 69: Mapping of input data acc. to Modbus-report

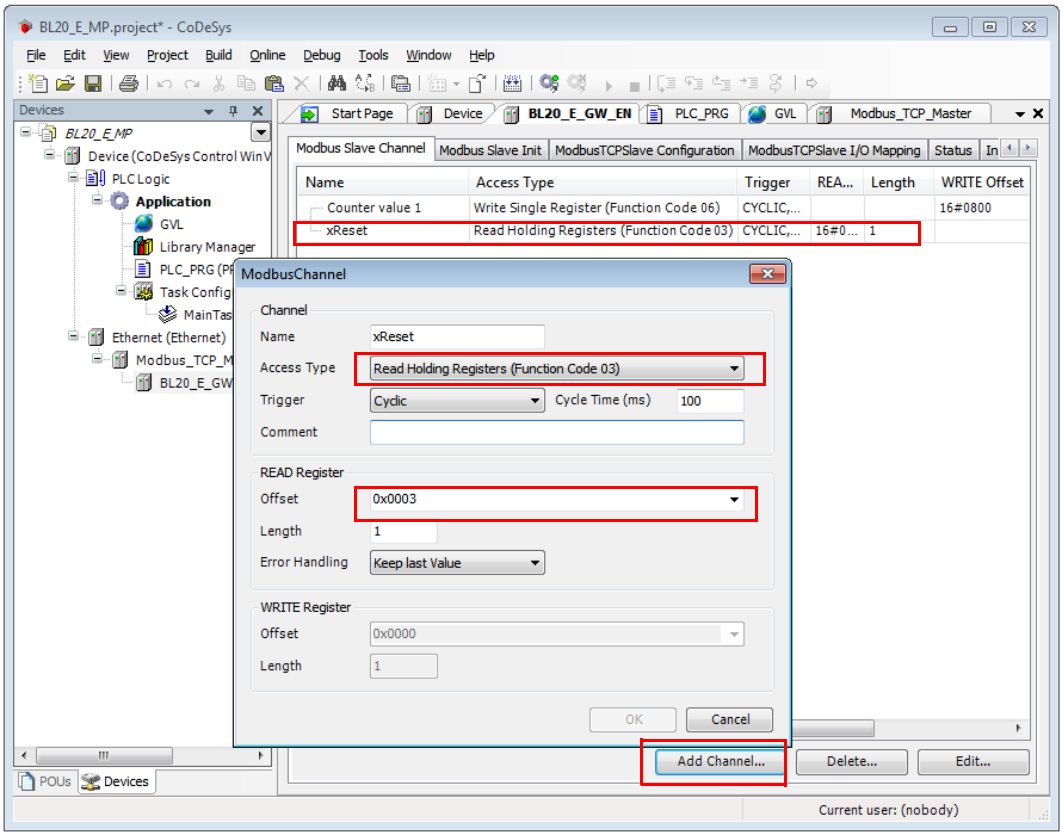


Fig. 70: Modbus channel, read "xReset", FC03

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

- "xReset" is mapped to the first bit in %IW0 of BL20-2DI-24VDC-P . 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 (page 143)**.

– Confirm with ”OK”. A ”1” at bit %IX0.0 will now reset the counter to zero.

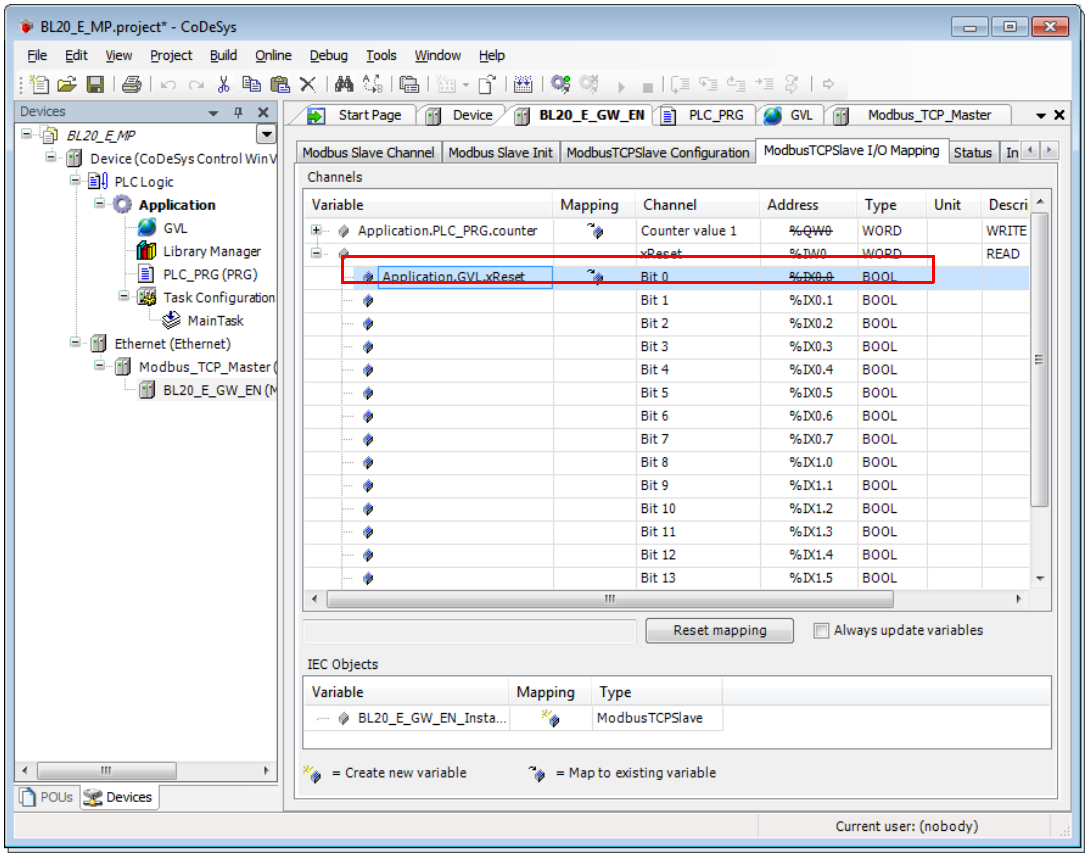


Fig. 71: Mapping of ”xReset” to bit %IX0.0

3 Read:
→Reading the station's Status Word

- Access Type:
  Read Holding Registers (function code **03**)
- Read Register, Offset:
  0x0004 (see below)
- The station's Status Word is read from register 0×0004 and displayed in &IW1 in the ModbusTCPSlave I/O Mapping.

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	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
0x0001	0001	04.15	04.14	04.13	04.12	04.11	04.10	04.09	04.08	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00
0x0002	0002	04.31	04.30	04.29	04.28	04.27	04.26	04.25	04.24	04.23	04.22	04.21	04.20	04.19	04.18	04.17	04.16
0x0003	0003	-	-	-	-	-	-	-	-	-	-	02.03	02.02	02.01	02.00	01.01	01.00
*0x0004	0004	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
**0x0005	0005	-	-	-	-	-	-	-	-	-	-	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: 6 Words

Fig. 72: Status Word mapping acc. to Modbus-report

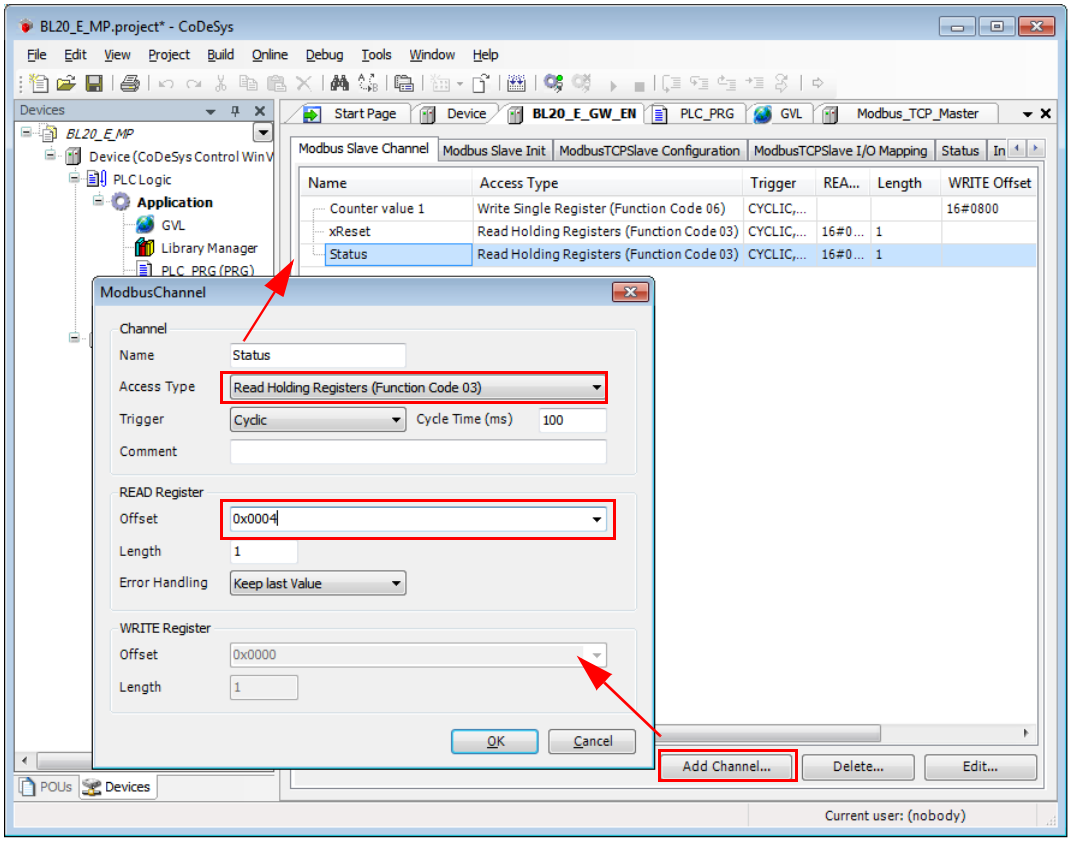


Fig. 73: Setting the Modbus channel for reading the status word

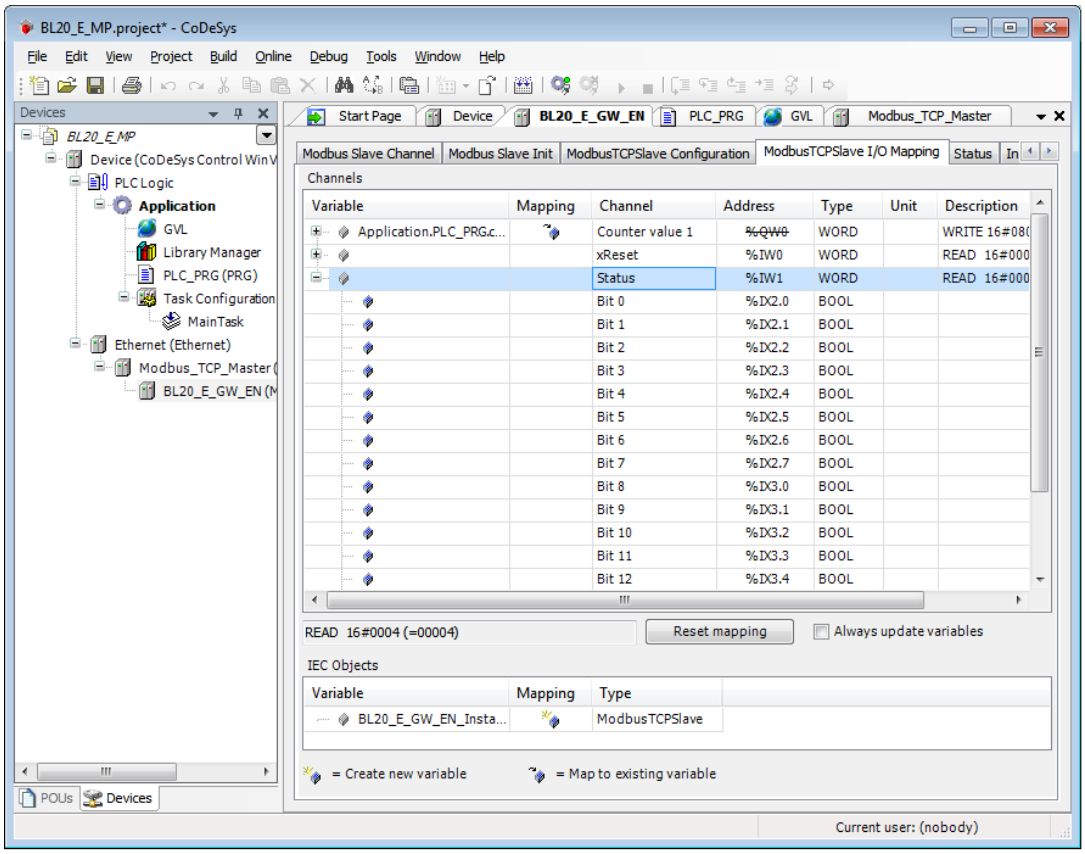


Fig. 74: Status Word in the process image

4 Write:
Parameters of the station
→
Disable channel diagnosis at channel 1 at slot 3 of the station BL20-1AI-U(-10/0…+10VDC)

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 Fig. 76: Setting the initialization channel for the parameterization (page 155)).

- Access Type:
  Write Single Register (function code **06**)
- Write Register, Offset:
  0xB040 (see below)

The parameters of the station can be found in register 0xB040 to 0xB060.

Parameterization of the station

The example parameterization will be the disabling of the channel diagnosis at channel 1, slot 3 of the station (Register 0×B040, Bit 2).

The parameter register is build up as follows:

2.4. Map for parameter data

Station report

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
B040	0	1	3	BL20-1AI-U(-10/0...+10VDC)	voltage mode	0 : 0..10V 1 : -10..+10V
B040	1	1	3	BL20-1AI-U(-10/0...+10VDC)	value representation	0 : Integer (15Bit + sign) 1 : 12Bit (left-justified)
B040	2	1	3	BL20-1AI-U(-10/0...+10VDC)	diagnostics	0 : release 1 : block
B040	3	1	3	BL20-1AI-U(-10/0...+10VDC)	channel	0 : activate 1 : deactivate
B060	0	1	4	BL20-2AI-THERMO-PI	mains suppression	0 : 50Hz 1 : 60Hz
B060	1	1	4	BL20-2AI-THERMO-PI	value representation	0 : Integer (15Bit + sign) 1 : 12Bit (left-justified)
B060	2	1	4	BL20-2AI-THERMO-PI	diagnostic	0 : release 1 : block
B060	3	1	4	BL20-2AI-THERMO-PI	channel	0 : activate 1 : deactivate
B060	4	4	4	BL20-2AI-THERMO-PI	element	0 : Type K, -270..1370°C

Fig. 75: Assignment of parameter registers

A $2^2 = 4$ will be written to register **0×B040**, which results from the station's the parameter byte assignment.

