Your Global Automation Partner

TURCK

BL20-E-GW-RS-MB/ET
ECO Gateway for Modbus RTU

Instructions for Use

Table of Contents

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 Modbus RTU-Gateway of the product line BL20 (BL20-E-GW-RS-MB/ET).

The following chapter contain a short BL20-description, a description of the used field bus system, exact information about function and structure of the field bus specific BL20-gateway as well as all bus specific information concerning the connection to automation devices, the maximum system extension etc.

The bus-independent I/O-modules of the BL20-system as well as all bus independent information as mounting, labeling etc. are described in a separate manual.

- BL20 I/O-modules (Turck-documentation no.: German D300716; English D300717)

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

1.3 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.

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2 Notes on the Product

2.1 Product identification

These instructions apply to the BL20 gateway BL20-E-GW-RS-MB/ET.

2.2 Scope of delivery

- BL20-E-GW-RS-MB/ET
- 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-RS-MB/ET is part of the BL20 system. It forms the interface to an Modbus RTU network and forwards the data collected by the BL20 I/O modules within the BL20 station from the field to the higher-level Modbus RTU master.

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 Technical features

4.1 Function

BL20-gateways are used to connect BL20 I/O modules to the Modbus-network.

The gateway handles the entire process data exchange between the I/O-level and the fieldbus and generates diagnostic information for higher-level nodes and the software tool I/O-ASSISTANT.

4.2 Technical data

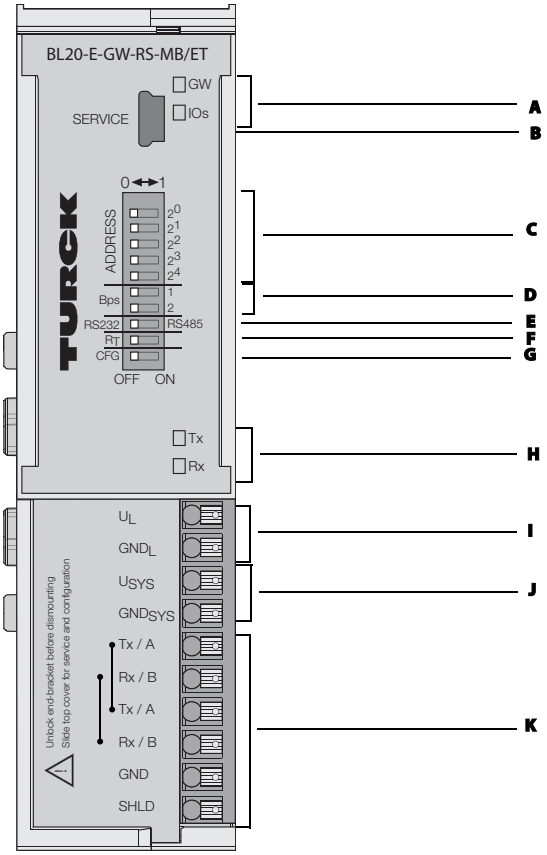

Fig. 1: Front view BL20-E-GW-RS-MB/ET

A LEDs for BL20 module bus
B Service interface
C DIP-switch for node address
D DIP-switch for bit rate
E DIP-switch for interface selection
F DIP-switch for terminating resistor
G DIP-switch for the configuration acceptance
H LEDs for the serial communication
I Field supply
J System power supply
K Fieldbus connection

4.2.1 Block diagram

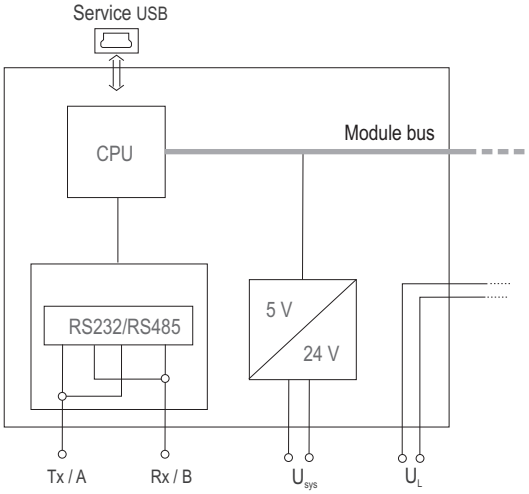

Fig. 2: Block diagram BL20-E-GW-RS-MB/ET

4.2.2 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} (with maximum system extension)	Approx. 0.5 A
U_L nominal value	24 V DC
Max. field current I_L	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	Serial Modbus (RS485/RS232)
Protocols	ASCII and RTU

Technical data	
Transmission rate	9.6…115.2 kbps
Data bits	7 or 8
Parity	None, even, odd
Address setting	1-31 (DIP-switches at the gateway, 2^0…2^4) 1…-127 (via DTM)
Service interface	Mini USB
Isolation voltages	
U_{BL} (U_{sys}/U_L)	500 V_{rms}
U_{ETH} (supply voltage against Ethernet)	-
U_{485} (system/RS485)	-
U_{232} (system/RS232)	-
Ambient conditions	
Ambient temperature	
– $t_{Ambient}$	-25…+60 °C
– t_{Store}	- 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	

Technical data	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and EN 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

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.

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	516 years according to SN 29500 (Ed. 99) 20 °C

4.2.3 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 mm
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 to DIN 46 228/1 (ferrules crimped gas-tight)	0.25…1.5 mm^2/0.0004…0.0023 $inch^2$/30…16 AWG

4.3 Connection options at the gateway

The field bus as well as the power supply are connected to the gateway using push-in tension clamp terminals.

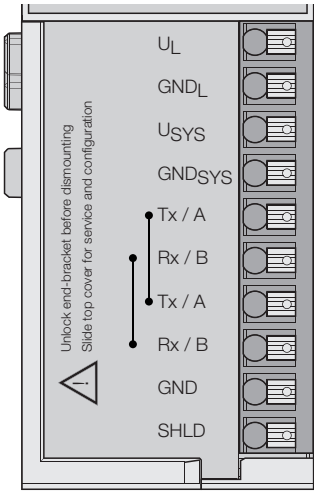

Fig. 3: Connection options at the gateway

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-GW-RS-MB/ET has push-in tension clamps for:

- field supply voltage (U_L, GND_L)
- system supply (U_{SYS}, GND_{SYS})

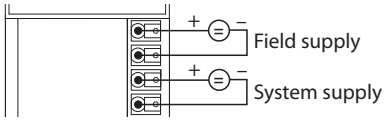

Fig. 4: Voltage supply connection

4.3.2 Fieldbus connection

BL20-E-GW-RS-MB/ET		Other data end device
RS232-connection		
GND		GND
Rx/B		RxD
Tx/A		TxD
-		RTS
-		CTS
RS485-connection		
120 Ω Tx/A		Rx/Tx+ (A) 120 Ω
Rx/B		Rx/Tx- (B)

4.3.3 Service interface connection (mini USB female connector)

The service interface is used to connect the gateway to the project planning and diagnostic software I/O-ASSISTANT (FDT/DTM).

The service interface is designed as a 5 pole mini-USB-connection.

In order to connect the gateway's service-interface to the PC, a commercial cable with mini USB connector (commonly used for e.g. digital cameras) is necessary.

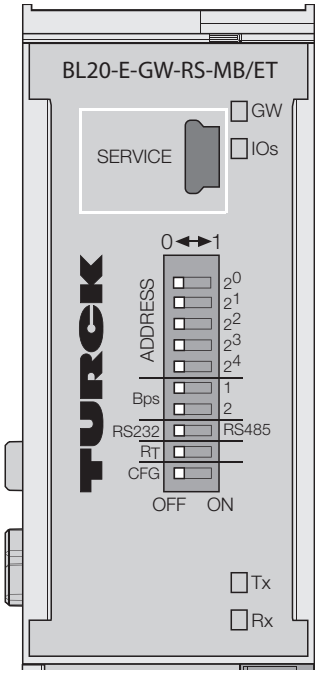

Fig. 5: Mini-USD female connector at the gateway

4.4 Configuration of the field bus parameters

The gateway can be configured in two different ways:

- **Standard mode (configuration via DIP-switches)**
  In standard mode, some parameters can not be set via DIP-switches and are thus fixed to these default settings:
  - Data bits: 8
  - Parity: even
  - Stop bits: 1
  - transmission: RTU

  The other parameters can be set via DIP-switches.

- **Extended mode (I/O-ASSISTANT 3 (FDT/DTM)** (state of delivery)

  The extended mode allows the gateway's parameterization using the software tool I/O-ASSISTANT (FDT/DTM) and offers, besides the default parameters mentioned above, extended parameterization for the transmission rate and the address assignment.

4.4.1 Standard mode (configuration via DIP-switches)

The DIP-switches for the gateway-configuration are located under the upper label of the gateway.

They are used for:

- assigning field bus address
- setting certain bit rates
- selecting the serial interface
- activating the terminating resistor
- storing the station configuration

Address setting via DIP-switches (2^0…2^4)

Addresses from **1 bis 31** can be set.

Address 0 is reserved for the address assignment via I/O-ASSISTANT (FDT/DTM). The software tool provides an address assignment within the range of 1…247 (see also **Extended mode (I/O-ASSISTANT 3 (FDT/DTM) (page 22)**).

The gateway's field bus address results from the addition of the valences (2^0…2^4) of the active DIP-switches (position = 1).