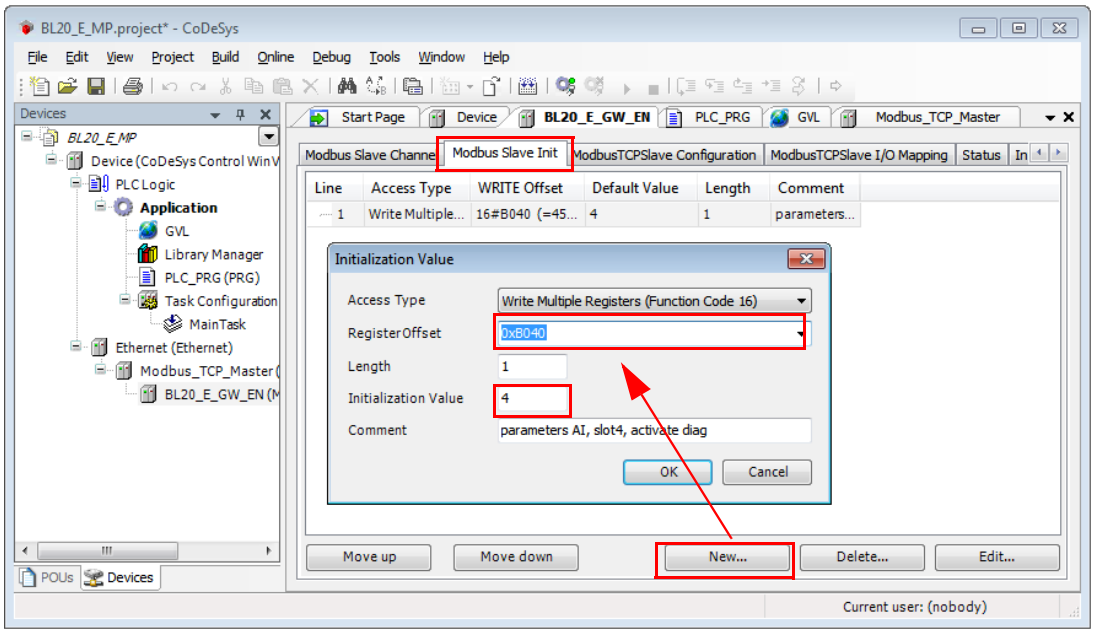


Fig. 76: Setting the initialization channel for the parameterization

8.3.10 Building, login and start

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

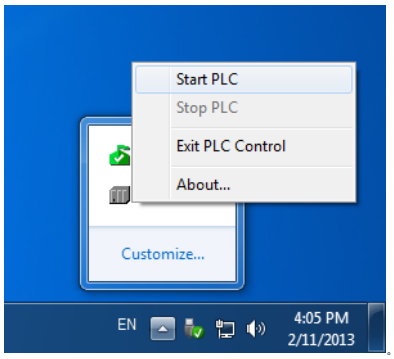


Fig. 77: Starting the WIN V3-PLC

2 Building the program:

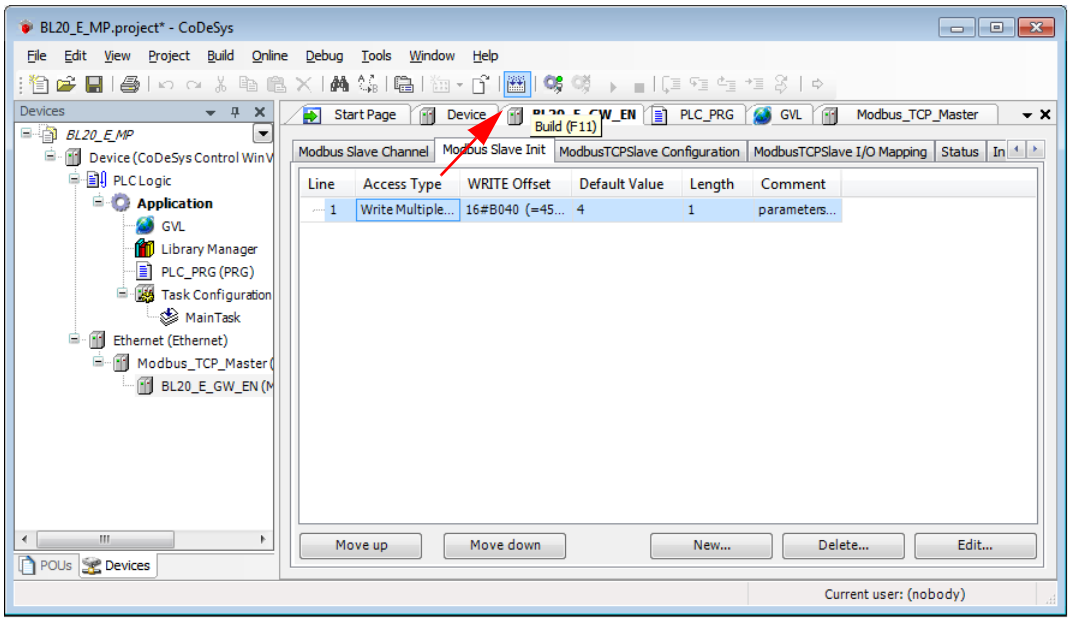


Fig. 78: Building the program

3 Login:

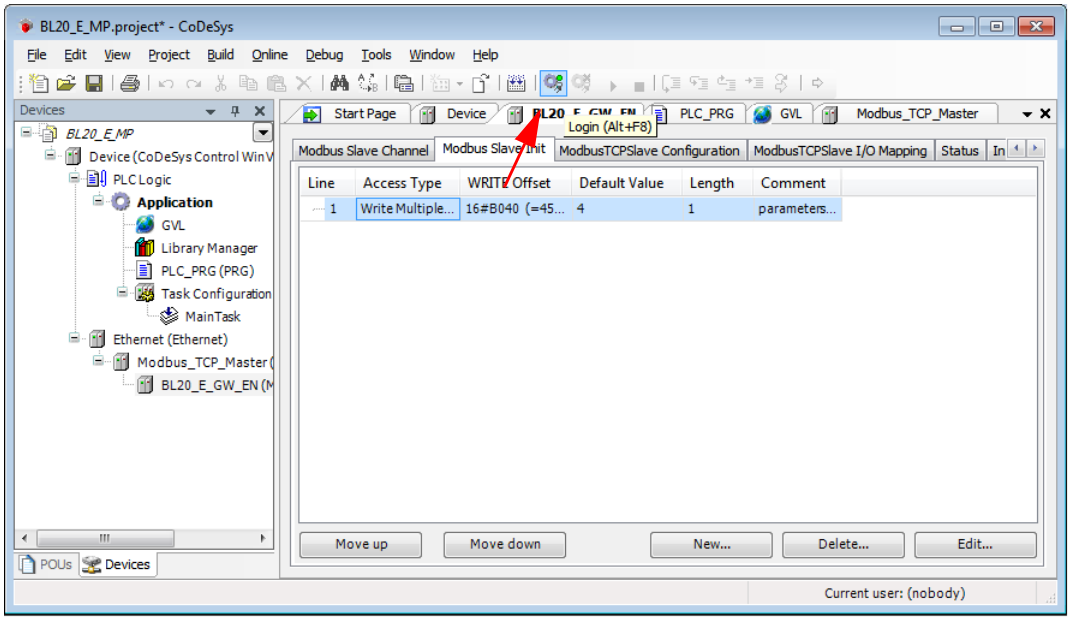


Fig. 79: Login

4 Start the program:

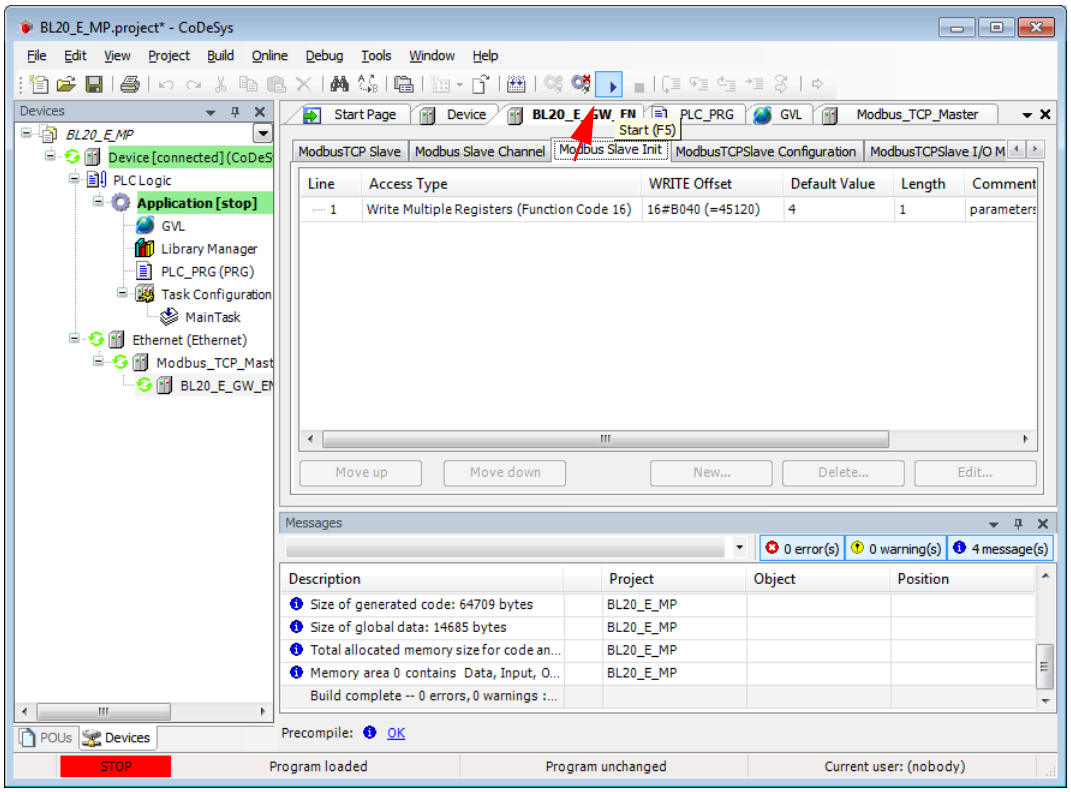


Fig. 80: Starting the program

8.3.11 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".

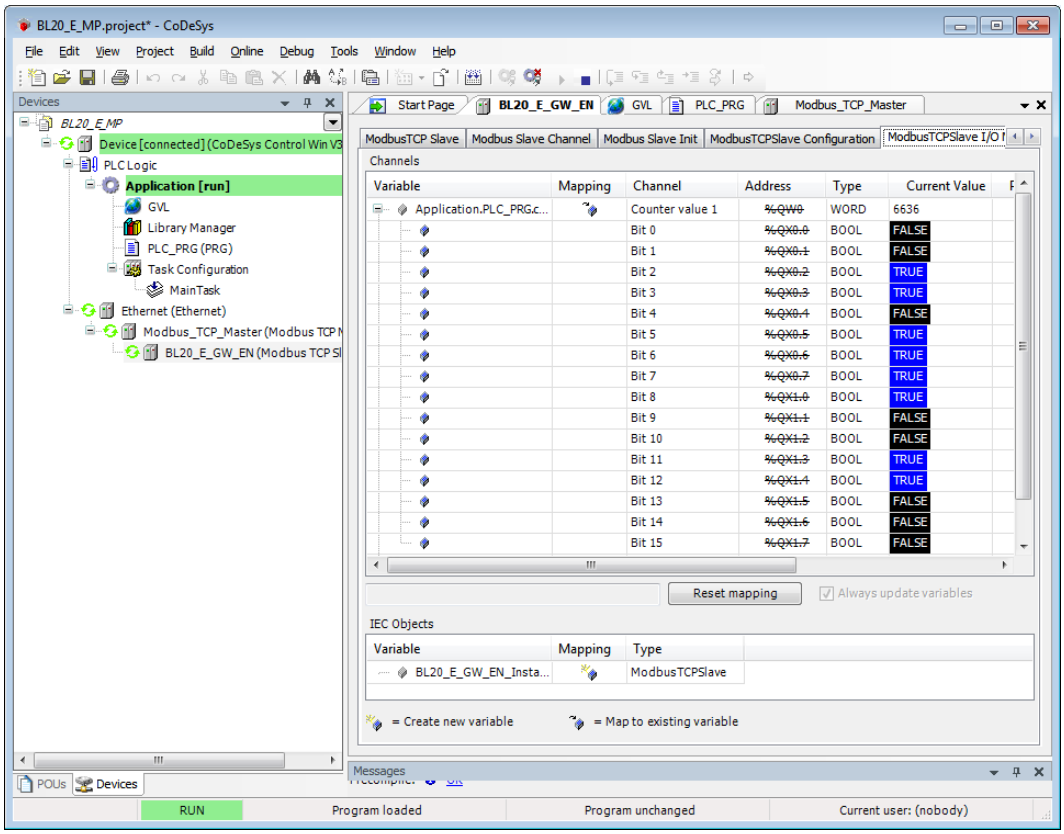


Fig. 81: Modbus TCP Slave I/O image with process data

8.3.12 Diagnosis evaluation

Evaluation of the Status word of the BL20-Station (%IW1)

Register 0x0004 contains the Status-word of the Station (see **Modbus data mapping (page 145)**).

According to the definition of the Modbus communication channel (see **Setting the Modbus-channels (examples) and data mapping (page 147)**, it is read from **%IW1** of the station image.

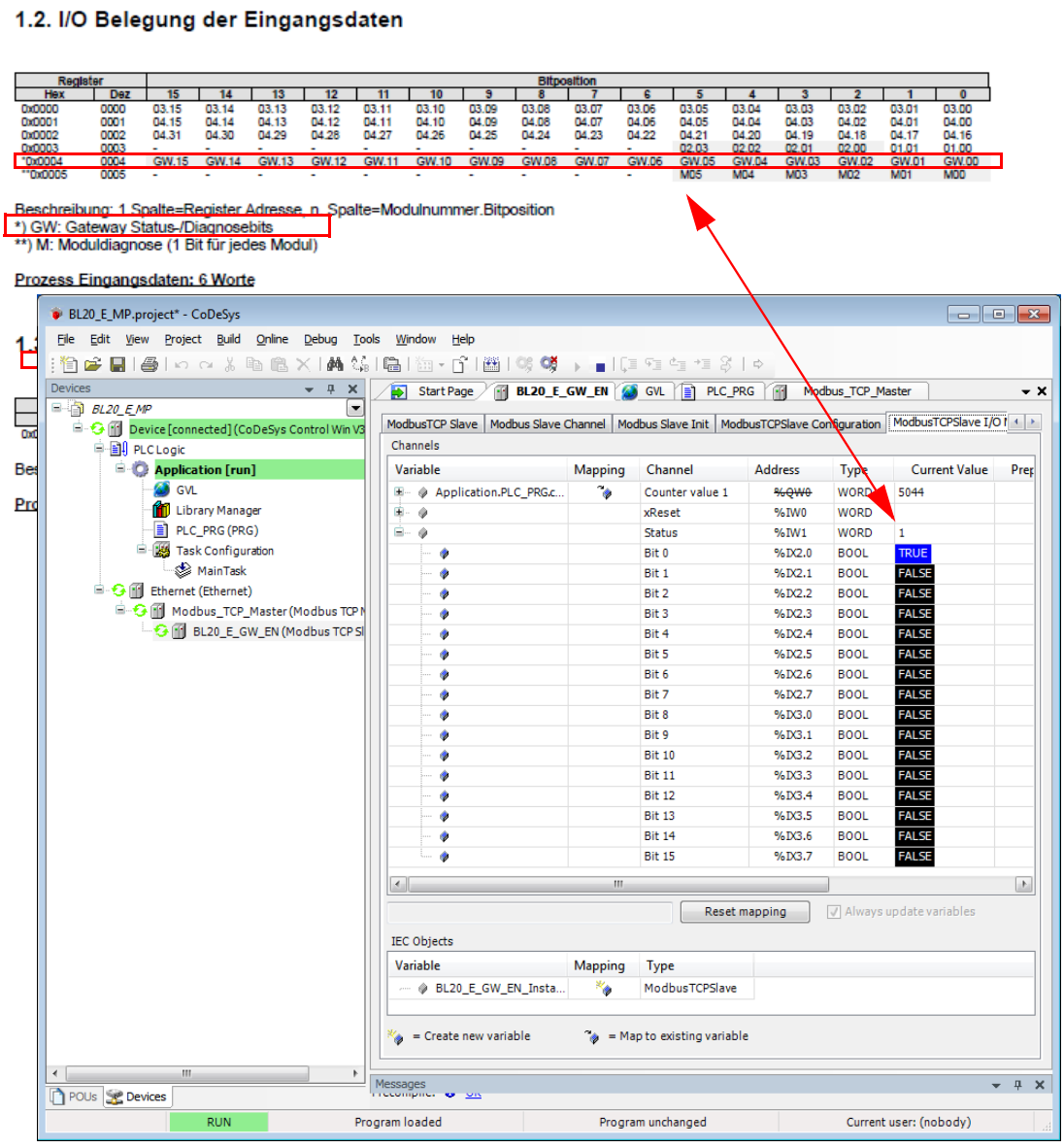


Fig. 82: Status Word of the station

The message has 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 0x100C: Gateway status (page 123)**).

Register	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0x0004	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 of 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 0×0005. It contains on bit per module in the BL20-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 BL20-station.

2. Modbus report

2.1. Station description

Station address: 192.168.1.112

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-EN (>= VN 03-00)	192.168.1.112/BL20-E-GW-EN (>= VN 03-00)	16 bit	0 bit
1	BL20-2DI-24VDC-P	01/BL20-2DI-24VDC-P	2 bit	0 bit
2	BL20-4DI-24VDC-P	02/BL20-4DI-24VDC-P	4 bit	0 bit
3	BL20-1AI-U(-10/0...+10VDC)	03/BL20-1AI-U(-10/0...+10VDC)	16 bit	0 bit
4	BL20-2AI-THERMO-PI	04/BL20-2AI-THERMO-PI	32 bit	0 bit
5	BL20-2DO-24VDC-0.5A-P	05/BL20-2DO-24VDC-0.5A-P	0 bit	2 bit
6	BL20-E-8DO-24VDC-0.5A-P	06/BL20-E-8DO-24VDC-0.5A-P	0 bit	8 bit
	Local I/O data incl. status/control		4 Words	1 Word
	Summarized diagnostics		1 Word	0 Words
Total size for in/out data rounded on full words			**6 Words**	**1 Word**

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

2.2. I/O map for input data

Register		Bit position															
Hex	Dec	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0x0000	0000	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
0x0001	0001	04.15	04.14	04.13	04.12	04.11	04.10	04.09	04.08	04.07	04.06	04.05	04.04	04.03	04.02	04.01	04.00
0x0002	0002	04.31	04.30	04.29	04.28	04.27	04.26	04.25	04.24	04.23	04.22	04.21	04.20	04.19	04.18	04.17	04.16
0x0003	0003	-	-	-	-	-	-	-	-	-	-	02.03	02.02	02.01	02.00	01.01	01.00
*0x0004	0004	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
**0x0005	0005	-	-	-	-	-	-	-	-	-	-	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: 6 Words

Fig. 83: Group diagnosis register

According to the examples for setting the modbus channels (see **Setting the Modbus-channels (examples) and data mapping (page 147)**), the following channel is add to read out the group diagnosis register.