Example:

Bus address 27 = 0×1B = 11011

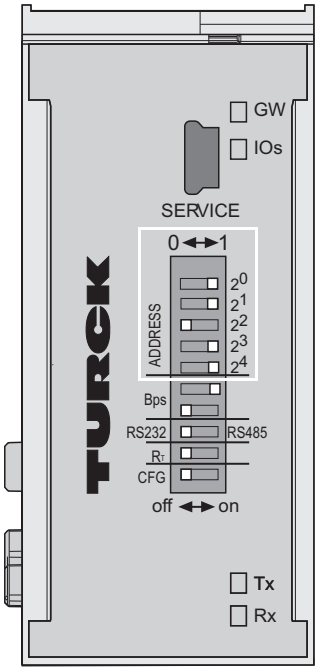

Fig. 6: Address setting, address 27

NOTE

The internal module bus does not require any addressing.

Switch position		
6	**7**	
0	0	9.6 kbps
1	0	19.2 kbps
0	1	38.4 kbps
1	1	115.2 kbps

NOTE

The bit rate 57.6 kbps is only parameterizable using the I/O-ASSISTANT (FDT/DTM).

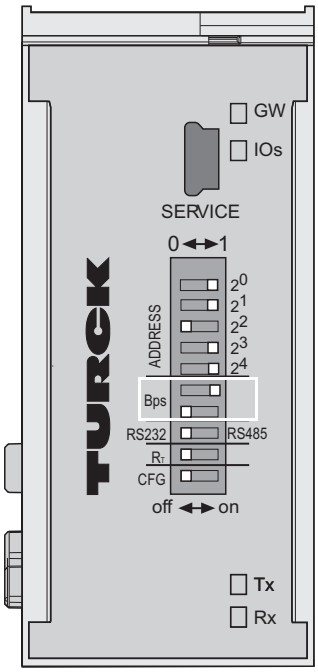

Fig. 7: Bit rates, example 38.4 kbps

Activating the bus terminating resistor (R_T)

In RS485-operation mode, the termination of the filed bus line with terminating resistors is necessary.

If the device is used as first or last node in the RS485-line, the terminating resistor R_T can be activated via the respective DIP-switch.

Bus termination resistor activated:

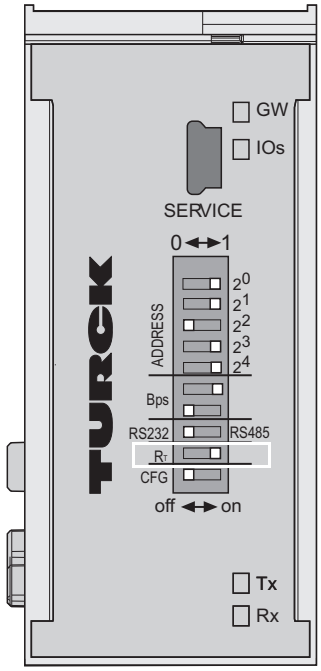

Fig. 8: Bus terminating resistor R_T

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.

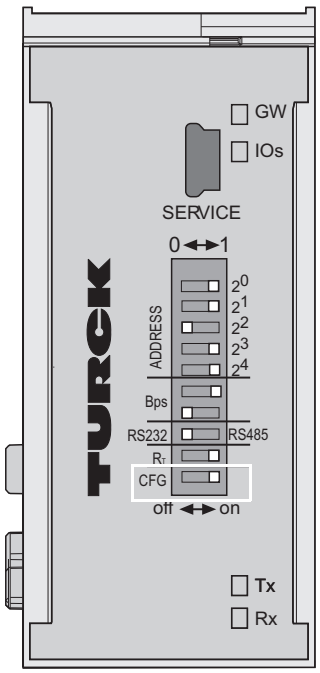

Fig. 9: DIP-switch for storing the station configuration

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

➤ Start the storage process.

➥ The LED IOs flashes green (1 Hz), the LED IOs shortly lits up orange.

➥ The storage process is active.

➤ Set back the DIP-switch from On to Off.

➥ → The storage process has terminated, 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.

4.5.2 Extended mode (I/O-ASSISTANT 3 (FDT/DTM)

The parameterization via the software tool I/O-ASSISTANT (FDT/DTM) offers extended configuration possibilities

- extended address range
- extended choice of bit rates
- parameterization of parity, transmission mode, watchdog-times

NOTE

In order to use parameterization in extended mode, the node's fieldbus address has to be set to "0". Only then, the parameters set via DTM are valid.

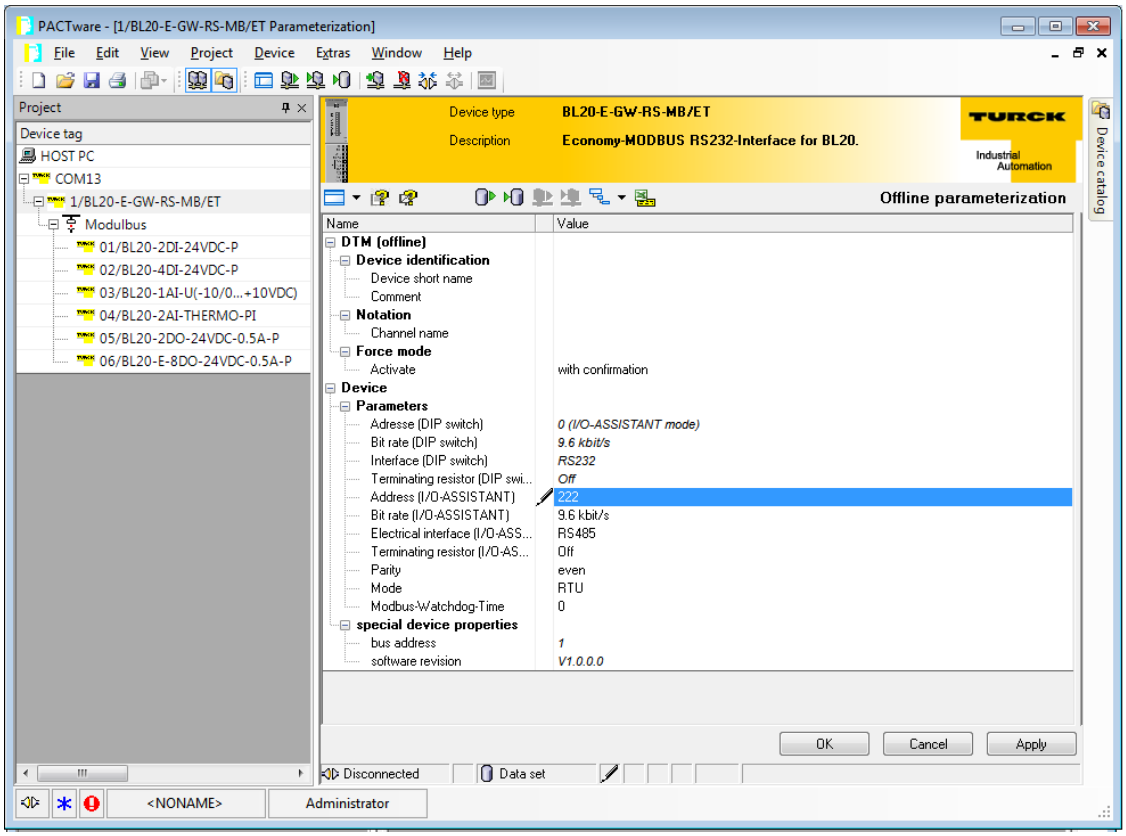

Fig. 10: Extended configuration mode via software

4.6 Status indicators/diagnostic messages gateway

The gateway sends out the following diagnostic information:

- undervoltage diagnosis for system and field supply
- status of BL20-station
- status of the internal communication via the module bus
- status of the Ethernet communication
- status of the gateway

Diagnostics messages are indicated in two different ways:

- via the LEDs
- via the configuration software (I/O-ASSISTANT) or the Modbus client

4.6.1 Diagnosis via LEDs

Every BL20-E-GW-RS-MB/ET displays the following statuses via LEDs:

- 2 LEDs for the module bus communication (module bus-LEDs): **GW** and **IOs**
- 2 LEDs for the serial communication: **Rx** and **Tx**

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, then firmware-download necessary
	Green flashing, 4 Hz	Firmware active, gateway hardware error.	Replace the gateway.
	Red	hardware failure	Replace the gateway.
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 I/O-ASSISTANT.

LED	Status	Meaning	Remedy
IOs	Red	Hardware failure, firmware not running.	– Replace the gateway, if necessary.
	Red flashing, 1 Hz	Non adaptable changes in the configuration of the module bus nodes.	– 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, 1 Hz	The current and configured module list do not match but the data exchange proceeds as normal.	– Check the physical station for pulled or new but not planned modules.
Tx	Off	idle	
	Green	Data are currently transferred.	
Rx	Off	idle	
	Green	Data are currently not received.	
	Red	Watchdog timeout	
	Red, flickering	Faulty frames are received (Parity error, baud rate error, …)	

5 Implementation of Modbus TCP

5.1 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 via Ethernet
- 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):

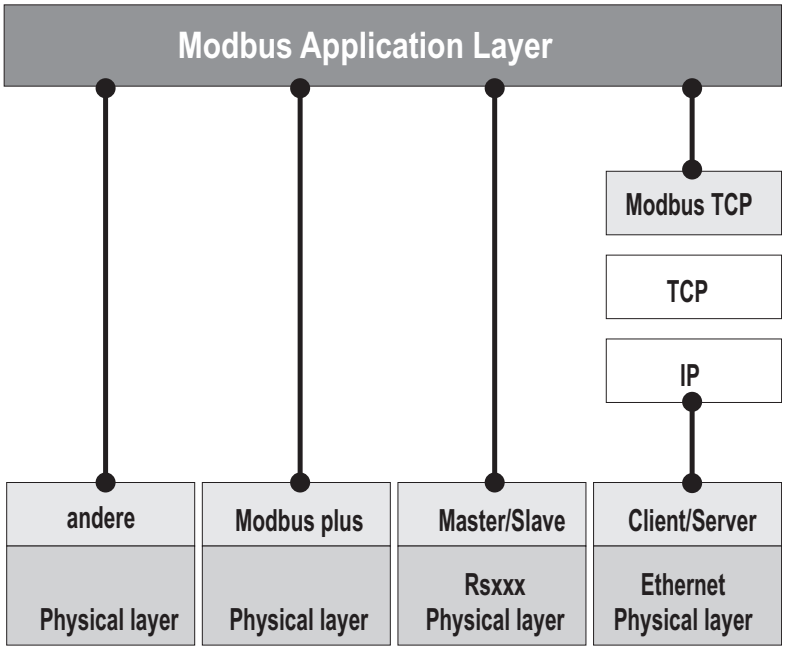

Fig. 11: Schematic representation of the Modbus Communication Stack

5.1.1 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).

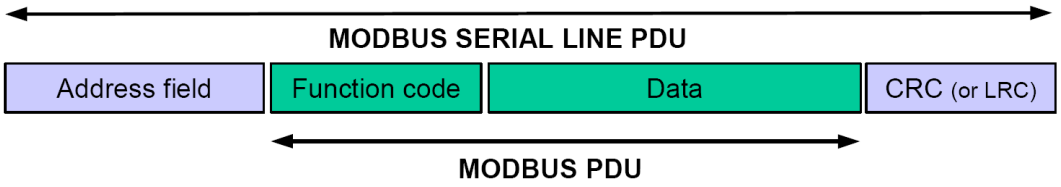

Fig. 12: Modbus telegram acc. to Modbus-IDA

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.

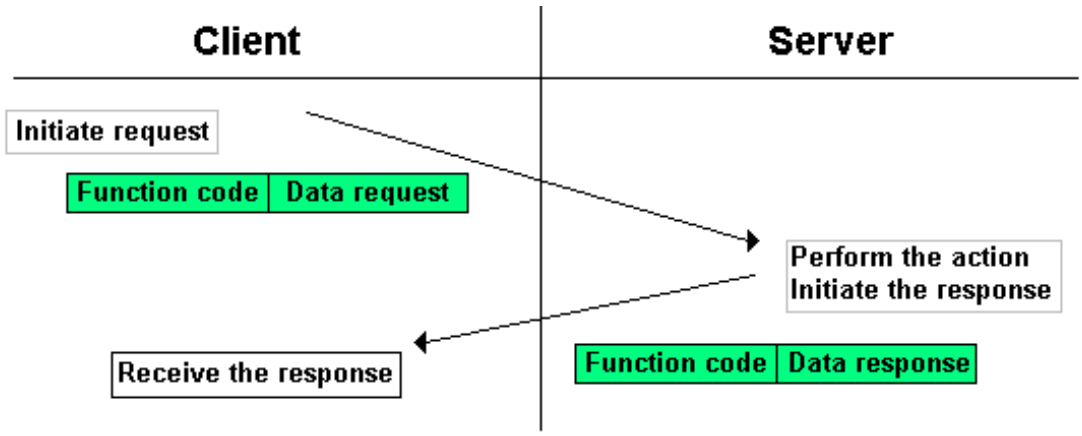

Fig. 13: Modbus data transmission (acc. to Modbus-IDA)

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.

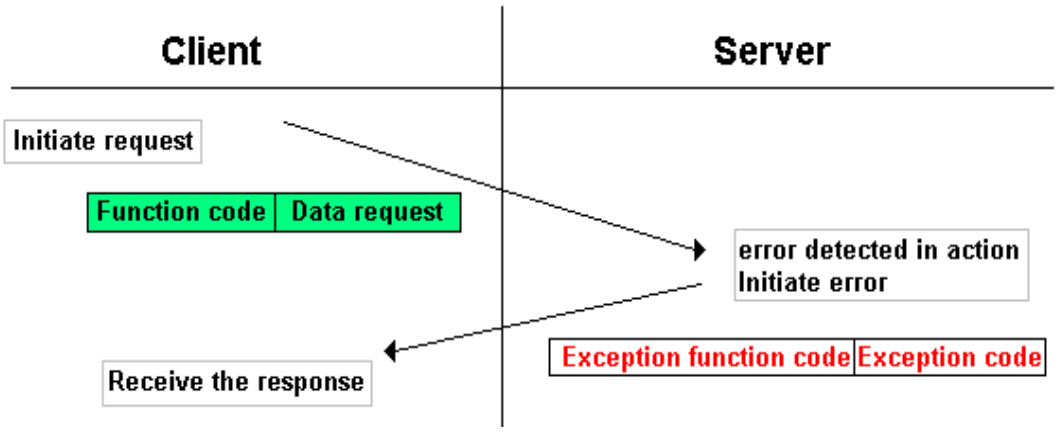

Fig. 14: Modbus data transmission (acc. to Modbus-IDA)

5.1.2 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. 10**).

The following example 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.

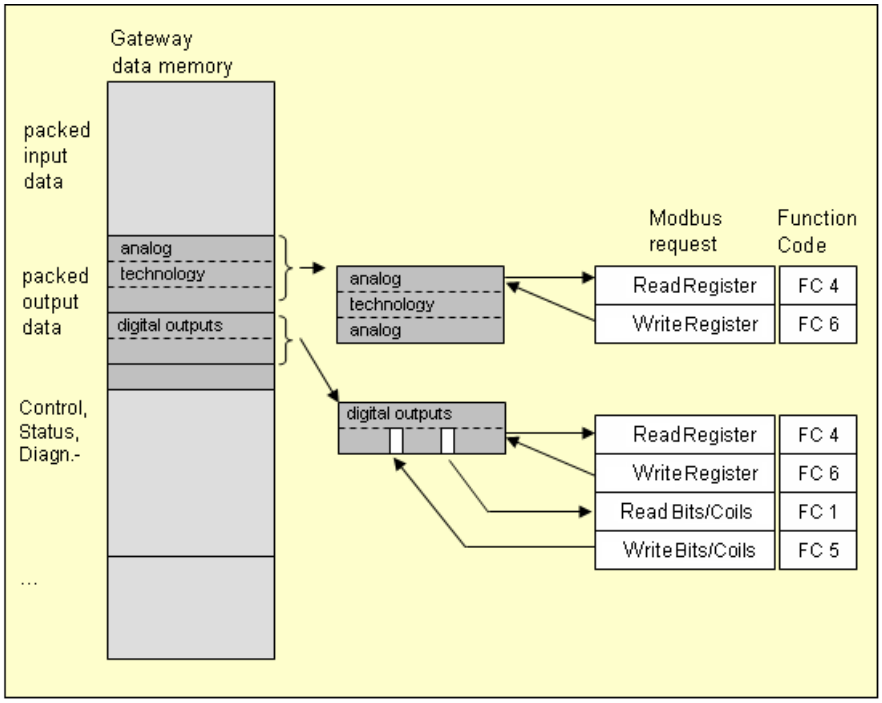

Fig. 15: Picture of the data memory of the BL20 modules

5.2 Implemented Modbus functions

The BL20-gateways for Modbus 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.

5.3 Modbus registers

Address (hex.)	Access ro = read only rw = read/write	Description
0x0000…0x01FF	ro	packed process data of inputs (process data length of the modules
0x0800…0x09FF	rw	packed process data of outputs (process data length of the modules
0x1000…0x1006	ro	gateway identifier
0x100C	ro	Gateway status (see **Register 0×100Ch: „Gateway-Status“**)
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…0x101A	ro	group diagnostics of I/O-modules 0…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 20)**)
0x1121	rw	Watchdog reset register
0x113C…0x113D	rw	Modbus parameter restore, s. **p. 16** (reset of parameters to default values)
0x113E…0x113F	rw	Modbus parameter save, s. **p. 17** (permanent storing of parameters)
0x2000…0x207F	rw	service-object, request-area, s. **p. 17**
0x2080…0x20FF	ro	service-object, response-area, s. **p. 17**
0x2400	ro	System voltage U_{SYS} [mV]
0x27FE	ro	no. of entries in actual module list
0x27FF	rw	no. of entries in reference module list
0x2800…0x283F	rw	Reference module list (max. 32 modules per station × 2 registers for module-ID)
0x2A00…0x2A3F	ro	Actual module list (max. 32 modules per station × 2 registers for module-ID)
0x8000…0x8400	ro	process data inputs (max. 32 modules per station × 32 registers for module-ID)
0x9000…0x9400	rw	process data outputs (max. 32 modules per station × 32 registers for module-ID)
0xA000…0xA400	ro	diagnostic data (max. 32 modules per station × 32 registers for module-ID)

Address (hex.)	Access ro = read only rw = read/write	Description
0xB000…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	0×0000… 0×01FF	0… 511	40001… 40512	400001to 400512
packed output data	0×0800… 0×09FF	2048… 2549	42049… 42560	402049… 402560
gateway identifier	0×1000… 0×1006	4096… 4102	44097… 44103	404097… 404103
Gateway status	0×100C	4108	44109	404109
process image length in bit for the intelligent output modules	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…32 (1 bit per I/O module)	0x1018… 0x1019	4120… 4121	44121… 44122	404121… 404122
watchdog, actual time	0x1020	4128	44129	404129
watchdog, predefined time	0x1120	4384	44385	404385
Watchdog reset register	0x1121	4385	44386	404386
Modbus parameter restore	0x113C… 0x113D	4412… 4413	44413… 44414	404413… 404414
Modbus parameter save	0x113E… 0x113F	4414… 4415	44415…4441 6	404415… 404416
service-object, request-area,	0x2000… 0x207F	8192… 8319	48193…4832 0	408193… 408320
service-object, response-area,	0x2080… 0x20FF	8320… 8447	48321… 48448	408321… 408448
System voltage U_{SYS} [mV]	0x2400	9216	49217	409217
no. of entries in actual module list	0x27FE	10238	-	410239
no. of entries in reference module list	0x27FF	10239	-	410240