Read Holding Registers (FC3), register 0×0005, length 1

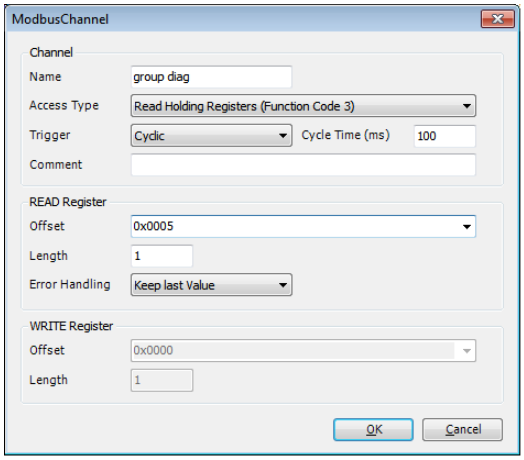


Fig. 84: Channel for reading out the group diagnosis

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

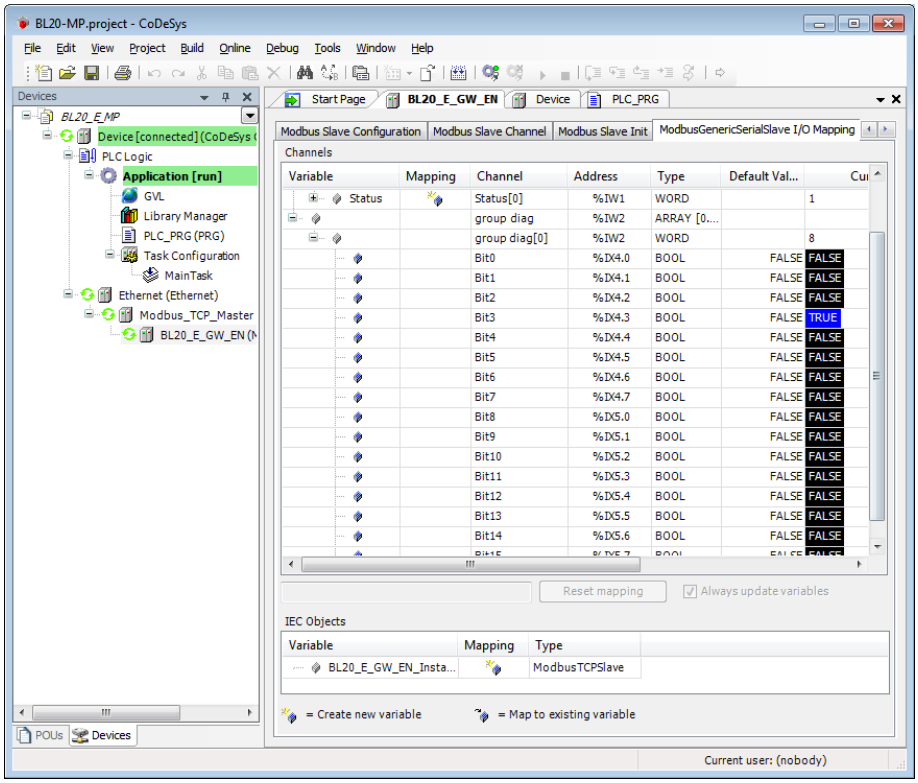


Fig. 85: Group diagnosis

→ bit 3 = 1

→ slot 4 sends diagnosis information

→ BL20-2AI-THERMO-PI (see also **Used hard-/software (page 131)**)

Evaluation of the module diagnosis information

The diagnosis data of module BL20-2AI-THERMO-PI at slot 4 of the example station can be found in registers 0×A060 to 0×A07F (see also Modbus TCP-report (**Fig. 65: Modbus report - Mapping of parameter and diagnostic data (page 146)**), whereby only register 0×A060 contains diagnosis information.

According to the examples for setting the modbus channels (see **Setting the Modbus-channels (examples) and data mapping (page 147)**), the following channel is add to read out the module diagnosis.

Read Holding Registers (FC3), register 0×A060, length 1:

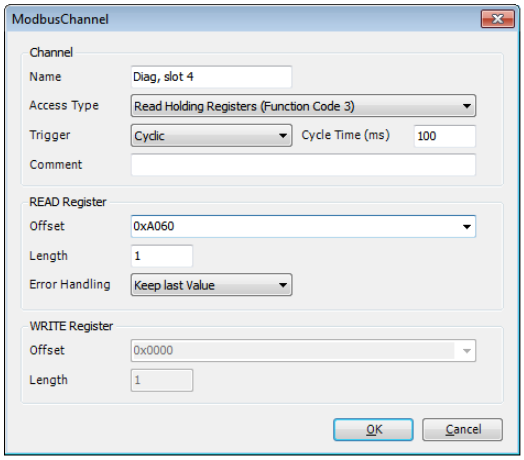


Fig. 86: Diagnosis channel

%IW3 in the I/O image of the example station shows the diagnosis information available at slot4:

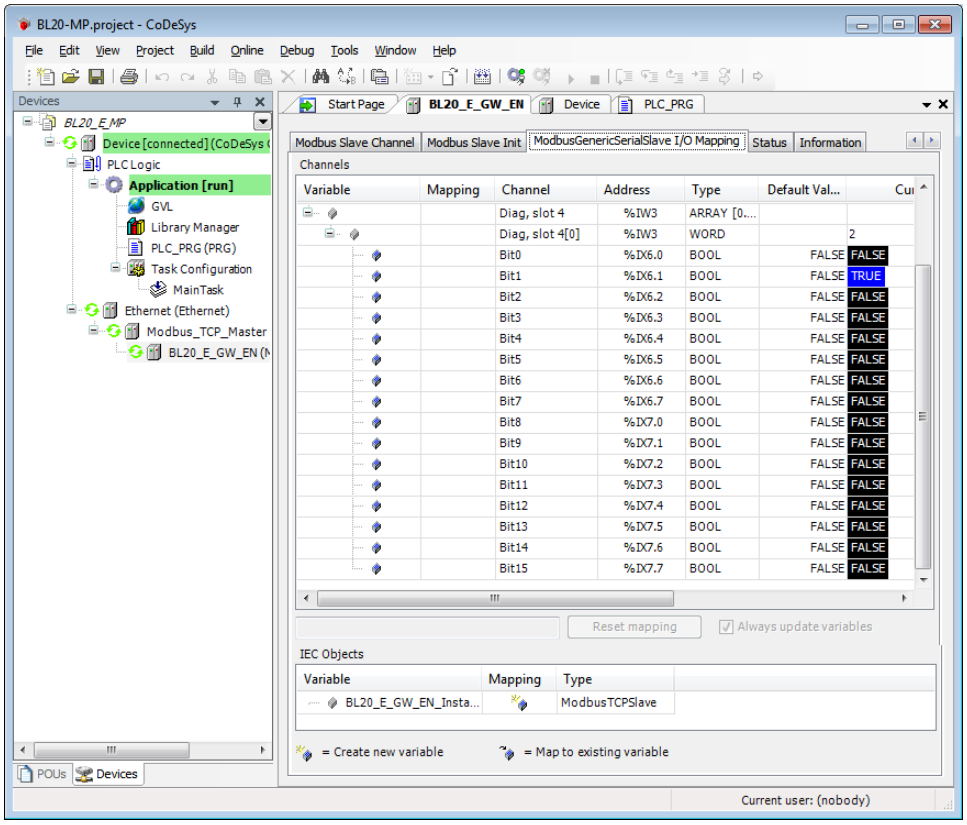


Fig. 87: Diagnosis data at slot 4

Meaning:
Bit 1: Open circuit at channel 1

(see also **Diagnostic messages of the modules (page 63)**)

1.5. Map for diagnostic data

Register	Bit pos.	Length	Slot	Module	Parameter	Value range
A040	0	1	3	BL20-1AI-U(-10/0...+10VDC)	Overflow/underrun channel x	0 : - 1 : activate
A060	0	1	4	BL20-2AI-THERMO-PI	Measurement value range error channel x	0 : - 1 : activate
A060	1	1	4	BL20-2AI-THERMO-PI	Open circuit channel x	0 : - 1 : activate
A060	2	1	4	BL20-2AI-THERMO-PI	No PT1000 sensor(cold j. comp) channel x	0 : - 1 : activate
A060	8	1	4	BL20-2AI-THERMO-PI	Measurement value range error channel x	0 : - 1 : activate
A060	9	1	4	BL20-2AI-THERMO-PI	Open circuit channel x	0 : - 1 : activate
A060	10	1	4	BL20-2AI-THERMO-PI	No PT1000 sensor(cold j. comp) channel x	0 : - 1 : activate
A080	0	1	5	BL20-2DO-24VDC-0.5A-P	Short circuit channel x	0 : - 1 : activate
A080	1	1	5	BL20-2DO-24VDC-0.5A-P	Short circuit channel x	0 : - 1 : activate

Fig. 88: Mapping of diagnosis data according to Modbus report

9 Implementation of PROFINET

9.1 PROFINET

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.

9.1.1 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.

9.1.2 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.

9.1.3 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.

9.1.4 PROFINET naming convention

Device name to be assigned to the PROFINET device

The name assignment is done via DCP. The device name has to meet the requirements of the Domain Name System (DNS) (see below). The device name is checked for correct spelling while being entered.

NOTE

The maximum length of the device name is 255 characters according to the specification. But, in a Step7- or TIA Portal environment only names with a maximum length of 127 characters will be accepted.

- All device names must be unique.
- Maximum name size: 127 characters (a…z, 0…9, '-' or '.'
- No upper-case letters
- The name cannot start or end with '-'.
- No special characters such as '$', '#', '/', '_'
- The name must not start with 0…9.
- The name must not start with 'port-xyz' (xyz = 0…9)

9.2 MRP (Media Redundancy Protocol)

The BL20-E-GW-EN (VN 03-00, FW version ≥ V3.2.9.0) supports MRP.

MRP is a standardized protocol according to IEC 62439. It describes a mechanism for media redundancy in ring topologies. With MRP, a defective ring topology with up to 50 nodes is detected and reconfigured in the event of an error. With MRP a trouble-free switch-over is not possible.

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). In the error-free state, the MRM blocks normal network traffic on one of its ring ports, with the exception of the test telegrams. The physical ring structure thus becomes a line structure again at the logical level for normal network traffic. In the event of an error, i.e. if a test telegram fails to be transmitted, there is a network error. In this case, the MRM opens its blocked port and establishes a new functioning connection between all remaining devices in the form of a linear network topology.

The time between ring interruption and recovery of a redundant path is called reconfiguration time. For MRP, this is a maximum of 200 ms. Therefore, an application must be able to compensate for the 200 ms interruption. The reconfiguration time always depends on the Media Redundancy Manager (e.g. the PROFINET PLC) and the I/O cycle and watchdog times set here. For PROFINET, the response monitoring time must be selected accordingly > 200 ms.

It is not possible to use Fast Start-Up in an MRP network.

9.3 GSDML-file

You can download the actual GSDML file for the gateway BL20-E-GW-PN "GSDML-V××-Turck-BL20-×××.xml" from our Homepage www.turck.com.

9.4 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).

9.5 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 10**, under **Diagnostic telegram with error code (page 198)**.

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

9.5.1 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} Channel 1: Undervoltage at U_L
Error codes (16 to 31 manufacturer specific)	

Value (dec.)	Diagnostics meaning for the gateway
16	Parametrization error/configuration error – **Station configuration changed** → The configuration is currently deviating from the reference list of modules. Process data can still be exchanged with the module bus stations which are at present connected to the module bus. The constellation of the module bus station that is set in the configuration software of the corresponding controller serves as a reference. – **Master configuration error** → **Display:** Configuration error/Parameterizing error at **channel 1** → The actual list of modules has been altered in such a manner, that no process data can be exchanged with the module bus stations which are at present connected to the module bus. – **Station configuration error** → **Display:** Configuration error/Parameterizing error at **channel 0** → The gateway could not prepare the station's configuration to be read out.
22	Behavior at communication loss – **Module bus error** → Communication with the module bus station on the module bus is not possible.

9.5.2 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:

Value (dec.)	Diagnosis
Error codes (1 to 9 according to the standards)	
1	Short circuit
2	Under voltage
4	overload
5	over temperature
6	wire break
7	overshoot upper limit
8	undershoot lower limit
9	error
Error codes (16 to 28 manufacturer specific)	
16	Parametrization error/configuration 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 failure The module detected a hardware failure. Exchange the module.
22	behavior at communication loss 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. Cold-junction compensation error Re-initialize user the application software of the module.
25	Cold-junction compensation error The module detected a defect or missing cold-junction compensation.
26	Overload sensor supply The module detected a load dump 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 error codes for the BL20 I/O-modules

The gateway changes the diagnostic messages sent by the BL20 I/O-modules to PROFINET error codes.

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

PROFINET Error code		Possible module diagnostics	
No. (dec.)	**Text**	**I/O module**	**Diagnostic message of the module**
1	Short circuit	BL20-2AIH-I	Short circuit
		BL20-4DI-NAMUR	overcurrent
2	Under voltage	BL20-BR-24VDC	**channel 0:** Undervoltage at U_{SYS} **channel 1:** Undervoltage at U_L
		BL20-PF-24VDC	**channel 1:** Undervoltage at U_L
		BL20-E-1SWIRE	voltage U_{SW}, U_{SWERR}
		BL20-2RFID-x	transceiver voltage supply error
3	overvoltage	not sent	
4	overload	BL20-BR-24VDC-D	overcurrent
		BL20-PF-120/230VAC-D	
		BL20-xDO-24VDC-0.5A-×	
		BL20-E-1SWIRE	Overcurrent protective circuit-breaker, $PKZE_{RR}$
		BL20-2RFID-×	Ident-overcurrent (supply of transceiver is switched-off)
		BL20-4AI-U/I	short circuit (SC)
		BL20-E-8AI-U/I-4AI-PT/NI	
		BL20-2AI-PT/NI-2/3	
		BL20-E-2CNT-2PWM	short-circuit at channel CH2 = P1_DIAG CH4 = P2_DIAG CH3 = D1_DIAG CH5 = D2_DIAG
5	over temperature	not sent	

PROFINET Error code		Possible module diagnostics	
No. (dec.)	Text	I/O module	Diagnostic message of the module
6	open circuit	BL20-×AI-I(0/4...20MA)	Open circuit
		BL20-2AI-PT/NI-2/3	
		BL20-2AI-THERMO-PI	
		BL20-2AIH-I	
		BL20-4AI-U/I	
		BL20-E-8AI-U/I-4AI-PT/NI	
		BL20-E-4AI-TC	
		BL20-2AOH-I	
		BL20-4DI-NAMUR	
7	overshoot upper limit	BL20-×AI-×	Measurement value range error (OoR)
		BL20-2AI-PT/NI-2/3	
		BL20-2AI-THERMO-PI	
		BL20-E-4AI-TC	
		BL20-4AI-U/I	
		BL20-E-8AI-U/I-4AI-PT/NI	
		BL20-2AIH-I	Overflow
		BL20-E-4AO-U/I	Measurement value range error (OoR)
		BL20-2AOH-I	Value above upper limit
		BL20-1SSI	Sensor value overflow
8	undershoot lower limit	BL20-×AI-×	Measurement value range error (OoR)
		BL20-2AI-PT/NI-2/3	
		BL20-2AI-THERMO-PI	
		BL20-E-4AI-TC	
		BL20-4AI-U/I	
		BL20-E-8AI-U/I-4AI-PT/NI	
		BL20-2AIH-I	Undervoltage
		BL20-E-4AO-U/I	Measurement value range error (OoR)
		BL20-2AOH-I	Value below lower limit
		BL20-1SSI	Sensor value underflow
9	error	BL20-E-8AI-U/I-4AI-PT/NI	Overflow/underflow OUFL
		BL20-E-4AO-U/I	
		BL20-2AOH-I	Invalid value

PROFINET Error code		Possible module diagnostics	
No. (dec.)	Text	I/O module	Diagnostic message of the module
16	parameterization error	BL20-E-1SWIRE	PLC SLAVE, RDYerr
		BL20-1RS×××	Parameterization error
		BL20-1SSI	
		BL20-2RFID-×	Invalid parameter
		BL20-E-2CNT-2PWM	Parameter error at channel CH0 = CNT1_PAR _ERR CH1 = CNT2_PAR _ERR CH2 = PWM1_PAR _ERR CH4 = PWM2_PAR _ERR
21	hardware failure	BL20-E-8AI-U/I-4AI-PT/NI	Hardware error
		BL20-2AIH-I	
		BL20-E-4AI-TC	
		BL20-E-4AO-U/I	
		BL20-2AOH-I	
		BL20-2RFID-×	Transceiver hardware error
		BL20-1RS×××	Hardware error
22	behavior at communication loss	BL20-2AIH-I	Communication error error
		BL20-2AOH-I	
		BL20-E-1SWIRE	Communication SWIRE slave (SD_{ERR})
		BL20-2RFID-×	Parameter not supported by transceiver
24	User software error	BL20-2AIH-I	Invalid parameter
		BL20-2AO-H	
		BL20-2RFID-×	Software error
25	Cold-junction compensation error	BL20-2AI-THERMO-PI	No Pt1000-sensor found
		BL20-E-4AI-TC	
27	unknown error	BL20-E-2CNT-2PWM	Hardware error
28	Common error	BL20-2AIH-I	HART status error
		BL20-E-4AI-TC	Measurement value range error
		BL20-2AOH-I	HART status error
		BL20-E-1SWIRE	General error message, GEN_{ERR}
		BL20-1SSI	SSI group diagnostics
29	configuration error	BL20-E-1SWIRE	SWIRE MASTER (SW_{ERR}) TYPE ERROR ($TYPE_{ERR}$)

9.6 Parameterization

9.6.1 Gateway parameters

The BL20-gateways for PROFINET occupy 4 parameter bytes.

Description of the gateway-parameters

Default values are shown in **bold**.

Byte	Bit parameters	Value	Meaning
0	Byte 0		
	Bit 0, bit 1: behavior at differing I/O configuration'		
	00	**output 0**	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, bit 3: Output behavior if one module is wrong		
	00	**output 0**	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”.

Byte	Bit parameters	Value	Meaning
0	Bit 2, bit 3: Output behavior if one module is wrong		
	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, bit 5: Output behavior at communication loss		
	00	**output 0**	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: Disable all diagnosis		
	0	**inactive**	Diagnostic messages and alarms are generated.
	1	active	Diagnostic messages and alarms are not generated.

Byte	Bit parameters	Value	Meaning
1	Bit 2: Disable output power diagnosis		
	0	**inactive**	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 is not monitored at the power feeding modules.
	1	active	An possible over- or undervoltage for V_O is not monitored.
	Bit 3: reserved		
	Bit 4: I/O-ASSISTANT Force Mode disable		
	0	**inactive**	-
	1	active	The I/O-ASSISTANT is not able to access the gateway via Force Mode.
	Bit 5: reserved		
	Bit 6: Startup also if configuration does not match		
	0	**inactive**	Changes in the station configuration are stored in the gateway following a power-on reset.
	1	active	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: EtherNet/IP deactivated		
	0	**inactive**	Explicit deactivating of the other Ethernet-protocols as well as of the web server.
	1	active	
	Bit 1: Modbus TCP deactivated		
	0	**inactive**	
	1	active	
	Bit 2 to Bit 7: reserved		
3	Bit 0 to Bit 6: reserved		
	Bit 7: Web server deactivated		
	0	**inactive**	Explicit deactivating of the web server
	1	active	

9.6.2 I/O-module-parameters

The description of the single I/O-module-parameters is protocol-independent and can thus be found in **chapter 4.9, Parameters of the I/O-modules (page 41)**.

9.6.3 Parameter "module parameterization"

Each parameterizable module, gets the additional parameter "module parameterization" via the GSDML-file of the gateway.

NOTE

This parameter is not part of the module parameters, but is only important for the communication between gateway and the modules.