Description	Hex	Decimal	5-digit	Modicon
Reference module list (max. 32 modules per station × 2 registers for module-ID)	0x2800… 0x283F	10240… 10303	-	410241… 410304
Actual module list (max. 32 modules per station × 2 registers for module-ID)	0x2A00… 0x2A3F	10752… 10815	-	410753…410 816
Slot-related address assignment				
Process data inputs (max. 32 modules per station × 32 registers for module-ID)	0x8000…0x8 400			
slot 1	0×8000	32768	-	432769
slot 2	0×8020	32800	-	432801
slot 3	0×8040	32832	-	432833
	…	…	…	…
slot 32	0×83E0	33760		433761
Process data outputs (max. 32 modules per station × 32 registers for module-ID)	0x9000… 0x9400			
slot 1	0×9000	36864	-	436865
slot 2	0×9020	36896	-	436897
slot 3	0×9040	36928	-	436929
…	…	…	…	…
slot 32	0×93E0	37856	-	437857
Diagnostics (max. 32 modules per station × 32 registers for module-ID)	0xA000… 0xA400			
slot 1	0×A000	40960	-	440961
slot 2	0×A020	40991	-	440992
slot 3	0×A040	41023	-	441024
…	…	…	…	…
slot 32	0×A3E0	41983	-	441984
Parameters (max. 32 modules per station × 32 registers for module-ID)	0xB000… 0xB400			
slot 1	0×B000	45056	-	445057
slot 2	0×B020	45088	-	445089
slot 3	0×B040	45120	-	445121
…	…	…	…	…
slot 32	0×B3E0	46048	-	446049

5.4 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, counters…).

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

NOTE

An example in **Modbus data mapping (page 22)** ff. describes the data mapping.

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

5.4.1 Packed input process data

- input register area: **0000h…01FFh**

0000h			01FFh
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 + 0000h		n + 0008h
Gateway status (reg. 100Ch)	group diagnosis I/O-modules 0…127 (registers 1018h…101Fh)	

5.4.2 Packed output process data

- output register area: **0800h…09FFh**

0800h		09FFh
intelligent modules, output data	Digital output modules	free

NOTE

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

5.5 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.

The process data of the SWIRE-modules is mapped into the register area for the digital in- and output modules.

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 words		word by word
BL20-2AIH-I	12 words		word by word
BL20-4AI-x	4 words		word by word
BL20-E-8AI-U/I-4PT/NI	8 words		word by word
– **Analog outputs**			
BL20-1AO-x		1 word	word by word
BL20-2AO-x		2 words	word by word
BL20-2AOH-I	8 words	2 words	word by word
BL20-E-4AO-U/I		4 words	word by word
– **Technology modules**			
BL20-1RS×××	4 words	4 words	word by word
BL20-1SSI	4 words	4 words	word by word
BL20-E-2CNT-2PWM	12 words	12 words	word by word

Module	Process input	Process output	Alignment
BL20-E-SWIRE **A**	4 words	4 words	word by word
BL20-2RFID-S	12 words	12 words	word by word
– **Power distribution modules**			
BL20-BR-×	-		
BL20-PF-×	-		

5.6 Register 0×100C: "Gateway status"

This register contains a general gateway/station status.

Bit	Name	Description
Gateway		
15	I/O Controller Error	The communication controller for the I/O-system is defective.
14	Force Mode Active Error	The Force Mode is activated, which means, the actual output values may no match the ones defined and sent by the field bus.
13	reserved	-
12	Modbus Wdog Error	A timeout occurred in the Modbus-communication.
Module bus		
11	I/O Cfg Modified Error	The I/O-configuration has be changed and is no longer compatible.
10	I/O Communication Lost Error	No Communication on the module bus.
Voltage errors		
9	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).
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.

5.7 Register 0×113C and 0×113D: "Restore Modbus-Connection-Parameters"

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

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

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

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

5.8 Register 0×113E and 0×113F: "Save Modbus-Connection-Parameters"

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

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

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

5.9 The Service-Object

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

2000h	2080h	20FFh
service request area	service response area	

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

- service request area

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

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

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

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

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

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

- Service-response-area

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

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

NOTE

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

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

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

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

Supported service numbers:

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

A service request may have the following results:

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

NOTE

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

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

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

Indirect reading of registers

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

- service-request

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

- service response

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

Indirect writing of registers

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

- service-request

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

- service response

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

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

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

NOTE

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

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

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

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

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

5.11 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, s. p. 10):

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

NOTE

Please observe that changes in the watchdog time have to be saved per save-command (see **Register 0×113E and 0×113F: "Save Modbus-Connection-Parameters" (page 17)**).

NOTE

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

5.12 Parameters of the modules.

5.12.1 Digital input modules

- BL20-4DI-NAMUR

Byte	Bit	Parameter name	Value – **Meaning**
0…3	0	input filter x	**0 = deactivate** – (input filter 0,25 ms) 1 = activate – (input filter 2,5 ms)
	1	digital input x	**0 = normal1 = inverted**
	2	Short circuit monitoring x	**0 = deactivate1 = activate**
	3	Short circuit diagnosis x	**0 = deactivate1 = activate**
	4	Open circuit monitoring x	**0 = deactivate1 = activate**
	5	Open circuit diagnosis x	**0 = deactivate1 = activate**
	6	Input on diagnostic x	**0 = output substitute value** 1 = keep last value
	7	Substitute value on diag x	**0 = off** 1 = on

5.12.2 Analog input modules

- BL20-1AI-I(0/4…20MA)

Byte	Bit	Parameter name	Value – Meaning
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 – Meaning
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 – Meaning
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 – Meaning
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 – Meaning
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)

Byte	Bit	Parameter name	Value – Meaning
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)

Byte	Bit	Parameter name	Value – Meaning
0…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

- BL20-2AIH-I

Byte	Bit	Parameter name	Value – Meaning
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 VA		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 – Meaning
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	Byte
0…7	0…5	Operation mode	000000	**voltage -10…10 V DC Standard**
			000001	voltage 0…10 V DC Standard
			000010	voltage -10…10 V DC NE 43
			000011	voltage 0…10 V DC 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

Byte	Bit	Parameter name	Value – Meaning	Byte
			100000	Ni 100, -60 °C…250 °C, 2-wire
			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

5.12.3 Analog output modules

- BL20-1AO-I(0/4…20MA)

Byte	Bit	Parameter name	Value – Meaning
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	In Modbus, it is not possible the give out a substitute value in case of an error, see also s. p. 20.
2		Substitute value high byte	

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

Byte	Bit	Parameter name	Value – Meaning
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	In Modbus, it is not possible the give out a substitute value in case of an error, see also s. p. 20.
2/5		Substitute value high byte	

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

Byte	Bit	Parameter name	Value – Meaning
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	In Modbus, it is not possible the give out a substitute value in case of an error, see also s. p. 20.
2/5		Substitute value high byte	

■ BL20-2AOH-I

Byte	Bit	Parameter name	Value – Meaning
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	In Modbus, it is not possible the give out a substitute value in case of an error, see also s. p. 20.
2+3 (channel 1)		substitute value Ax	

Byte	Bit	Parameter name	Value – Meaning
4…7 (channel 2)	similar to byte 0…3		
8	HART®-Variable VA		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 – Meaning
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…3	Operation mode Kx	000000	**voltage -10…10 V DC Standard**
			000001	voltage 0…10 V DC Standard
			000010	voltage -10…10 V DC NE 43
			000011	voltage 0…10 V DC 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
			1110	reserved
			1111	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 low byte Ax	In Modbus, it is not possible the give out a substitute value in case of an error, see also s. p. 20.	
2/5/8/11		substitute value Ax high byte		

5.12.4 Technology modules

- BL20-1RS232

Byte	Bit	Parameter name	Value – **Meaning**
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.
	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 – **Meaning**
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 – **Meaning**
0	3…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.