This parameter extension is always necessary, even if the module is parameterized via a IO-supervisor.

- **"module parameterization" activated**

  The module receives its parameter settings from the controller, IO-supervisor, I/O-ASSISTANT or similar.
  In this case, parameter changes which were done in the meantime for example by a configuration tool or similar will be overwritten with the valid parameter data set.

- **"module parameterization" deactivated**

  Changes in the parameter settings are ignored for the respective module. The stored parameter data will be used.

NOTE

If the "module parameterization" is activated and a module is replaced by a new one, the gateway has to be operated with active U_{SYS}, in order to keep the module's parameter-settings for the new module.

U_L has to be switched-off and the station has to be separated from the field bus. Now, the gateway sends the parameters defined for the old module, into the new module.

9.7 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

9.7.1 Description of the acyclic gateway user data

Index	Name	Data Type	r/w	Comment
1 (0x01)	Gateway parameters	WORD	r/w	Parameter data of the module
2 (0x02)	Gateway Designation	STRING	r	Product name of the gateway
3 (0x03)	Gateway revision	STRING	r	Firmware-revision of the gateway
4 (0x04)	Vendor-ID	WORD	r	Ident number for Turck
5 (0x05)	Gateway-Name	STRING	r	Name assigned to the gateway
6 (0x06)	Gateway type	STRING	r	Device type of the gateway
7 (0x07)	Device-ID	WORD	r	Ident number of the gateway
8 (0x08) to 23 (0x17)	reserved			
24 (0x18)	Gateway diagnosis	WORD	r	Diagnosis data of the gateway
025 (0x19) to 31 (0x1F)	reserved			
32 (0x20)	Module input list	Array of BYTE	r	List of all input channels in the station
33 (0x21)	Module output list	Array of BYTE	r	List of all output channels in the station
34 (0x22)	Module diag. list	Array of BYTE	r	List of all module diagnosis messages
35 (0x23)	Module parameter list	Array of BYTE	r	List of all module parameters
36 (0x24) to 45039 (0xAFEF)	reserved			
45040 (0xAFF0)	I&M0-functions		r	Identification & Maintenance

Index	Name	Data Type	r/w	Comment
45041 (0xAFF1)	I&M1-functions	STRING[54]	r/w	not supported
45042 (0xAFF2)	I&M2-functions	STRING[16]	r/w	
45043 (0xAFF3)	I&M3-functions	STRING[54]	r/w	
45044 (0xAFF4)	I&M4-functions	STRING[54]	r/w	
45045 (0xAFF5)	I&M5-functions			
28672 (0x7000)	Gateway parameters	WORD	r/w	activating/deactivating the Ethernet-protocols (see also Gateway parameters (page 174))

9.7.2 Description of the acyclic module user data

Index	Name	Data type	r/w	Comment
1 (0x01)	Module parameter	specific	r/w	Parameter of the module
2 (0x02)	Module type	ENUM UINT8	r	Module type
3 (0x03)	Module version	UINT8	r	Firmware-revision of the module
4 (0x04)	Module ID	DWORD	r	Ident number of the module
5 (0x05) to 18 (0x12)	reserved			
19 (0x13)	Input data	specific	r	Input data of the respective module
20 (0x14) to 22 (0x16)	reserved			
23 (0x17)	Output data	specific	r/w	Output data of the respective module
24 (0x18) to 31 (0x1F)	reserved			
32 (0x20) to 255 (0xFF)	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.		

10 Application example: BL20-E-GW-EN with PROFINET (S7)

10.1 Application example

10.1.1 General

In order to configure the connection of a BL20 multi-protocol gateway for PROFINET to a Siemens PLC S7, the software package "SIMATIC Manager" version 5.5 from Siemens is used.

10.1.2 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
- BL20-E-GW-EN
  Gateway for connecting PROFINET to the BL20 example station
  - Device name: not assigned, yet
  - IP-address: not assigned, yet
  - example station:

Module		Data width	
		Process input	Process output
GW	BL20-E-GW-EN		
1	BL20-2DI-24VDC-P	2 Bit	-
2	BL20-4DI-24VDC-P	4 Bit	-
3	BL20-2AI-U(-10/0…+10VDC)	4 Byte	-
4	BL20-2AI-THERMO-PI	4 Byte	
5	BL20-2DO-24VDC-0.5A-P		2 Bit
6	BL20-E-8DO-24VDC-0.5A-P		8 Bit

10.1.3 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.

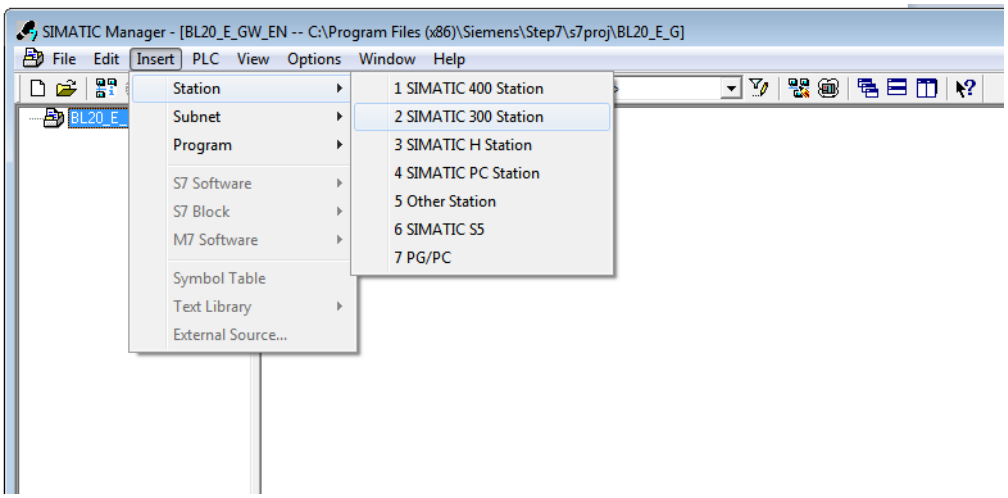


Fig. 89: Selecting a Simatic station

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

10.1.4 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.

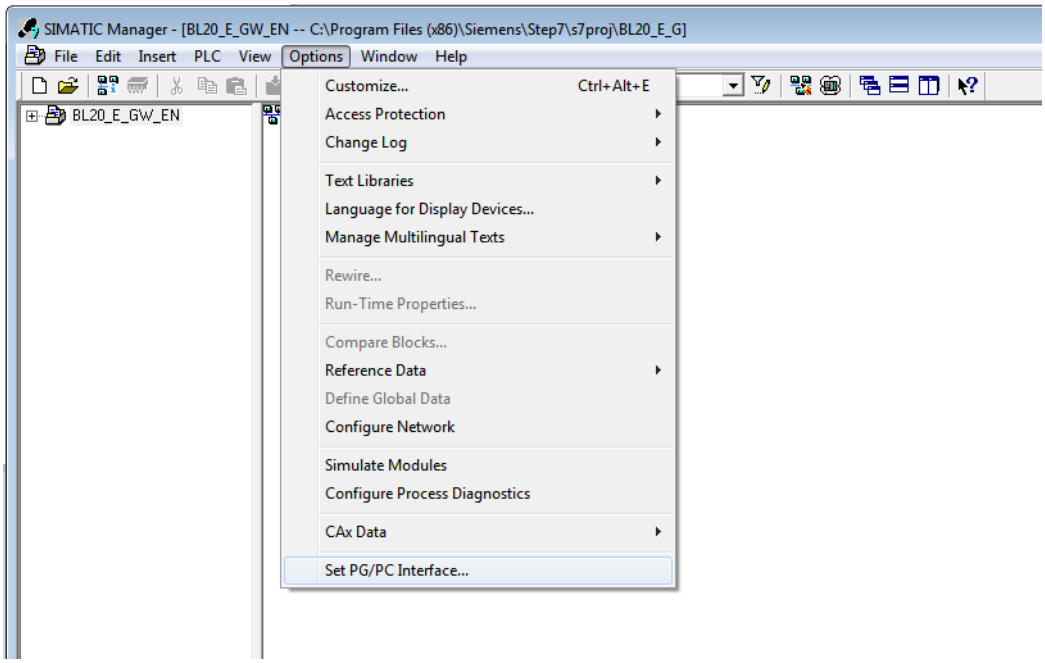


Fig. 90: Command "Set PG/PC Interface..."

10.1.5 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.

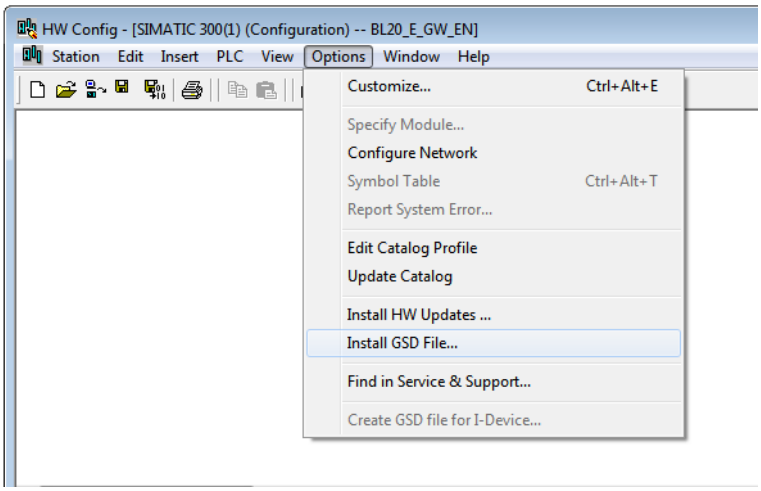


Fig. 91: GSD files install

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

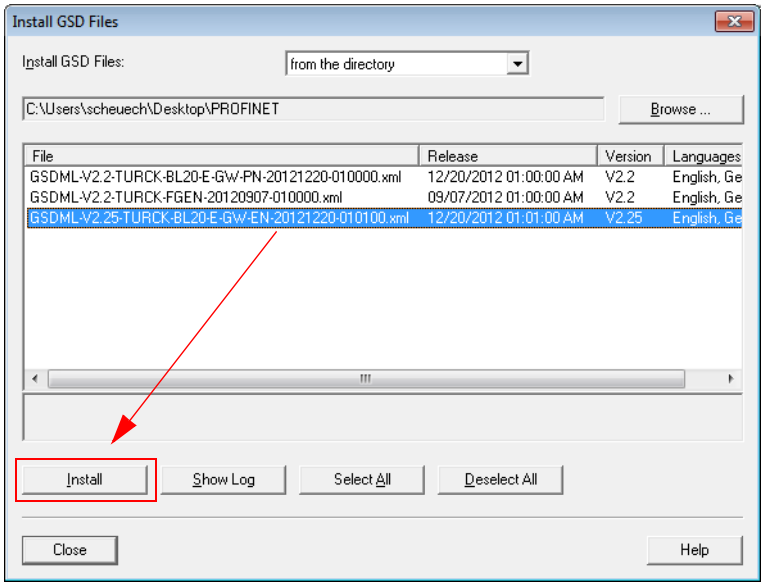


Fig. 92: Install GSD files

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

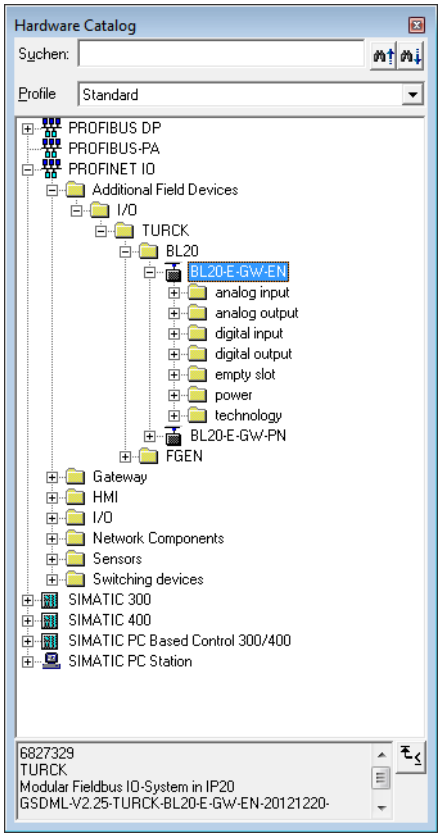


Fig. 93: BL20 gateway in the hardware catalog

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

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

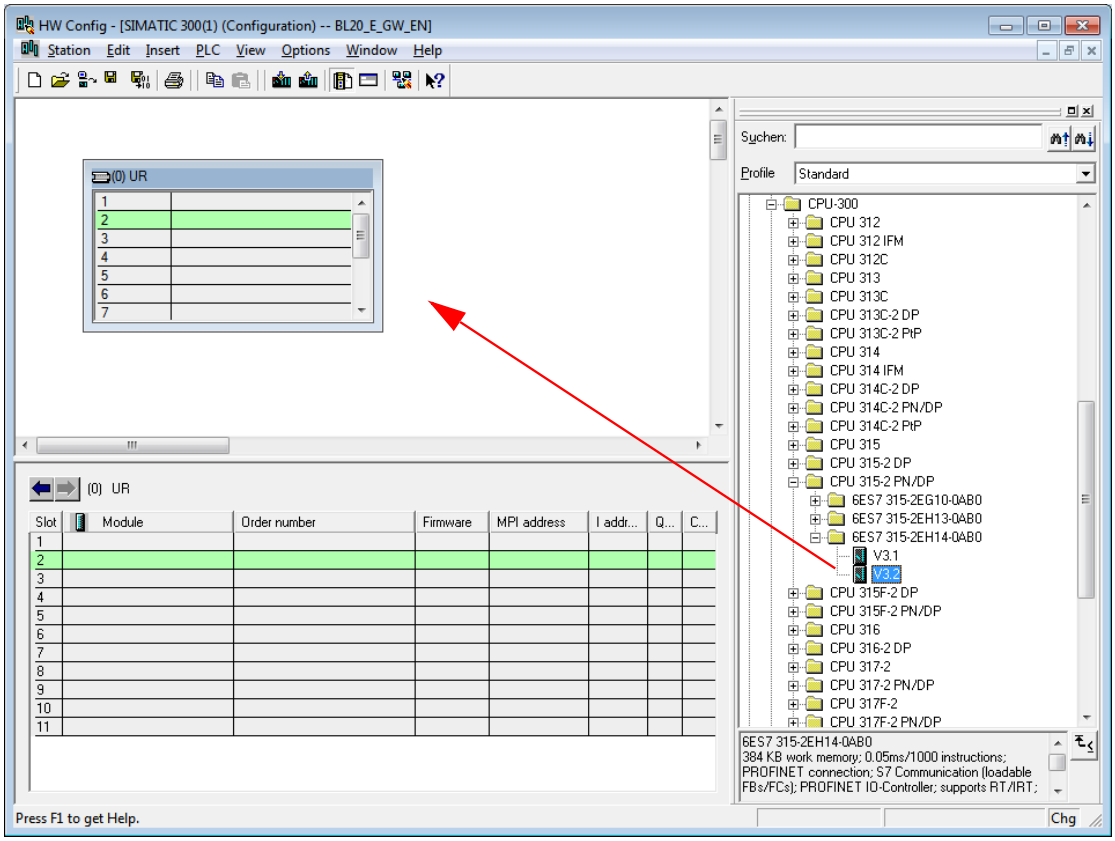


Fig. 94: Selecting the CPU

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.

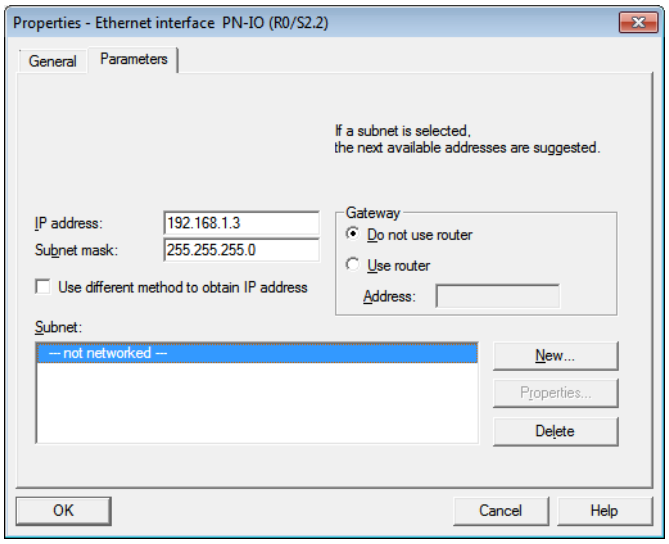


Fig. 95: Properties Ethernet interface

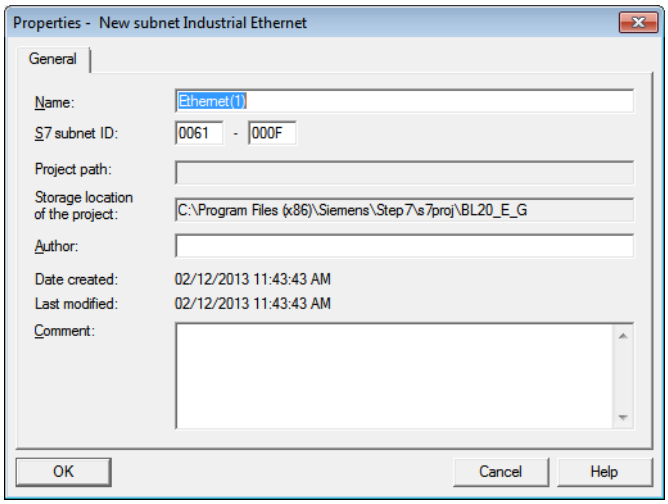


Fig. 96: Add new Ethernet subnet

10.1.6 Adding PROFINET-network nodes

The nodes of the example network (see s. S. 181) are added to the PROFINET as follows:

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

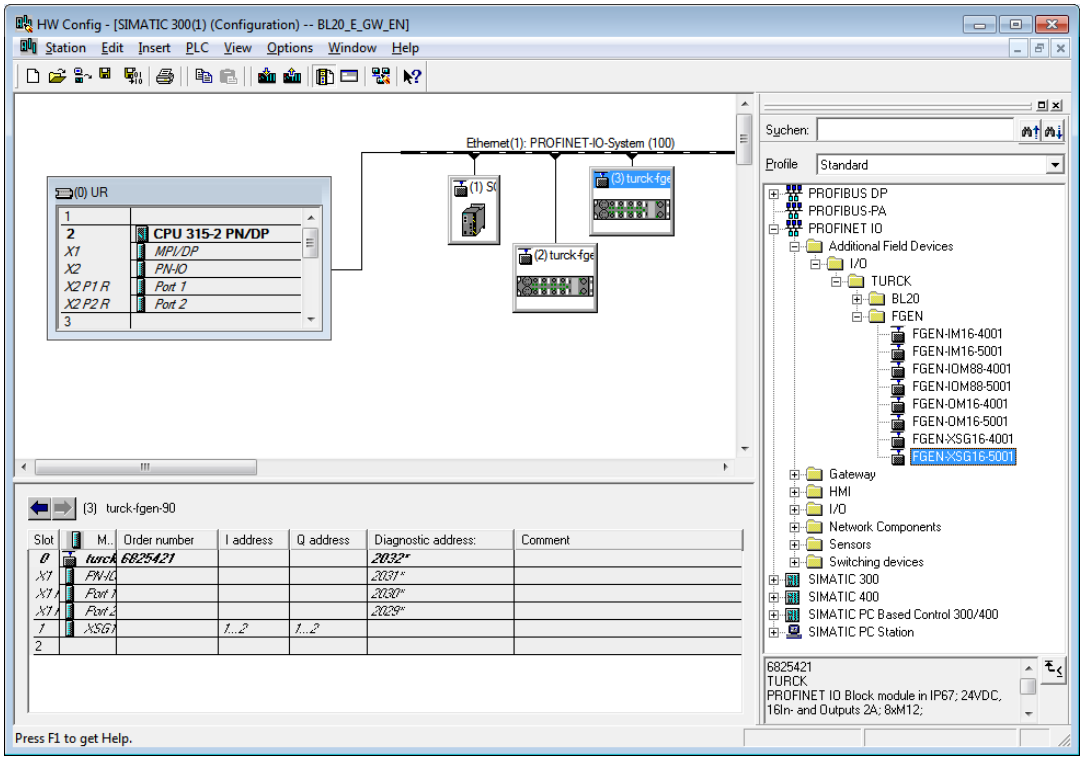


Fig. 97: Add network node

Adding a BL20-gateway and configuring the BL20-station

Now, the BL20-gateway is selected from the Hardware Catalog and added to the configuration

- BL20-E-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 → BL20" and add it to the Ethernet-network.