Byte	Bit	Parameter name	Value – **Meaning**
0	7	diagnosis	**0 = release**
			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.
			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…0	reserved	
	5	Sensor 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	

Byte	Bit	Parameter name	Value – **Meaning**
1	3…0	Number of invalid bits (LSB)	0000…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.
	6…4	Number of invalid bits (MSB)	000…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…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…4	reserved	
3	5…0	Number of data frame bits	00000…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	Meaning
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	Meaning
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 =	
	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	Meaning
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: 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…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 this module D301224)
- BL20-2RFID-S (see RFID-documentation www.turck.de)
- BL20-E-4IOL/BL20-E-4IOL (siehe separates Handbuch zum Modul D301333

5.13 Diagnostic messages of the modules

5.13.1 Power distribution modules

- BL20-BR-24VDC-D

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

- BL20-PF-24VDC

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

- BL20-PF-120/230VAC-D

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

5.13.2 Digital input modules

- BL20-4DI-NAMUR

Diagnostic byte	Bit	Diagnostic message
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

5.13.3 Analog input modules

- BL20-1AI-I(0/4…20MA)

Diagnostic byte	Bit	Diagnostic message
n (channel 1)	0	measurement value range error Only in the measurement range 4…20 mA
	1	open circuit

- BL20-2AI-I(0/4…20MA)

Diagnostic byte	Bit	Diagnostic message
n (channel 1)	0	measurement value range error Only in the measurement range 4…20 mA
	1	open circuit
n + 1 (channel 2)	0	measurement value range error Only in the measurement range 4…20 mA
	1	open circuit

- BL20-1AI-U(-10/0…+10VDC)

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

- BL20-2AI-U(-10/0…+10VDC)

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

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

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

Diagnostic byte	Bit	Diagnostic message
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…7	

- BL20-2AI-THERMO-PI

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

- BL20-2AIH-I

Diagnostic byte	Bit	Diagnostic message
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	Diagnostic message
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…7	reserved

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

Diagnostic byte	Bit	Diagnostic message	
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…6	reserved	
	7	Hardware error	

5.13.4 Digital output modules

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

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

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

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

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

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

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

Diagnostic byte	Bit	Diagnostic message
n	0	Overcurrent/short-circuit (1 ch. min)

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

Diagnostic byte	Bit	Diagnostic message
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	Diagnostic message
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)

5.13.5 Analog output modules

- BL20-2AOH-I

Diagnostic byte	Bit	Diagnostic message
n	0	Value above upper limit Display of a measurement range exceeding→ limit values according to parameterization
	1	open circuit Shows a wire break 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	Diagnostic message	
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…6	reserved	
	7	Hardware error	

5.13.6 Technology modules

- BL20-1RS232

Diagnostic byte	Bit	Diagnostic message
n	0	parameterization error
	1	hardware failure
	2	data flow control error
	3	frame error
	4	buffer overflow

- BL20-1RS485/422

Diagnostic byte	Bit	Diagnostic message
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	Diagnostic message
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	GENER-AL$_{ERR}$	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$_{ERR}$S16	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$_{ERR}$S16	PKZ$_{ERR}$S15	PKZ$_{ERR}$S14	PKZ$_{ERR}$S13	PKZ$_{ERR}$S12	PKZ$_{ERR}$S11	PKZ$_{ERR}$S10	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.

Designation	Value	Meaning	
$GENE\text{-}RAL_{ERR}$	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.
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 bit indicates 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			

Designation	Value	Meaning	
$TYP_{ERR}Sx$	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 the TYP_{INFO} parameter is set with individual diagnostics, the error is indicated in this bit field as soon as a PLC configuration check detects differing slave numbers, types or position of 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			
$PKZ_{ERR}Sx$	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)
- BL20-E-4IOL/BL20-E-4IOL (siehe separates Handbuch zum Modul D301333

6 Application example: Modbus

6.1 Used hard-/software

6.1.1 Hardware

- **PLC**
  Turck VT250-57P-L7-DPM (V1.5.3.0)
  Protocol: RS485
  Bit rate: 9.6 kbps
  Data bits: 8
  Parity: even
  Stop bits: 1
- **Slave**
  BL20-E-GW-RS-MB/ET, node address 16
  parameterization: (default)
  Protocol: RS485
  Bit rate: 9.6 kbps
  Data bits: 8
  Parity: even
  Stop bits: 1

  Structure of the example station:
  - 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

6.1.2 Software

- CODESYS 3.5, Hotfix 1 incl:
  - Modbus COM port
  - Modbus-master, COM port (serial Modbus-master)

6.2 Configuring the hardware

The BL20-gateways are delivered in "extended mode", which means with node address "0".

The electrical interface (DIP-switch "RSxxx") is pre-set to **RS485**.

In the "extended mode", the gateway parameters (node-address, bit rate, etc.) are set using the software tool I/O-ASSISTANT (FDT(DTM).

In the example, the gateway is set as follows using the I/O-ASSISTANT (FDT/DTM):
The DIP-switches remain unaffected.

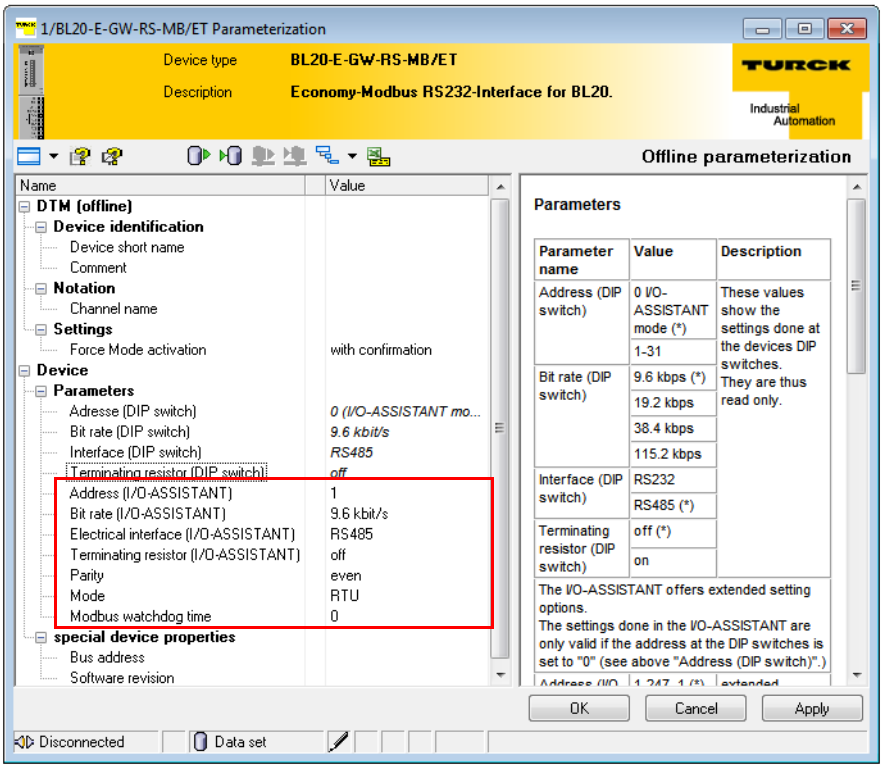

Fig. 16: Parameterization in the DTM

Hans Turck GmbH & Co. KG | T +49 208 4952-0 | F +49 208 4952-264 | more@turck.com | www.turck.com

6.2.1 Connection of the BL20-gateway in the example

The BL20-gateway is used in **RS485**-mode and thus connected to the VT250 as described in the following.

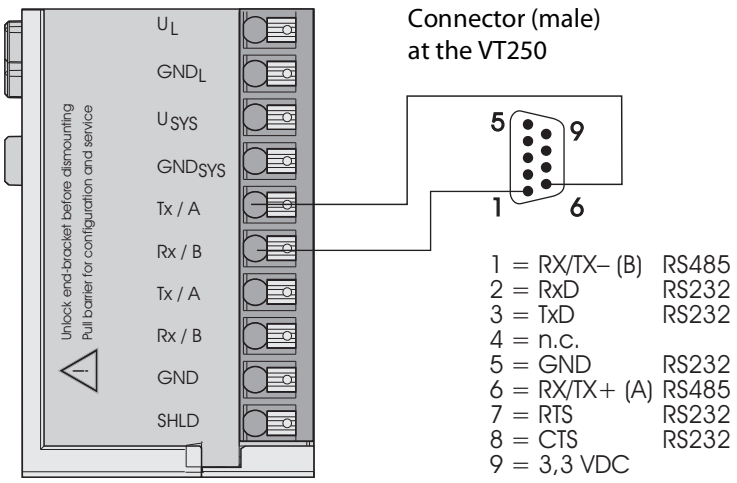

Fig. 17: BL20-Gateway at VT250 in RS485-mode

6.3 Operation with CODESYS

Open CODESYS via "Start → All programs → 3S CODESYS → CODESYS → CODESYS V 3.5".

6.3.1 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.