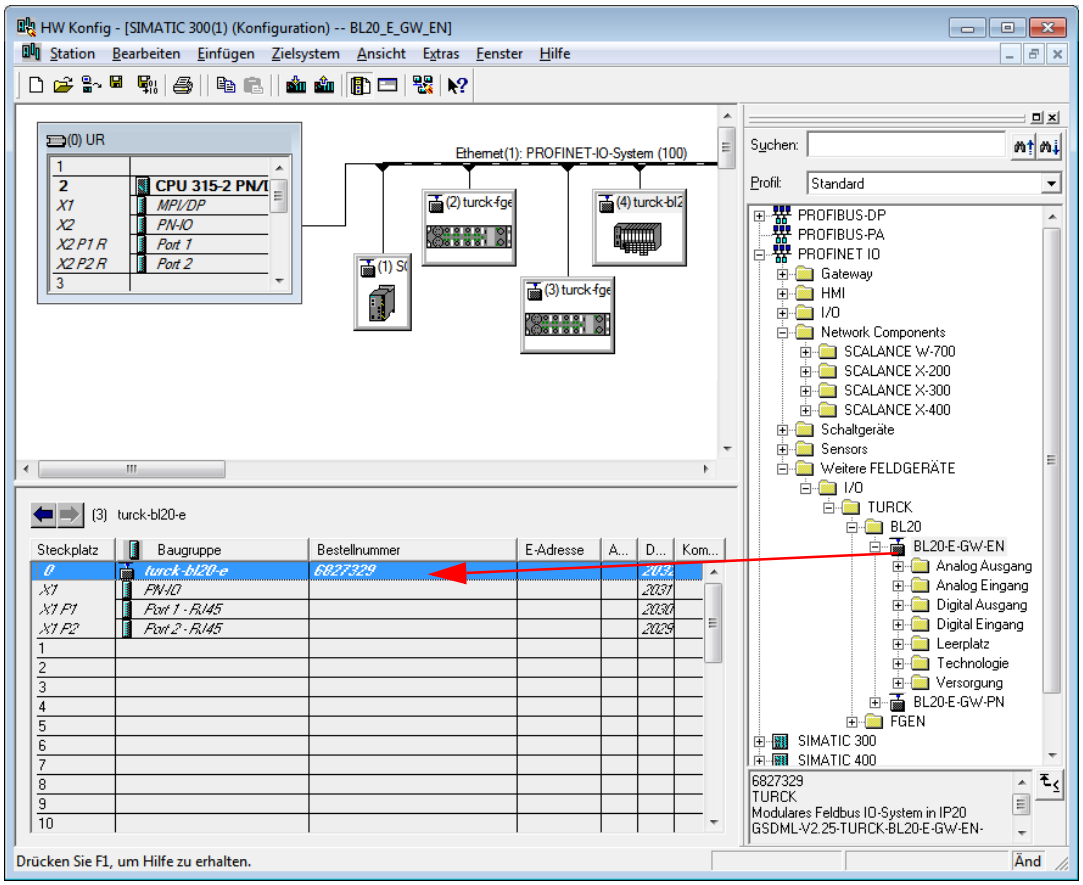


Fig. 98: Select BL20 gateway

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

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

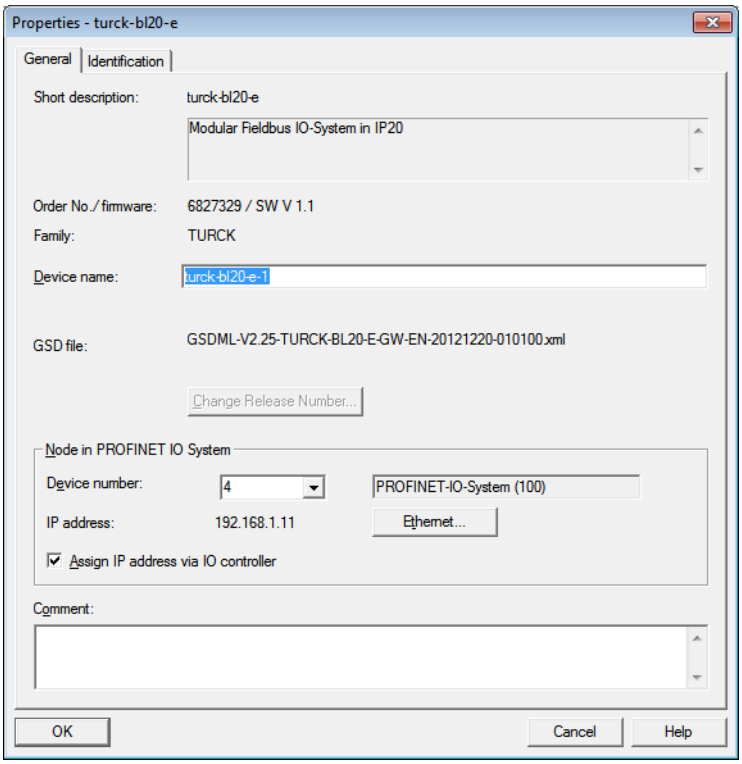


Fig. 99: Dialog: Properties Turck

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.

10.1.7 Configuring the BL20-station

After the assignment of the device name, the I/O modules, which are connected to the BL20 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.

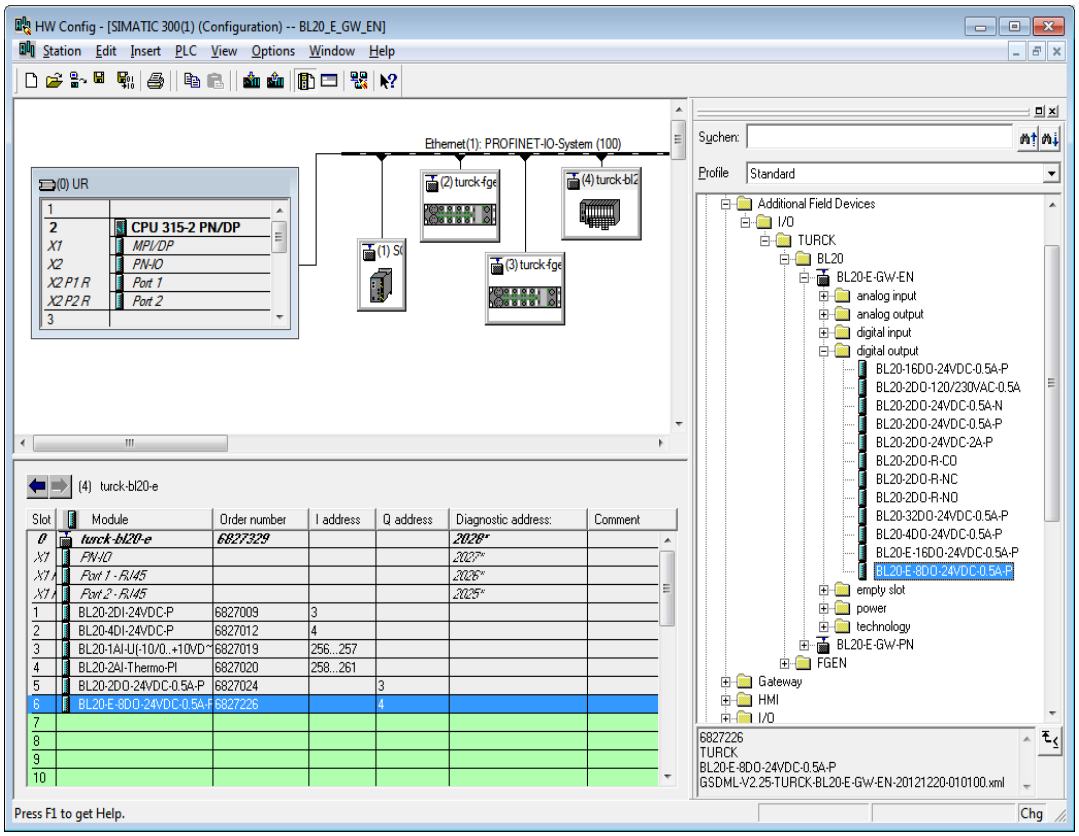


Fig. 100: Add I/O-modules to the station Add a station

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 fo the respective device.

This can be done following different ways:

Hardware reset:

– F_RESET at the gateway (see also **F_Reset (Reset to factory setting) (Seite 24)**

Software reset:

– HW Config: "PLC → Ethernet →Edit Ethernet Node...→ Browse", select a node and execute the reset in the dialog box "Edit Ethernet Node..." via "Reset".

– other PROFINET-tool (PST-tool from Siemens, etc.)

10.1.8 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".

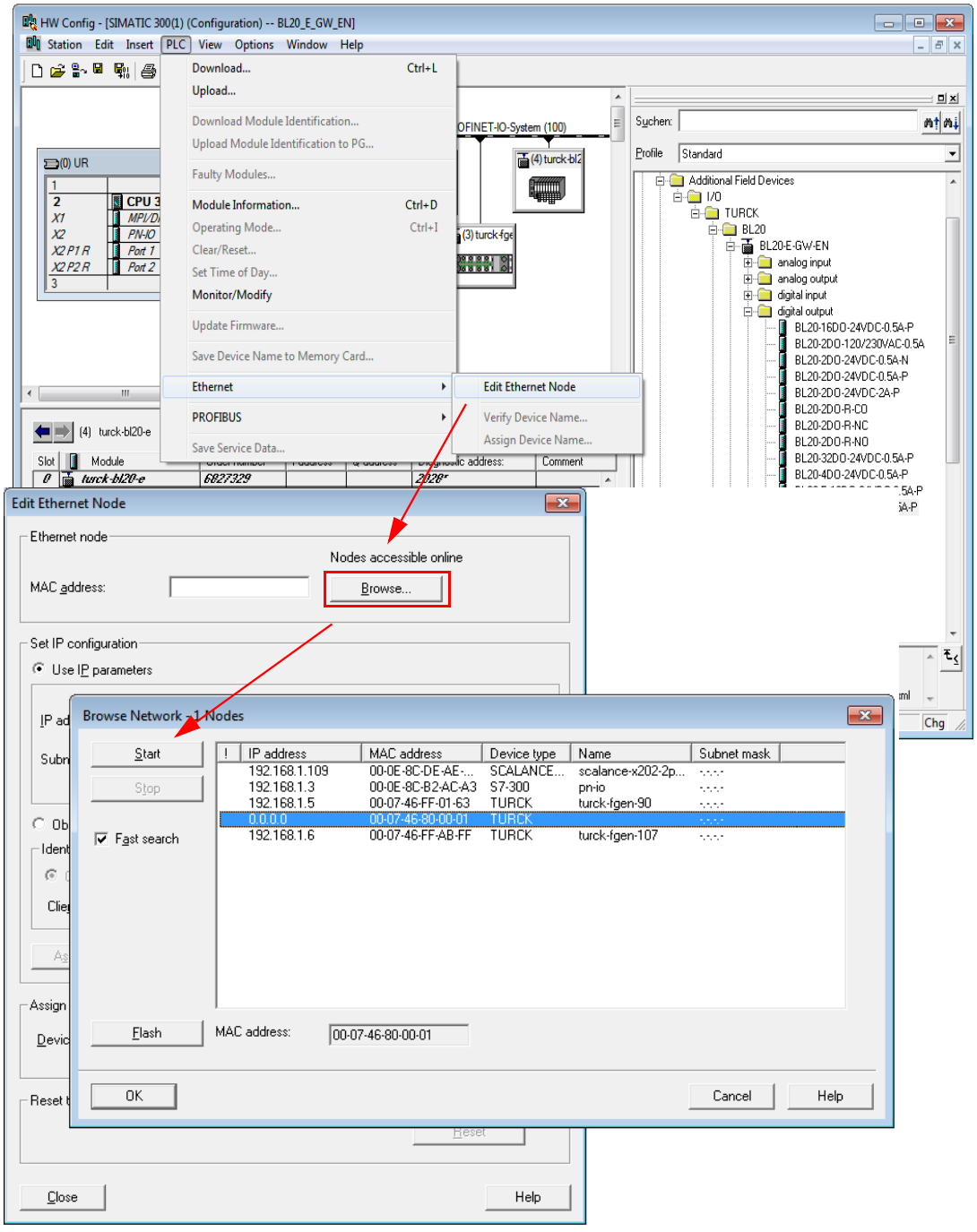


Fig. 101: Configure Ethernet node

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 and their device name.

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 BL20-gateway

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

In this example, the following name is assigned to the BL20-gateway:

- Device name: turck-bl20-e-1

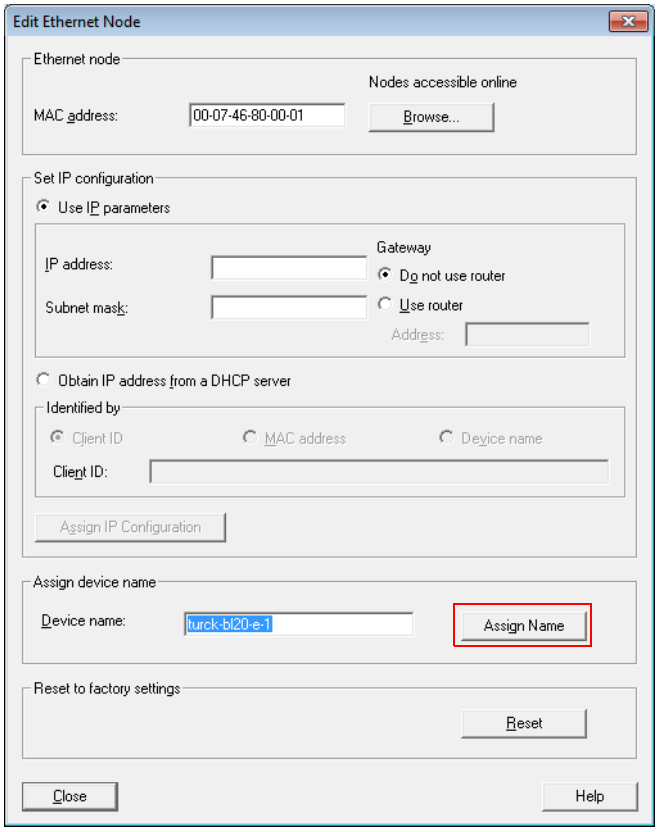


Fig. 102: Adaptation of the Ethernet node configuration

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.

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

10.1.9 PROFINET neighborhood detection via LLDP

Due to the neighborhood detection, there is no previous PROFINET name assignment (see **Device name assignment BL20-gateway (Seite 192)** 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 (Seite 194)**).

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.

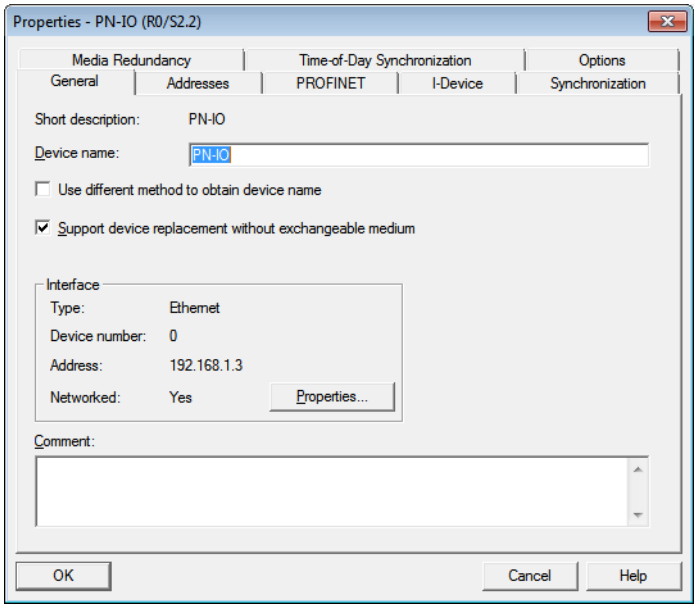


Fig. 103: Settings of the PROFINET-controller

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 (sees. S. 195).