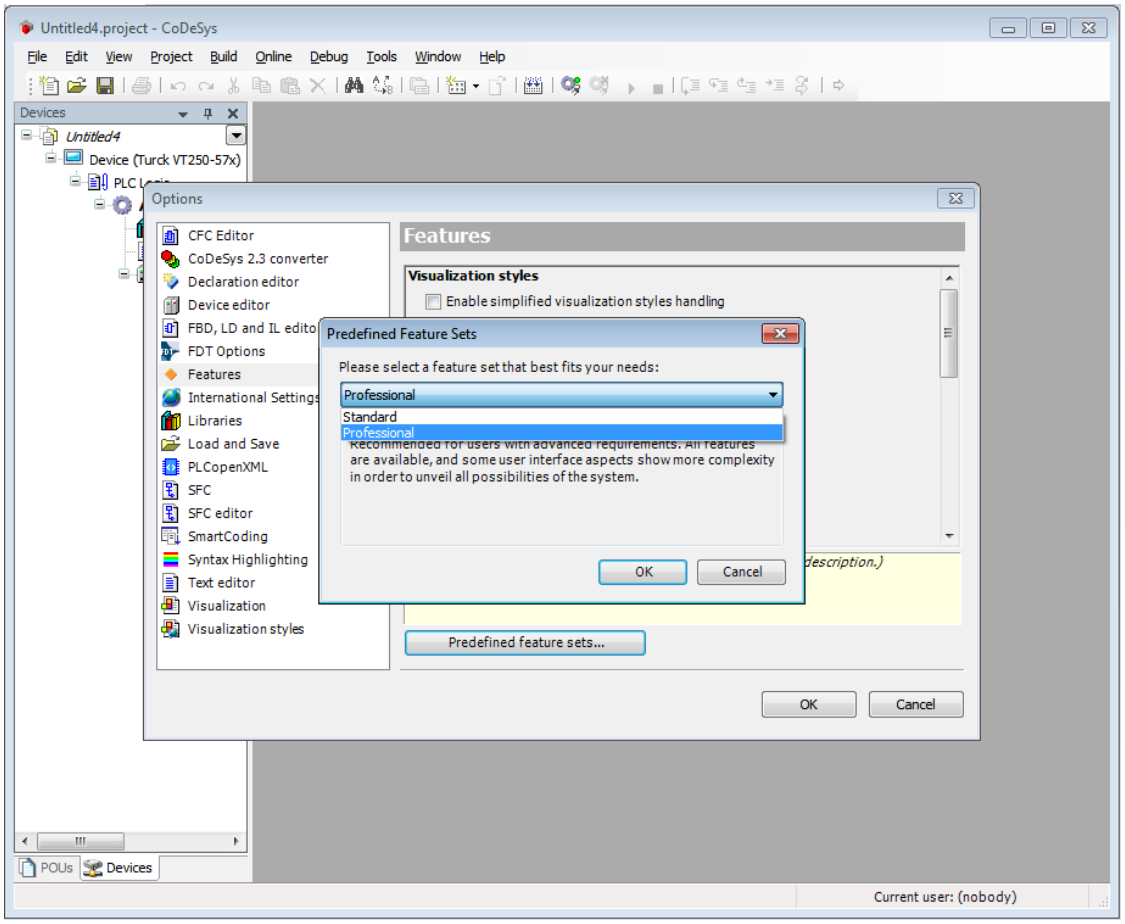

Fig. 18: Predefined feature sets

6.3.2 Creating a new project

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

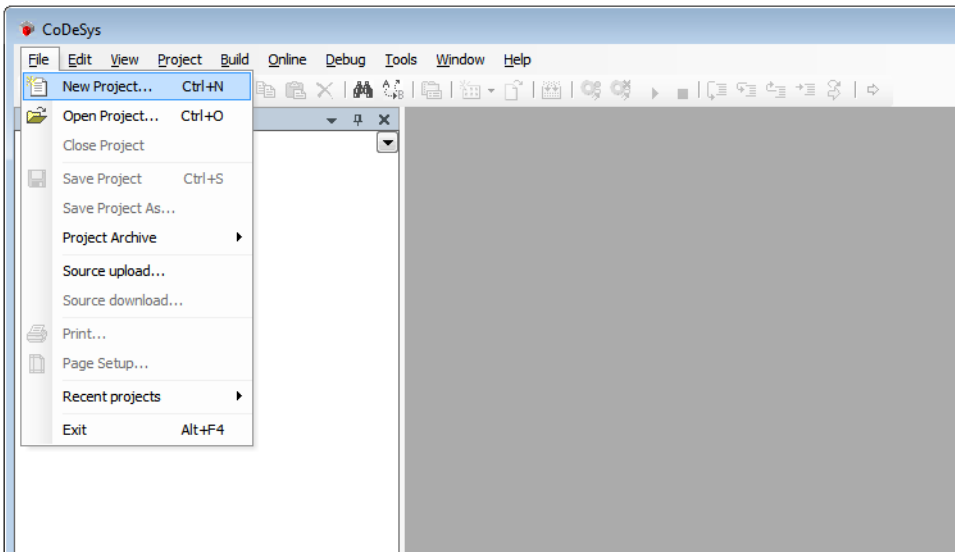

Fig. 19: New project

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

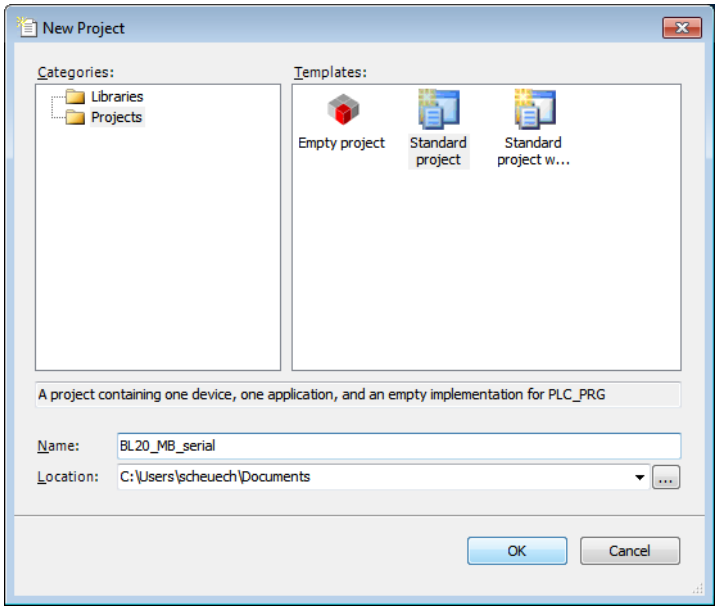

Fig. 20: Standard project

3 Select the PLC used in the project.
In this example, the HMI-PLC VT250-57-P from Turck is used.

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

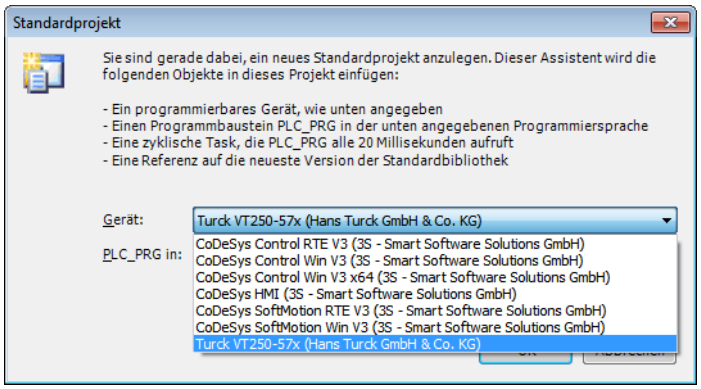

Fig. 21: Selection of the VT250-57P

5 The new project is created.

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

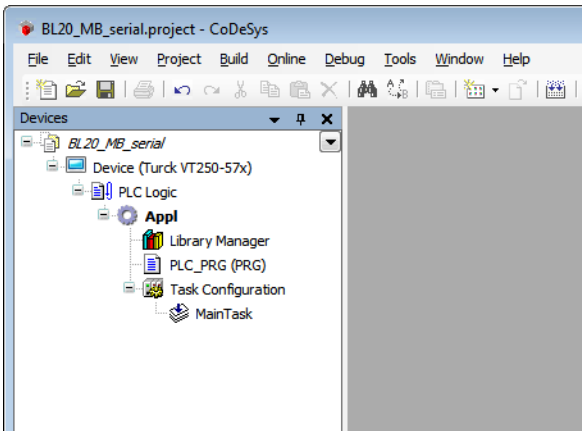

Fig. 22: Project tree

6.3.3 Defining the communication settings

Double-clicking the "Device Turck VT250-57x)" 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.

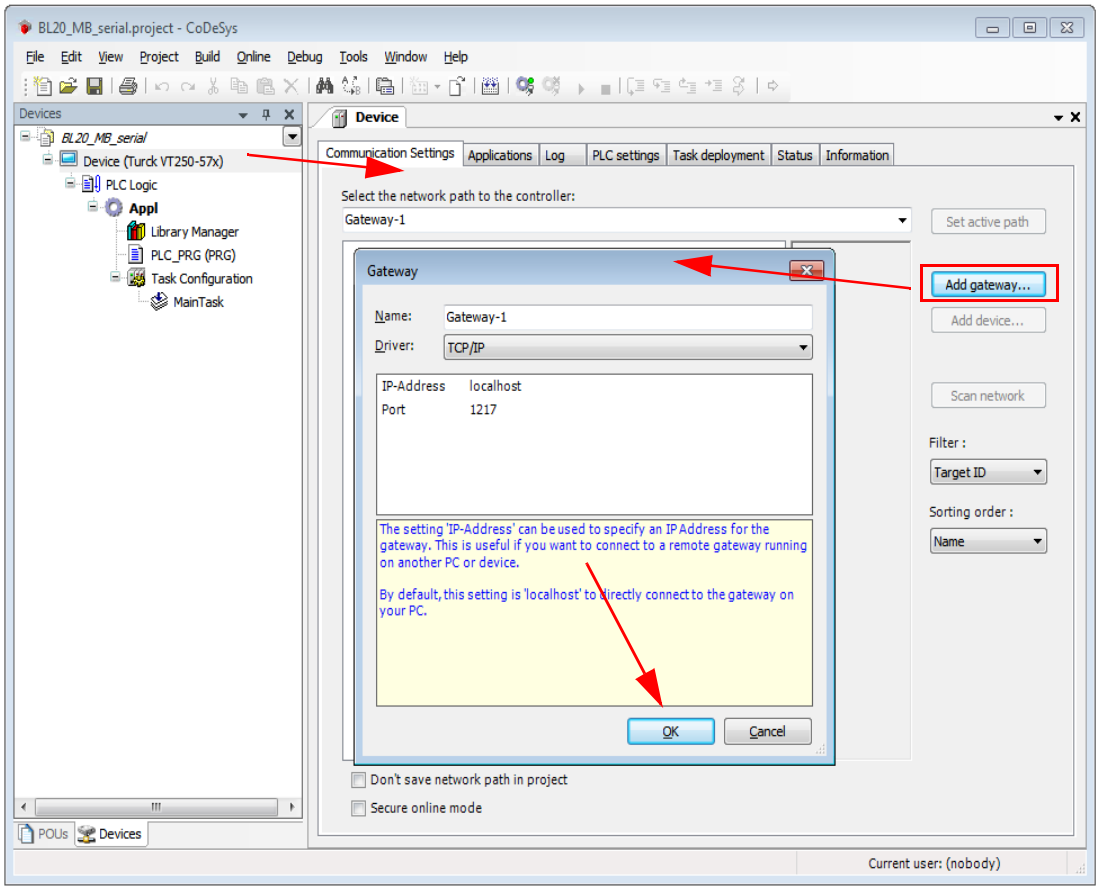

Fig. 23: Communication settings

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.