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

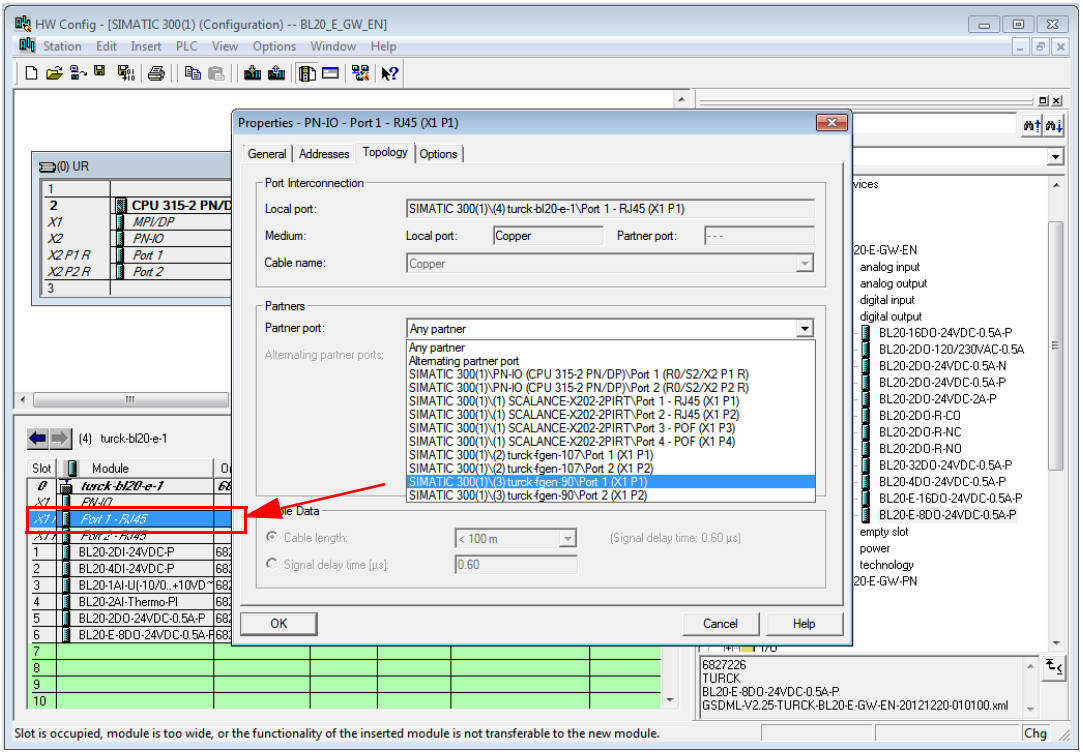


Fig. 104: Partner-port definition (Example)

- 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.

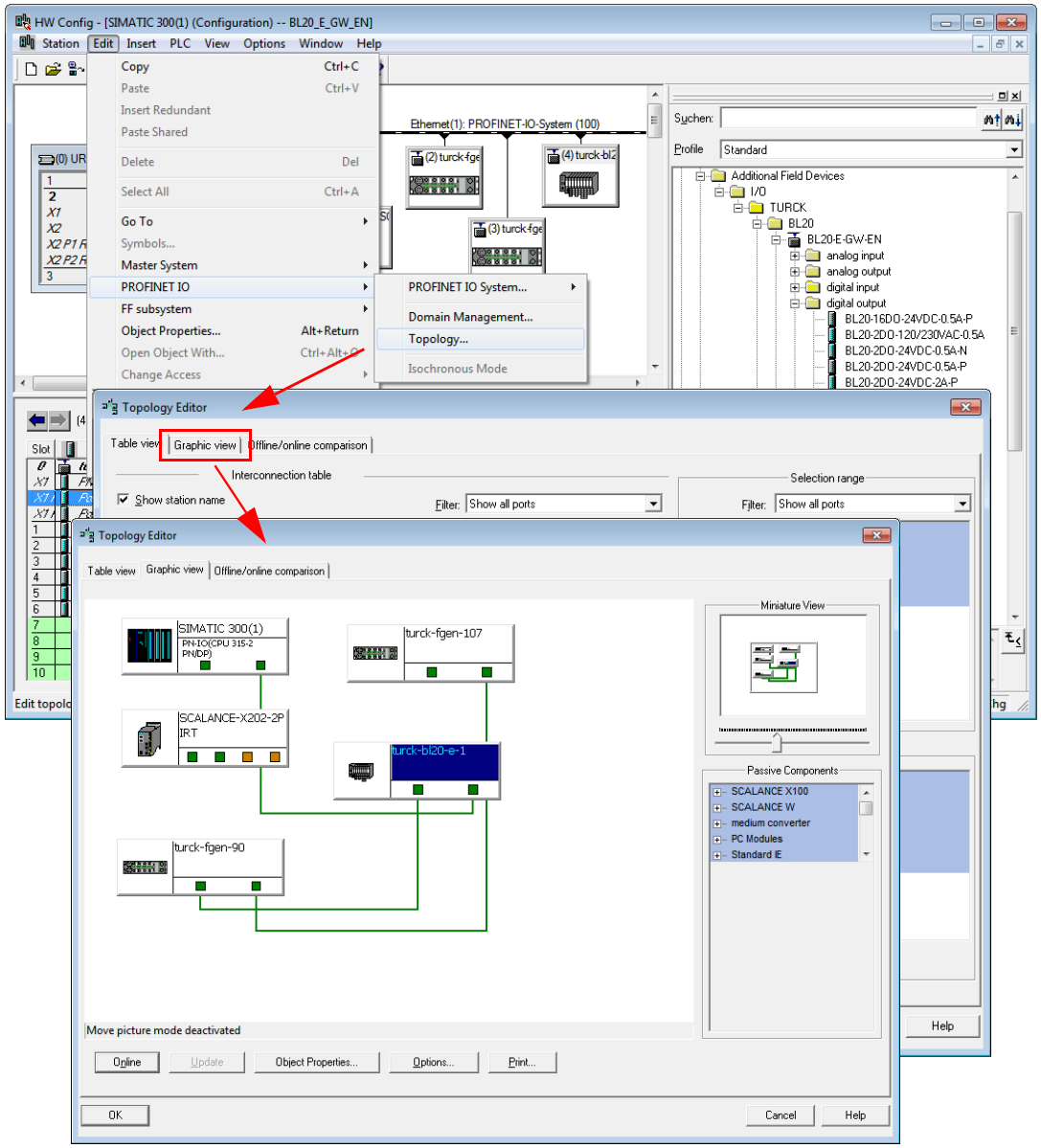


Fig. 105: PROFINET Topology Editor

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

10.1.10 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.

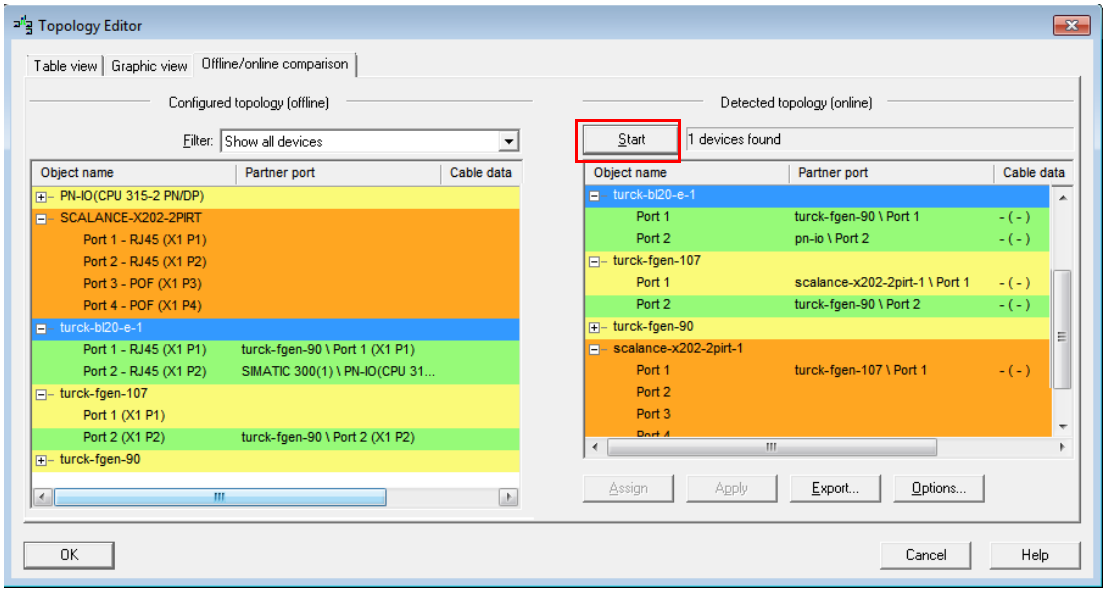


Fig. 106: PROFINET Topology Editor Offline/online comparison

10.2 Diagnostics with Step 7

10.2.1 Diagnostic messages in the hardware configuration

The BL20 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:

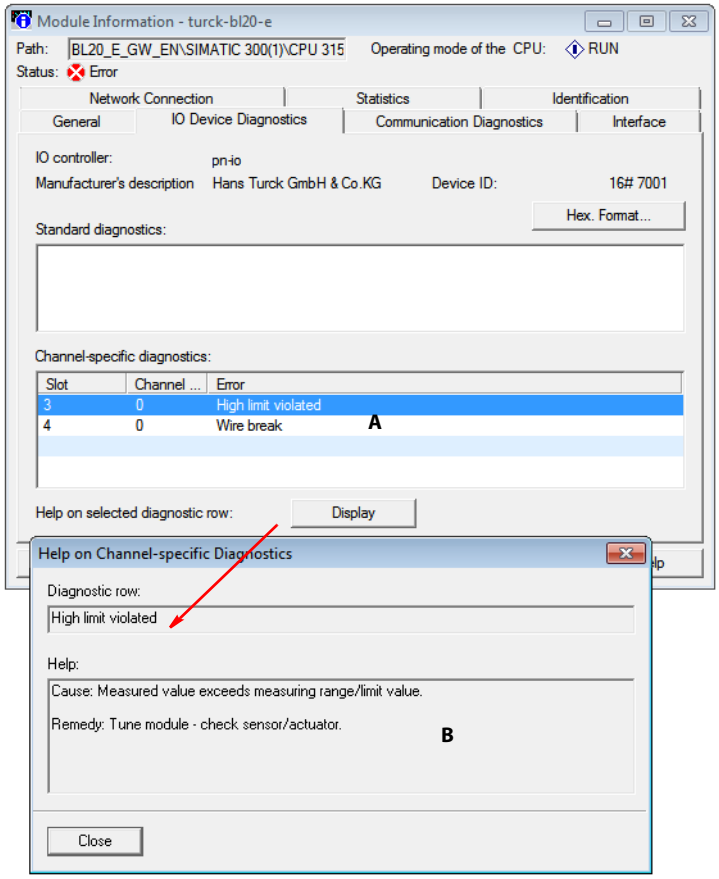


Fig. 107: Diagnostics

A channel-specific module diagnostics
B manufacturer specific help texts

10.2.2 Diagnostic telegram with error code

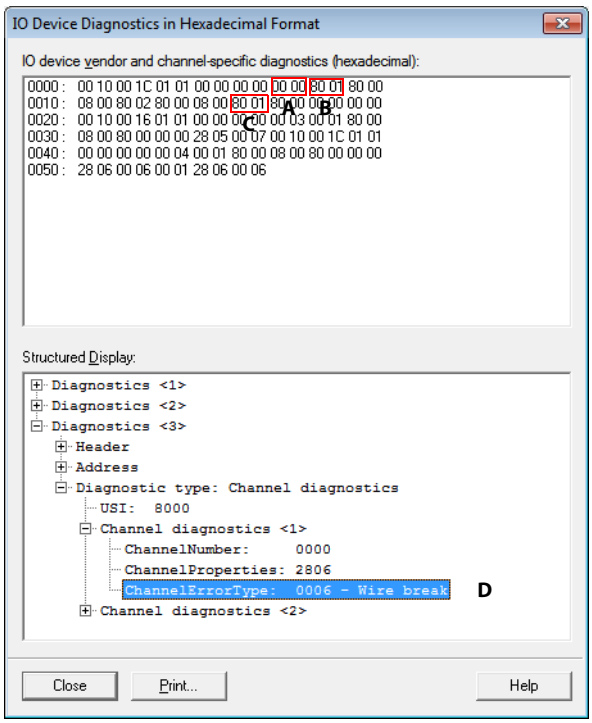


Fig. 108: Diagnostic message

A slot-no.
B sub slot-no.
C error code
D plaint text diagnostic message

11 Guidelines for station planning

11.1 Module arrangement

11.1.1 Random module arrangement

The arrangement of the I/O-modules within a BL20 station can basically be chosen at will.

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

NOTE

A mixed usage of gateways of the BL20 ECO and the BL20 standard product line and I/O modules of both product lines (base modules with tension clamp terminals) is possible without any problems.

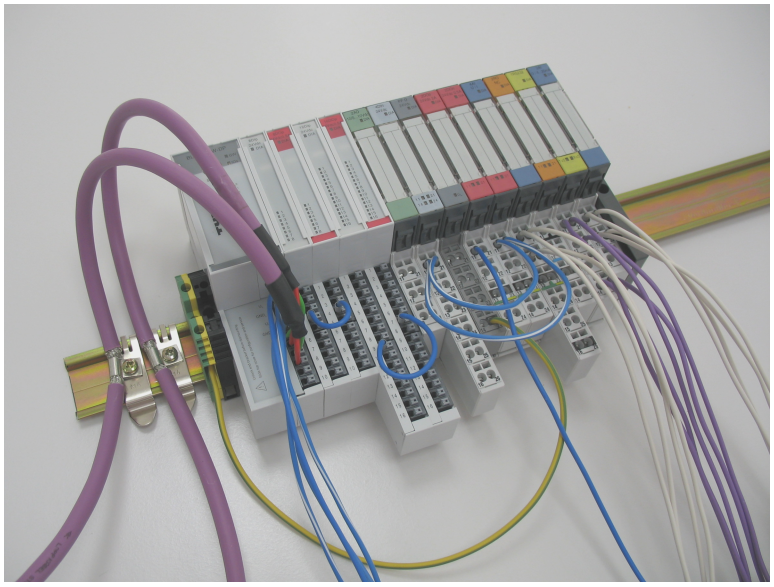


Fig. 109: Example of a station structure with ECO gateway (here for CANopen), ECO and standard I/O modules

NOTE

Next to the gateway, only base modules with tension clamp terminals and ECO-modules can be used.

Base modules with screw terminals can only be used, if a power supply module (BR or PF) with screw terminals was set before.

11.1.2 Complete planning

The planning of a BL20 station should be thorough to avoid faults and increase operating reliability. If there are more than two empty slots next to one another, the communication is interrupted to all following BL20 modules.

The system supply of a BL20 station is provided by a common, external voltage source, independent of the number of bus refreshing modules used in the station. This prevents the occurrence of potential equalization currents within the BL20 station.

11.1.3 Maximum system extension

The maximum number of modules connected to the gateway BL20-E-GW-EN depends on the following:

- The station extension may not exceed the maximum number of **32 modules**.
- Die maximum number of **192** communications bytes, which are transferred via the module bus from the gateway to the modules may not be exceeded.
- If the maximum sum of the modules' nominal current consumptions right to the gateway (max. sum ΣI_{MB} = **400 mA**) is reached, a Bus Refreshing module has to be used in order to provide the module bus voltage.
  To the right of the Bus Refreshing module, the sum of the modules' current consumptions can amount to **1,5 A**. 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 when the user activates the command "Verify station".

For the calculation of the maximum system extension, the following table contains an overview about the modules' communication bytes and the nominal current consumptions.

Module	Communication bytes (on the module bus)	Nominal current consumption at the module bus
BL20-PF-24VDC-D	2	28 mA
BL20-PF-120/230VAC-D	2	25 mA
BL20-2DI-24VDC-P	1	28 mA
BL20-2DI-24VDC-N	1	28 mA
BL20-2DI-120/230VAC	1	28 mA
BL20-4DI-24VDC-P	1	29 mA
BL20-4DI-24VDC-N	1	28 mA
BL20-4DI-NAMUR	5	40 mA
BL20-E-8DI-24VDC-P	1	15 mA
BL20-E-16DI-24VDC-P	2	15 mA
BL20-E-16DI-24VDC-N	2	15 mA
BL20-16DI-24VDC-P	2	45 mA
BL20-32DI-24VDC-P	4	30 mA
BL20-1AI-I(0/4…20MA)	3	41 mA
BL20-2AI-I(0/4…20MA)	5	35 mA
BL20-1AI-U(-10/0…+10VDC)	3	41 mA

Module	Communication bytes (on the module bus)	Nominal current consumption at the module bus
BL20-2AI-U(-10/0…+10VDC)	5	35 mA
BL20-2AI-PT/NI-2/3	5	45 mA
BL20-2AI-THERMO-PI	5	45 mA
BL20-4AI-U/I	9	30 mA
BL20-E-8AI-U/I-4AI-PT/NI	9	50 mA
BL20-2DO-24VDC-0.5A-P	2	32 mA
BL20-2DO-24VDC-0.5A-N	2	32 mA
BL20-2DO-24VDC-2A-P	2	33 mA
BL20-2DO-120/230VAC-0.5A	2	35 mA
BL20-4DO-24VDC-0.5A-P	2	30 mA
BL20-E-8DO-24VDC-0.5A-P	2	15 mA
BL20-E-16DO-24VDC-0.5A-P	2	25 mA
BL20-E-16DO-24VDC-0.5A-P	2	25 mA
BL20-16DO-24VDC-0.5A-P	3	120 mA
BL20-32DO-24VDC-0.5A-P	5	30 mA
BL20-1AO-I(0/4…20MA)	4	39 mA
BL20-2AO-I(0/4…20MA)	7	40 mA
BL20-2AO-U(-10/0…+10VDC)	7	43 mA
BL20-E-4AO-U/I	9	50 mA
BL20-2DO-R-NC	1	28 mA
BL20-2DO-R-NO	1	28 mA
BL20-2DO-R-CO	1	28 mA
BL20-E-2CNT/2PWM	9	30 mA
BL20-1RS232	9	140 mA
BL20-1RS485/422	9	60 mA
BL20-1SSI	9	50 mA
BL20-2RFID-×	9	30 mA
BL20-E-1SWIRE	9	60 mA
BL20-E-4IOL	9	40 mA
BL20-E-4IOL-10	9	40 mA

11.2 Power supply

11.2.1 Power supply to the gateway

The gateway BL20-E-GW-EN offers an integrated power supply (see also **Power supply (page 16)**).