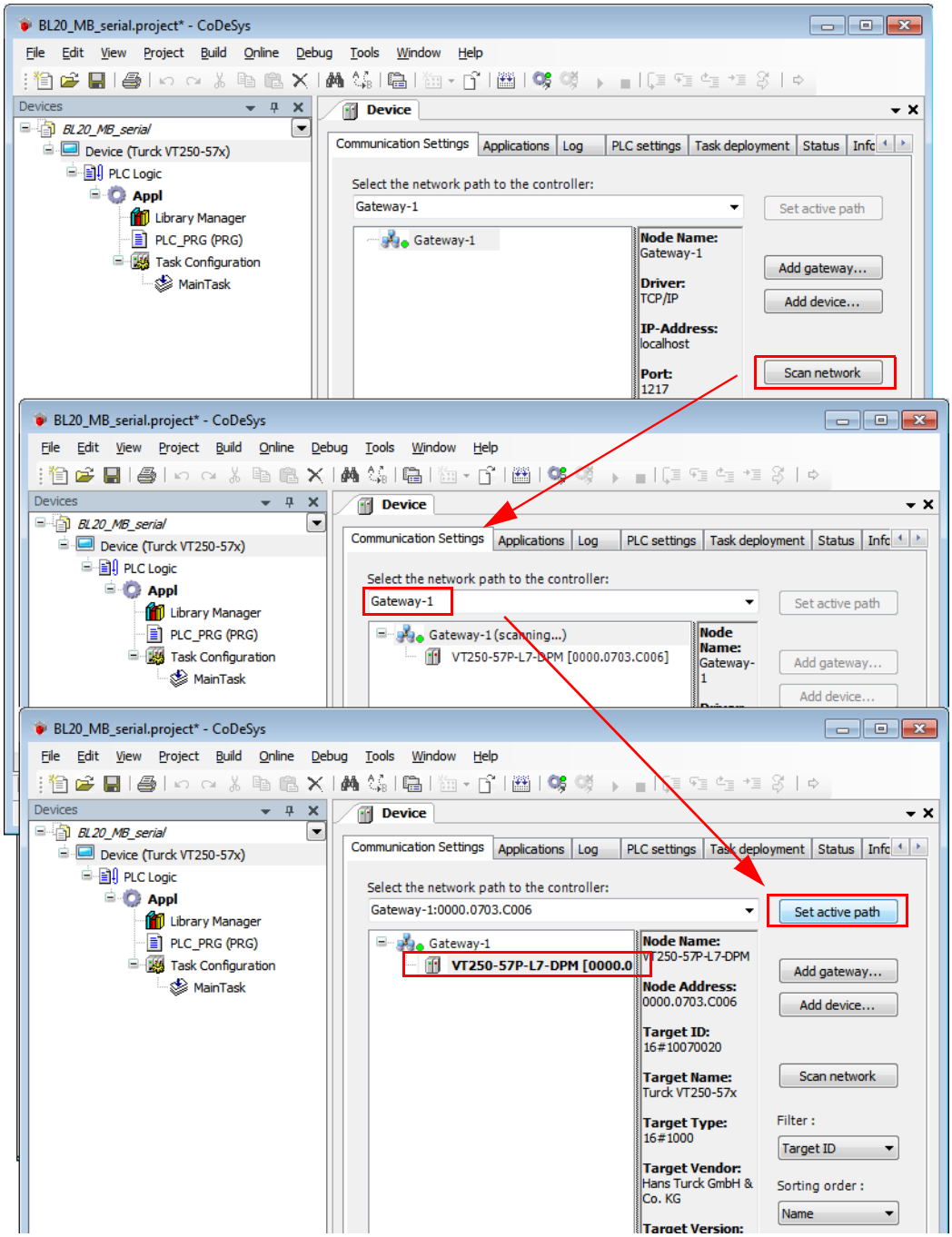

Fig. 24: Setting the communication path

6.3.4 Adding the Modbus COM port

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

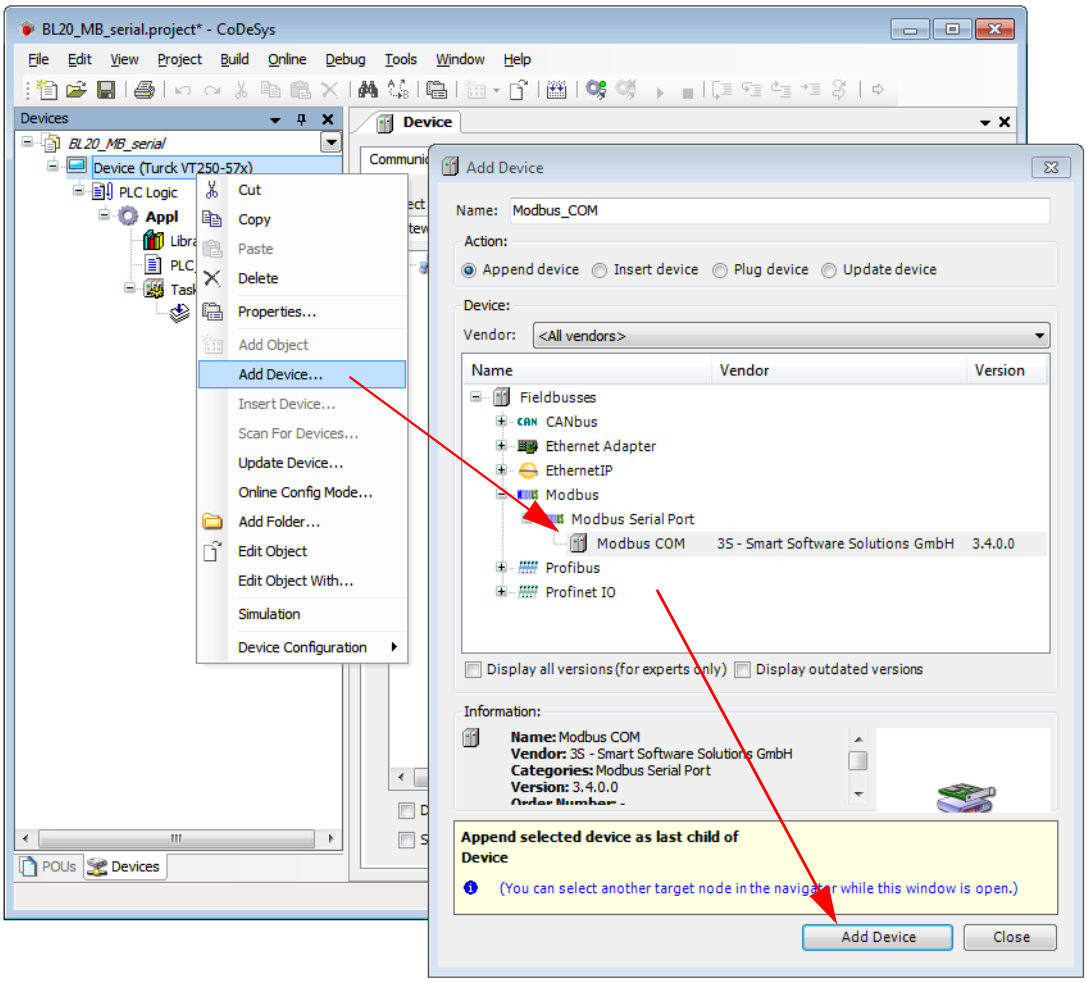

Fig. 25: Adding Modbus COM port as device

2 Double-clicking the Modbus COM port-entry in the project tree opens the corresponding editors.

3 In the register-tab "Modbus serial port, configuration" set the COM-port, the bit rate and all other parameters of the communication interface.