11.2.2 Module bus refreshing (BL20-BR-24VDC-D)

The number of BL20 modules, which can be supplied via the internal module bus by the gateway or a Bus Refreshing module depends on the modules' nominal current consumptions at the module bus.

NOTICE

The sum of the nominal current consumptions of the used BL20 modules may not exceed 400 mA.
If a Bus Refreshing module is mounted, the sum of the current consumptions which follow the Bus Refreshing module must not exceed 1,5 A.

NOTE

The Bus Refreshing modules which are used in a station with BL20-E-GW-EC have to be combined with the base modules BL20-P3T-SBB-B or BL20-P4T-SBBC-B (tension clamp) or with the base modules BL20-P3S-SBB-B or BL20-P4S-SBBC-B (screw terminals).

With the system supply, it must be ensured that the same ground potential and ground connections are used. Compensating currents flow via the module bus if different ground potentials or ground connections are used, which can lead to the destruction of the Bus Refreshing module.

All Bus Refreshing modules are connected to one another via the same ground potential.

The power to the module bus is supplied via the connections 11 and 21 on the base module.

If the power supply from the module bus is not guaranteed, the software I/O-ASSISTANT 3 (FDT/DTM) generates an error message if the user activates the DTM "Additional functions → Verify station".

11.2.3 Creating potential groups

Bus Refreshing and 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. Ensure that the correct base modules are planned for when using Bus Refreshing modules.

NOTE

The system can be supplied with power independent of the potential group formation.

When using a digital input module for 120/230 V AC, it should be ensured that a potential group is created in conjunction with the Power Feeding module BL20-PF-120/230VAC-D.

NOTICE

Common potential of 24 VDC and 230 VAC field supply

Destruction of electronic

➤ Make sure that the 24 VDC and 230 VAC modules belong to separate potential groups.

11.2.4 C-rail (cross connection)

The C-rail runs through all base modules. The C-rail of the base modules for power distribution modules is mechanically separated; thus potentially isolating the adjoining supply groups.

Access to the C-rail is possible with the help of base modules with a C in their designation (for example, BL20-S4T-SBCS). The corresponding connection level is indicated on these modules by a thick black line. The black line is continuous on all I/O modules. On power distribution modules, the black line is only above the connection 24. This makes clear that the C-rail is separated from the adjoining potential group to its left.

Abb. 110: C-rail (front view)

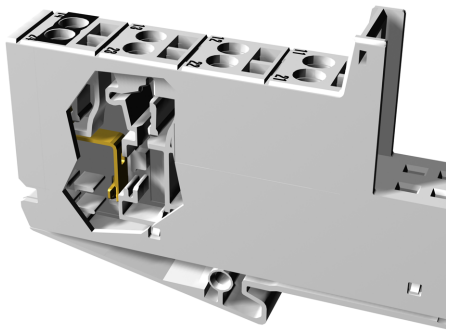


Abb. 111: C-rail front (side view)

WARNUNG

Incorrect C-rail load of 230 V

Possible danger to life due to electric shock

➤ Ensure that the C-rail is loaded with a maximum of 24 V DC, not 230 V.

The C-rail can be used as required by the application, for example, as a protective earth (PE). In this case, the PE connection of each power distribution module must be connected to the mounting rail via an additional PE terminal, which is available as an accessory.

The C-rail is not interrupted by the modules of the BL20-ECO-products. It is connected through the modules' connection level. But, an access to the C-rail is not possible.

NOTE

For information about introducing a BL20 station into a ground reference system, please read **Kapitel 11**.

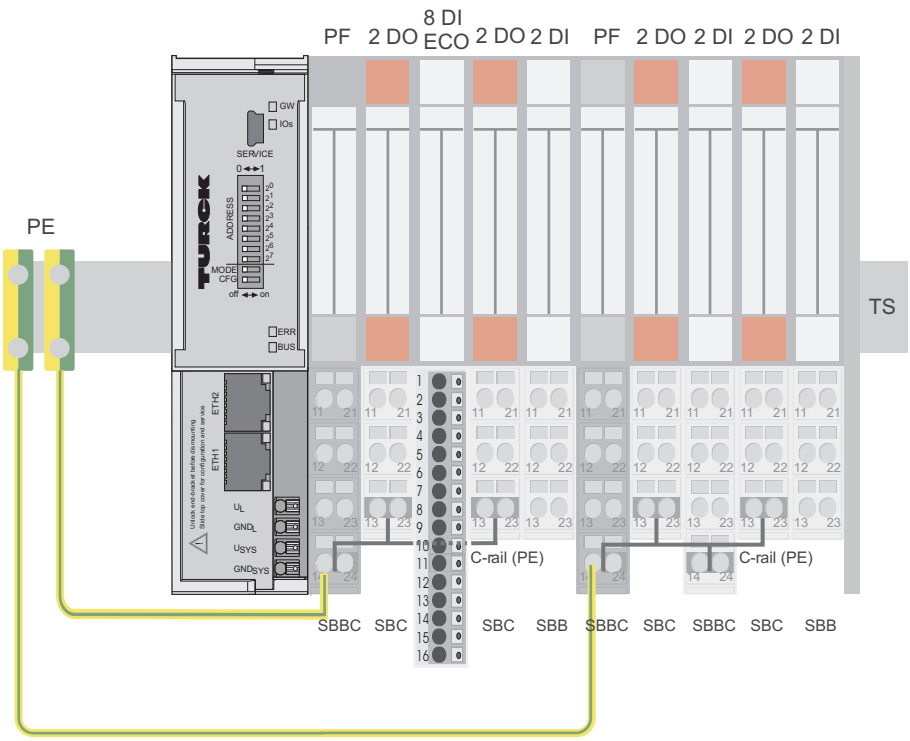


Fig. 112: Using the C-rail as a protective earth

C-rails can be used for a common voltage supply (24 V DC) when relay modules are planned. To accomplish this, the load voltage is connected to a Power Feeding module with the BL20-P4x-SBBC base module. All the following relay modules are then supplied with power via the C-rail.

NOTICE

Missing potential isolation

Destruction of module electronic

➤ Ensure that after using the C-rail for the common voltage supply of relay modules an additional supply module is used for the potential separation to the following modules. Only then can the C-rail serve as PE again.

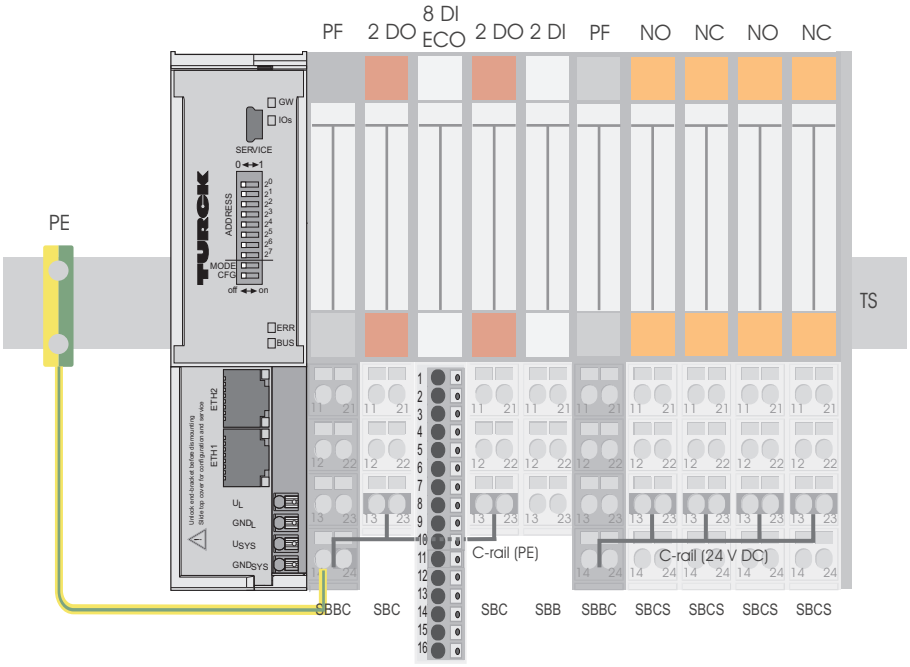


Fig. 113: Using the C-rail as protective earth and for the power supply with relay modules

Cross-connecting relay module roots is achieved by the use of jumpers. The corresponding wiring diagram including the jumpers can be found the manuals for BL20 I/O modules (German: D300716, English: D300717).

11.2.5 Direct wiring of relay modules

As well as the options mentioned above, relay modules can be wired directly. In this case, base modules without C-rail connections should be chosen to guarantee the potential isolation to the adjoining modules.

11.3 Protecting the service interface on the gateway

During operation, BL20 label protecting the service interface and the rotary coding switches must remain in place due to EMC and ESD requirements.

11.4 Plugging and pulling electronics modules

BL20 enables the pulling and plugging of electronics modules without having to disconnect the field wiring. The BL20 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

NOTICE

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

11.5 Extending an existing station

NOTICE

Station expansion under load
Risk of injury due to electric shock!
➤ Switch off the power supply.
➤ Secure the power supply against being switched on again.
➤ Ensure that the unit is de-energized.n.

11.6 Firmware download

Firmware can be downloaded via the service interface on the gateway using the software tool I/OASSISTANT. More information is available in the program's online help.

NOTICE

Firmware download under load
Damage of the firmware
➤ Disconnect the station from the modules bus before the download.
➤ Disconnect the field side.

12 Guidelines for Electrical Installation

12.1 General notes

12.1.1 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.).

12.1.2 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

Insufficient lightning protection measures
Risk of death due to lightning strike
➤ When installing cables outside buildings, observe all applicable guidelines for internal and external lightning protection and all earthing regulations.

12.1.3 Lightning protection

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

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

12.1.4 Transmission media

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

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

NOTE

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

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

12.2 Potential relationships

12.2.1 General

The potential relationship of a Ethernet system realized with BL20 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 BL20 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 BL20 station with Ethernet gateway.

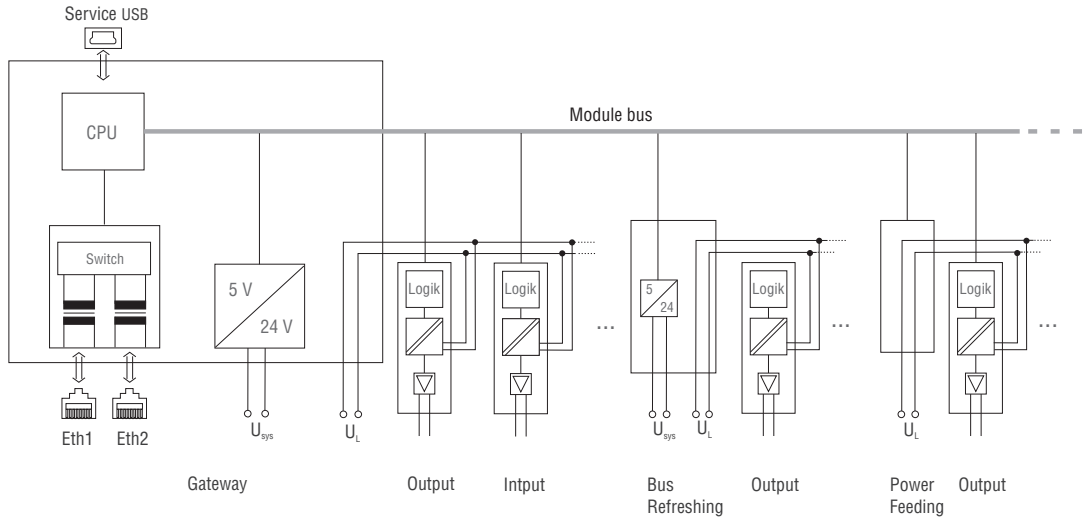


Fig. 114: Block diagram of a BL20 station with BL20-E-GW-EN

12.3 Electromagnetic compatibility (EMC

BL20 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.

12.3.1 Ensuring electromagnetic compatibility

The EMC of BL20 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.

12.3.2 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

12.3.3 PE connection

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

12.3.4 Earth-free operation

Observe all relevant safety regulations when operating an earth-free system.PE connection

12.3.5 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

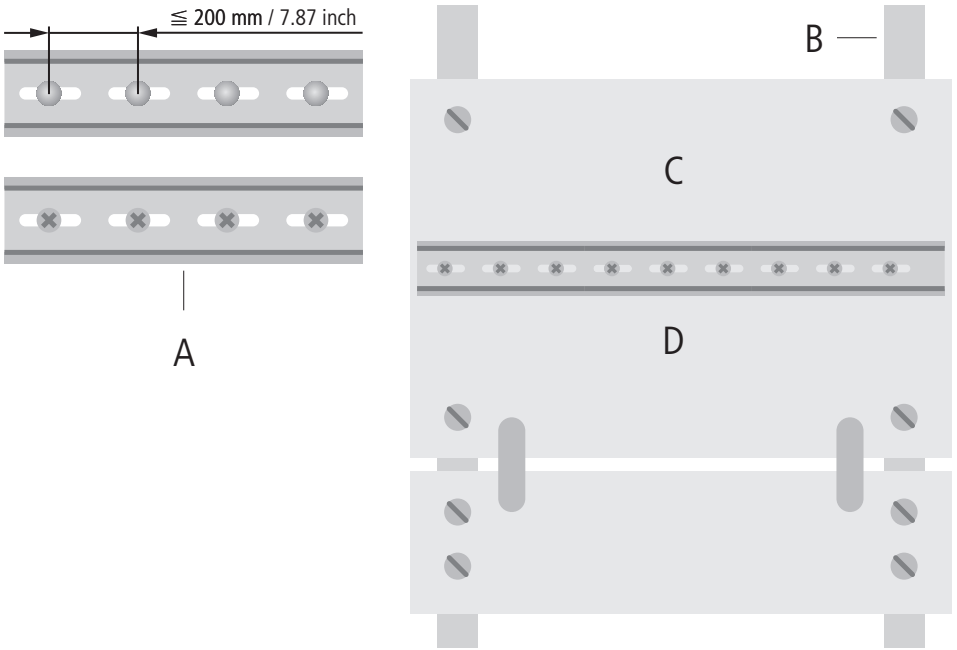


Abb. 115: Mounting options
A *TS 35*
B mounting rail
C mounting plate
D TS 35

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).

12.3.6 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 potential compensation.

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.

12.3.7 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.

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.

12.3.8 Switching inductive loads

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

12.3.9 Protection against Electrostatic Discharge (ESD)

NOTICE

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

13 BL20-Approvals for Zone 2/Division 2

NOTE

The Zone 2 - approval certificates for BL20 can be found in a separate manual for approvals **D301255** under **www.turck.de**.

14 Appendix

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

14.1.1 Changing the IP address in Windows

The IP address is changed in the Control Panel:

- **in Windows 7 under "Network and Sharing Center".**

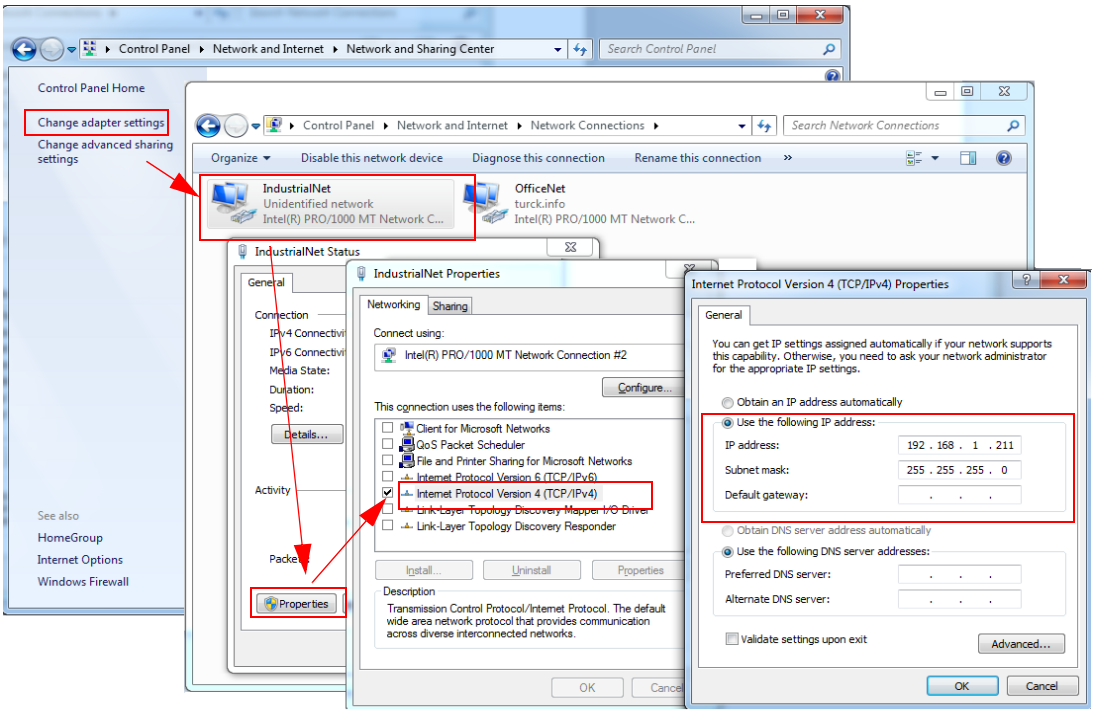


Fig. 116: Changing the IP address in Windows 7

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

The Busaddress Management DTM in the software I/O-ASSISTANT (access via: "Additional functions → Busaddress Management") offers the possibility to browse the whole Ethernet network for connected nodes and to change their IP address as well as the subnet mask according to the application (see also).

Further information about this issue can be found under **Addressing via I/O-ASSISTANT 3 (FDT/DTM) (page 26)**.

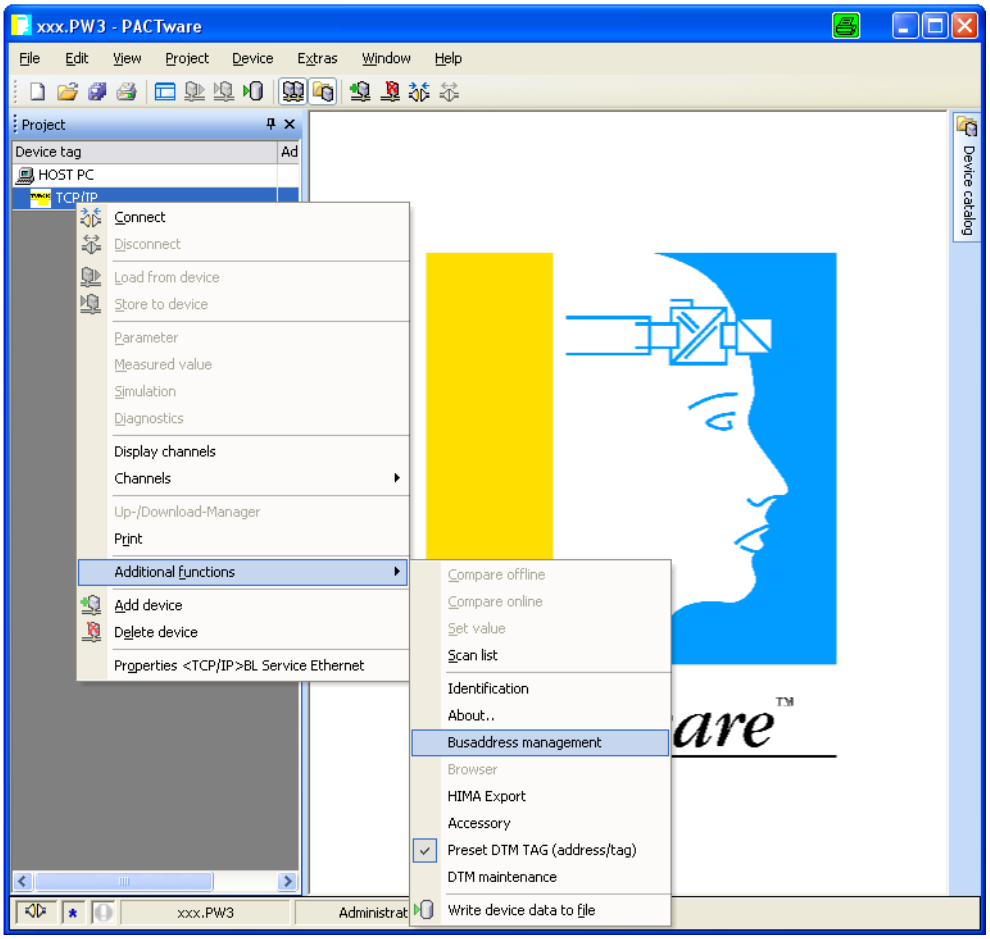


Fig. 117: Busaddress Management

14.2 Deactivating/adapting the firewall in Windows

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

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

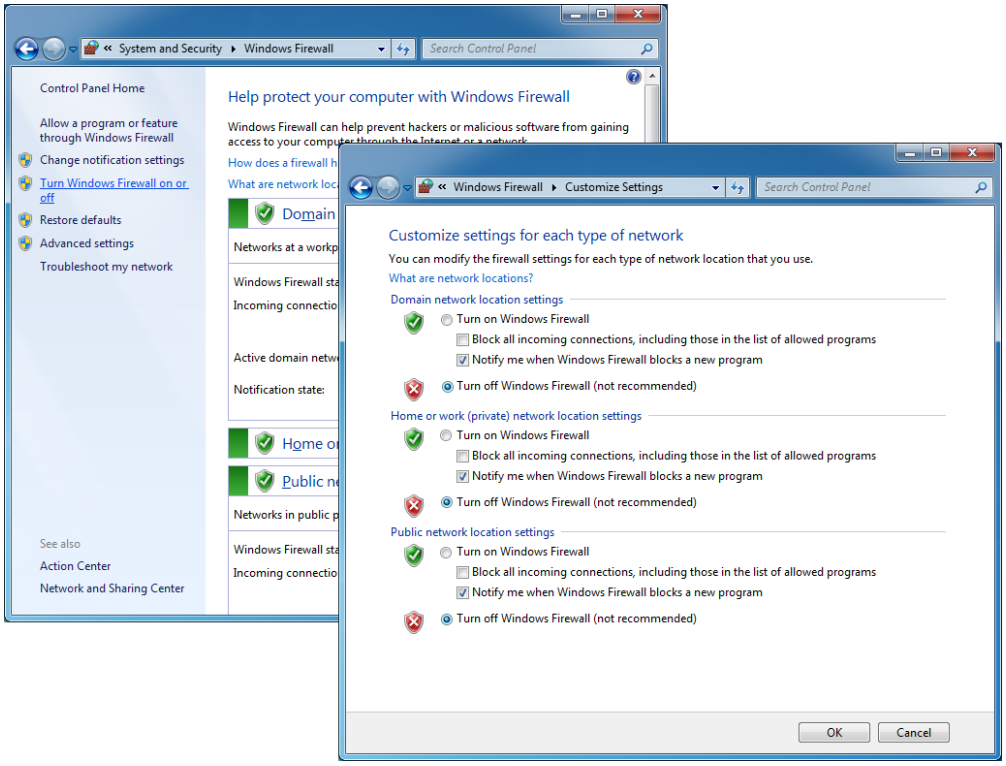
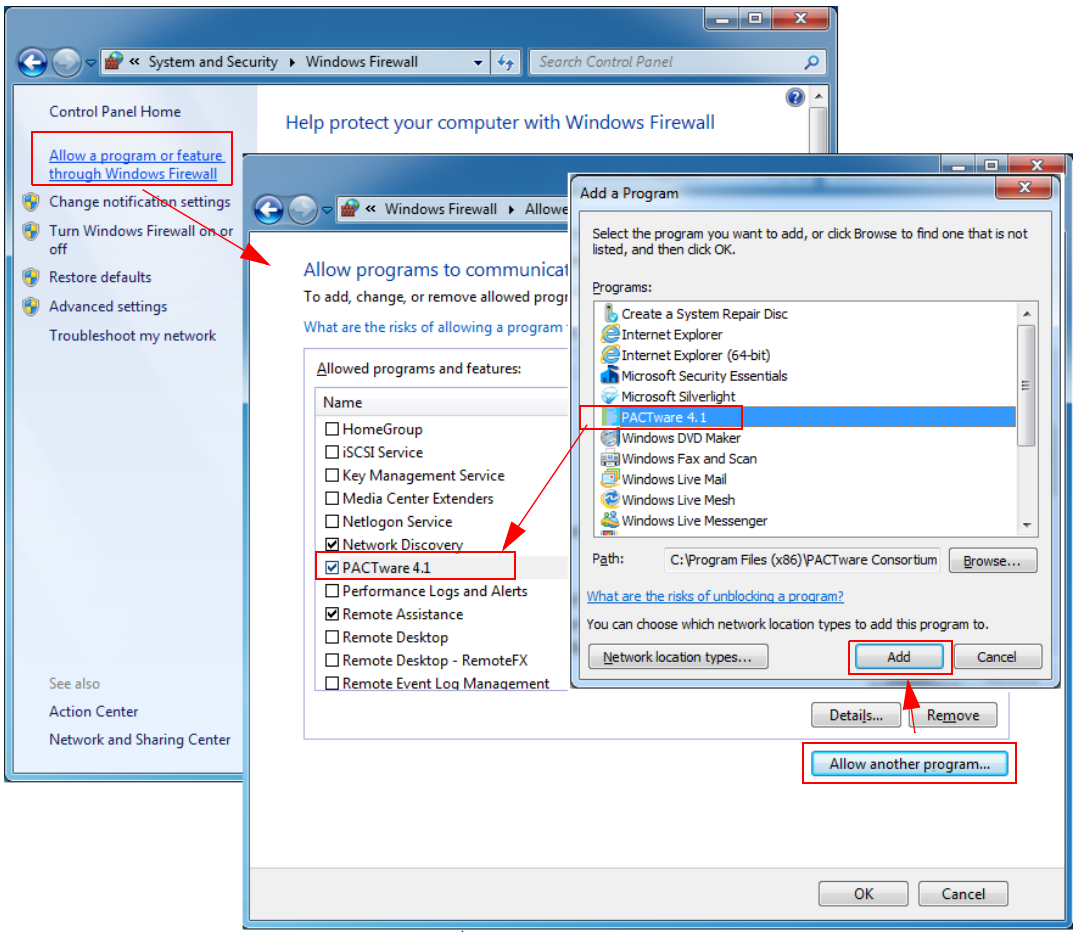


Fig. 118: Deactivating the Firewall in Windows 7

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



Adapting the Firewall in Windows 7

14.3 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.

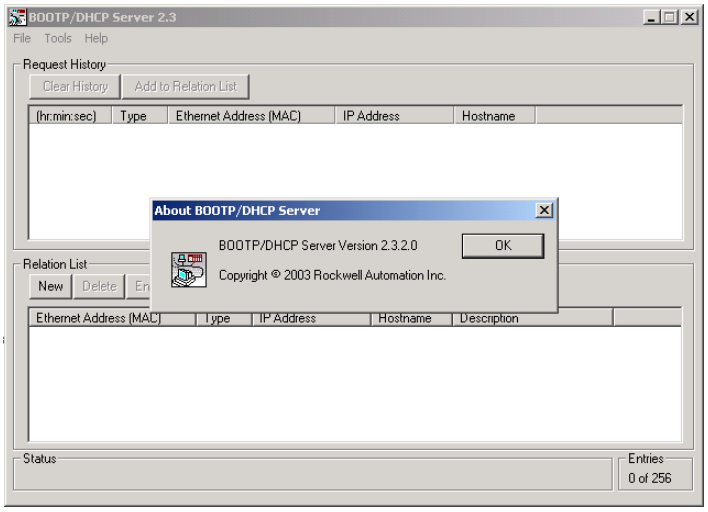


Fig. 119: BootP-Server from Rockwell Automation

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

NOTE

The rotary coding switches on the gateway must be set to "300" = BootP, "400" = DHCP or "600" = PGM-DHCP in order to enable the BootP/DHCP-Mode.
(see also **chapter 4**, section **Address assignment (page 17)**).

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

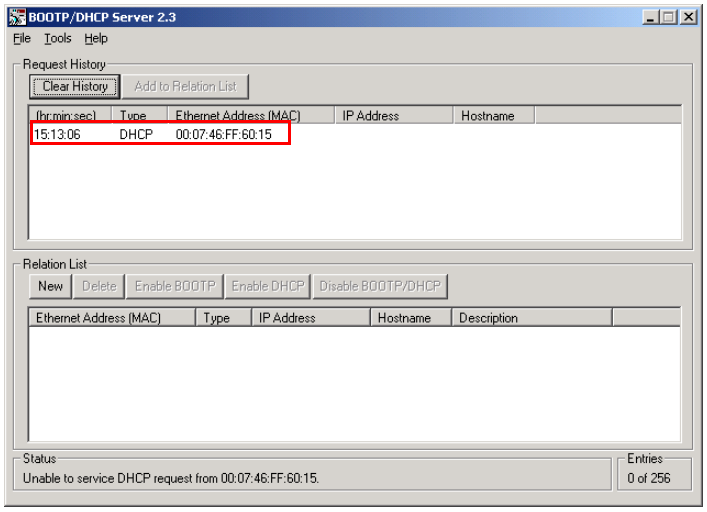


Fig. 120: DHCP-request of the device

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.

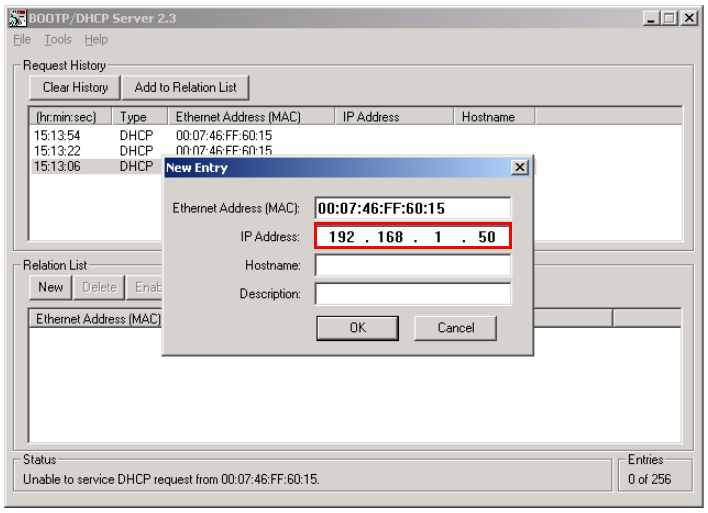


Fig. 121: Setting the IP address via DHCP

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.

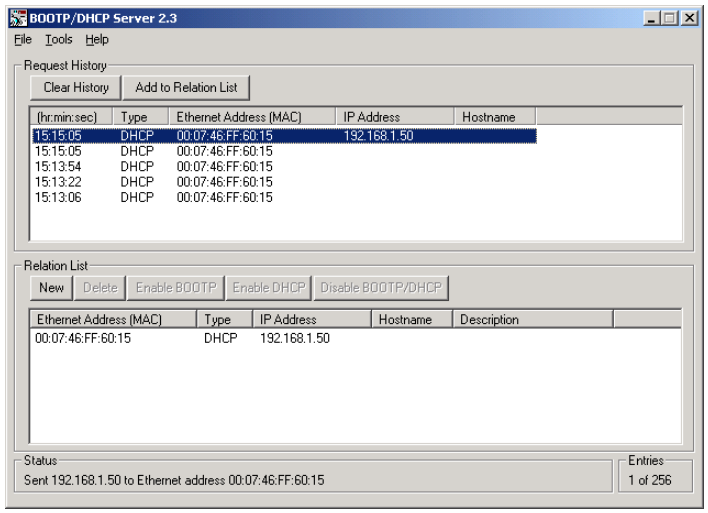


Fig. 122: Set IP address

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

14.4 Identifiers of BL20-modules

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

Module	Identifier
Digital input modules	
BL20-2DI-24VDC-P	0x210020xx
BL20-2DI-24VDC-N	0x220020xx
BL20-2DI-120/230VAC	0x230020xx
BL20-4DI-24VDC-P	0x410030xx
BL20-4DI-24VDC-N	0x420030xx
BL20-4DI-NAMUR	0x015640xx
BL20-E-8DI-24VDC-P	0x610040xx
BL20-16DI-24VDC-P	0x810050xx
BL20-E-16DI-24VDC-P	0x820050xx
BL20-E-16DI-24VDC-N	0x830050xx
BL20-32DI-24VDC-P	0xA10070xx
Analog input modules	
BL20-1AI-I(0/4…20MA)	0x012350xx
BL20-2AI-I(0/4…20MA)	0x225570xx
BL20-1AI-U(-10/0…+10VDC)	0x011350xx
BL20-2AI-U(-10/0…+10VDC)	0x235570xx
BL20-2AI-PT/NI-2/3	0x215770xx
BL20-2AI-THERMO-PI	0x215570xx
BL20-2AIH-I	0x2179C0xx
BL20-4AI-U/I	0x417790xx
BL20-E-4AI-TC	0x427790xx
BL20-E-8AI-U/I-4AI-PT/NI	0x6199B0xx
Digital output modules	
BL20-2DO-24VDC-0,5A-P	0x212002xx
BL20-2DO-24VDC-0,5A-N	0x222002xx
BL20-2DO-24VDC-2A-P	0x232002xx
BL20-2DO-120/230VAC-0.5A	0x250002xx
BL20-4DO-24VDC-0,5A-P	0x013003xx
BL20-E-8DO-24VDC-0.5A-P	0x610004xx
BL20-16DO-24VDC-0,5A-P	0x413005xx

Module	Identifier
BL20-E-16DO-24VDC-0.5A-P	0x820005xx
BL20-E-16DO-24VDC-0.5A-N	0x8300005xx
BL20-32DO-24VDC-0,5A-P	0x614007xx
Analog output modules	
BL20-1AO-I(0/4…20MA)	0x010605xx
BL20-2AO-I(0/4…20MA)	0x220807xx
BL20-2AO-U(-10/0…+10VDC)	0x210807xx
BL20-2AO-H	0x217AB7xx
BL20-E-4AO-U/I	0x417A09xx
Relay modules	
BL20-2DO-R-NC	0x230002xx
BL20-2DO-R-NO	0x220002xx
BL20-2DO-R-CO	0x210002xx
Technology modules	
BL20-1RS232	0x014799xx
BL20-1RS485/422	0x024799xx
BL20-1SSI	0x044799xx
BL20-E-1SWIRE	0x169C99xx
BL20-E-2CNT-2PWM	0x017BCCxx
BL20-2RFID-A	0x017977xx
BL20-2RFID-S	0x2179CCxx
BL20-E-4IOL	0x409BBBxx
BL20-E-4IOL-10	0x409DDDxx
Power distribution modules	
BL20-BR-24VDC-D	0x013000xx
BL20-BR-24VDC-RED	0x440030xx
BL20-PF-24VDC-D	0x023000xx
BL20-PF-120/230VAC-D	0x053000xx

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