NOTE

In our example the RS485-interface of the VT250 is used. For this reason, please select COM-port no. 2. COM-port no. 1 is the devices RS232-interface (see also D301191 "VT250-57x-Hardware description)

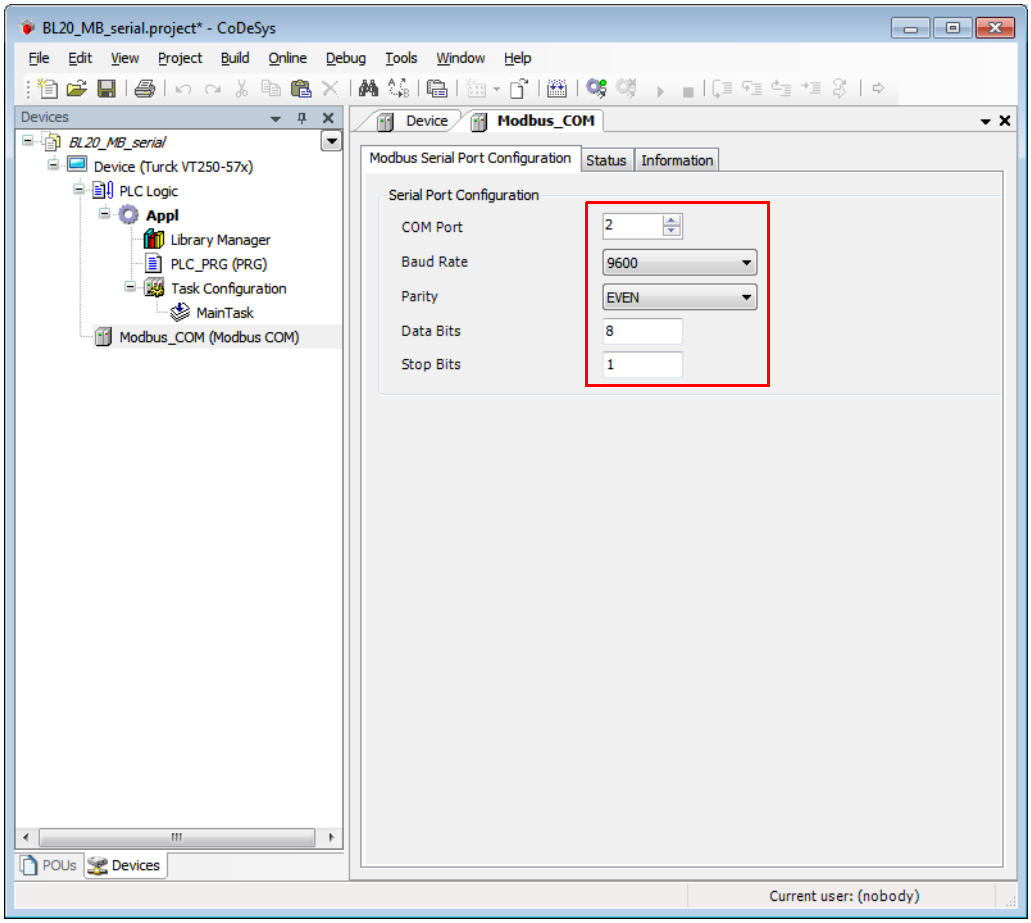

Fig. 26: Modbus serial port, configuration

4 Please assure, that the parameters set here correspond to the settings of the BL20-gateway.

6.3.5 Adding the serial Modbus master

Now, click on the entry of the Modbus COM-port, select the ”Modbus-Master, COM Port” in the dialog box "Add device" and add it to the project.

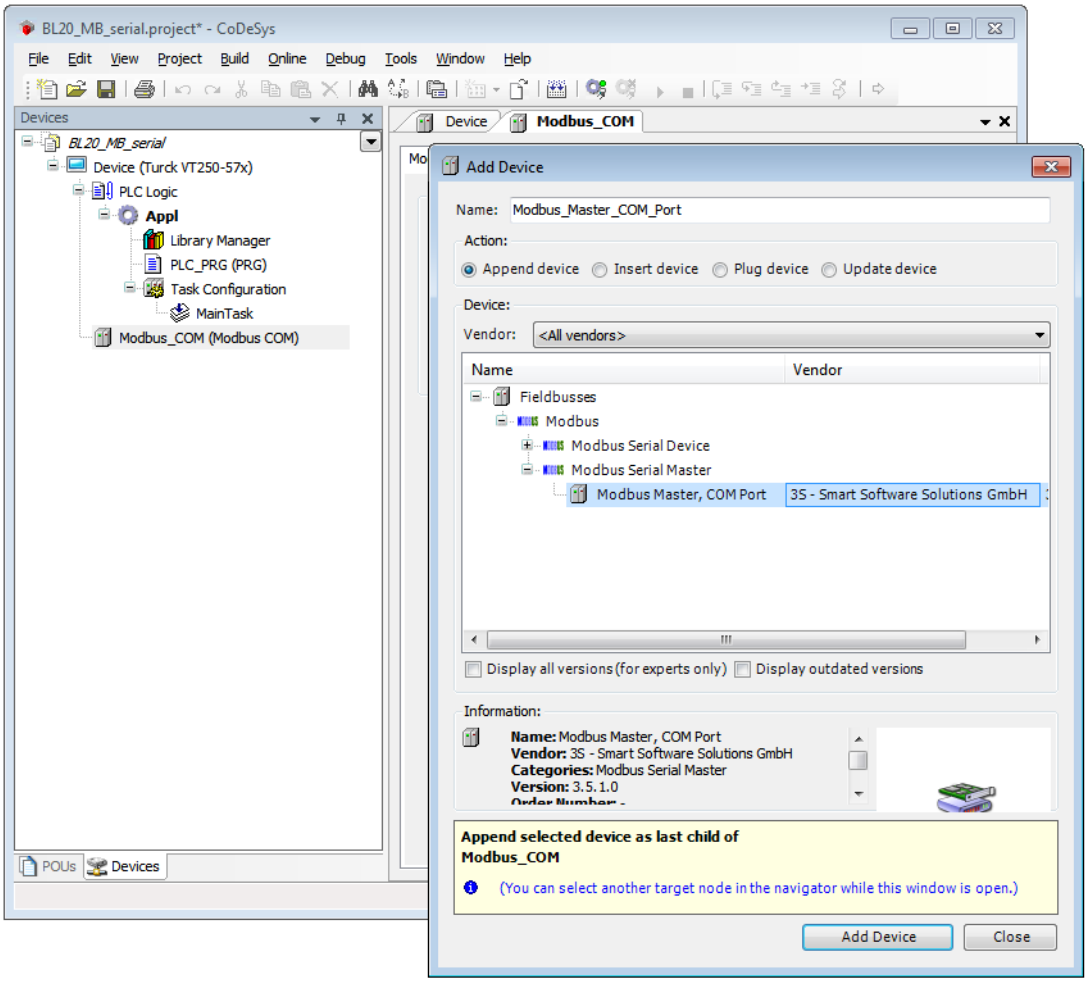

Fig. 27: Adding the serial Modbus-master

6.3.6 Adding a Modbus-slave

1 Now, add a serial Modbus-slave to the project.

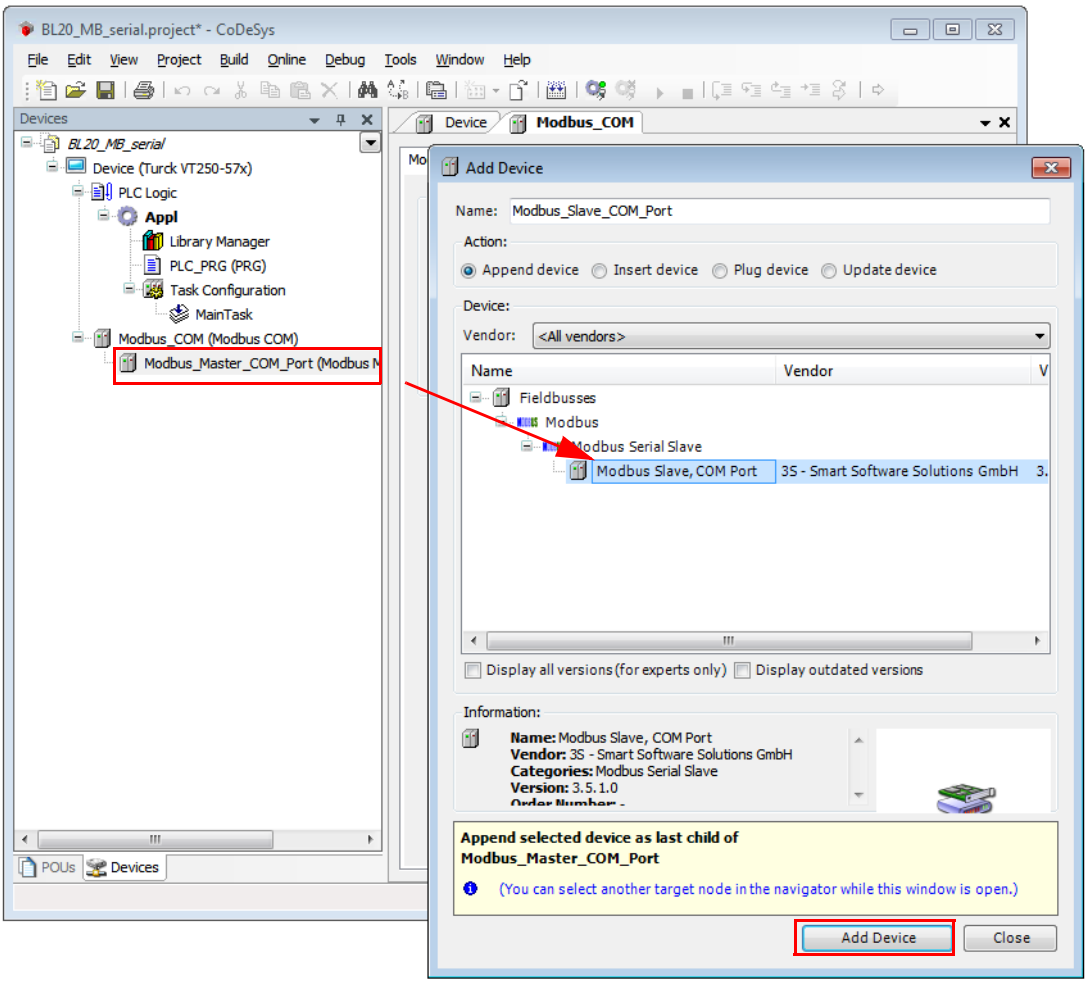

Fig. 28: Selecting a slave

2 You can adapt the settings of the slave according to your application. Open the context menu by right-clicking the slave-entry and select the dialog-box "Properties".

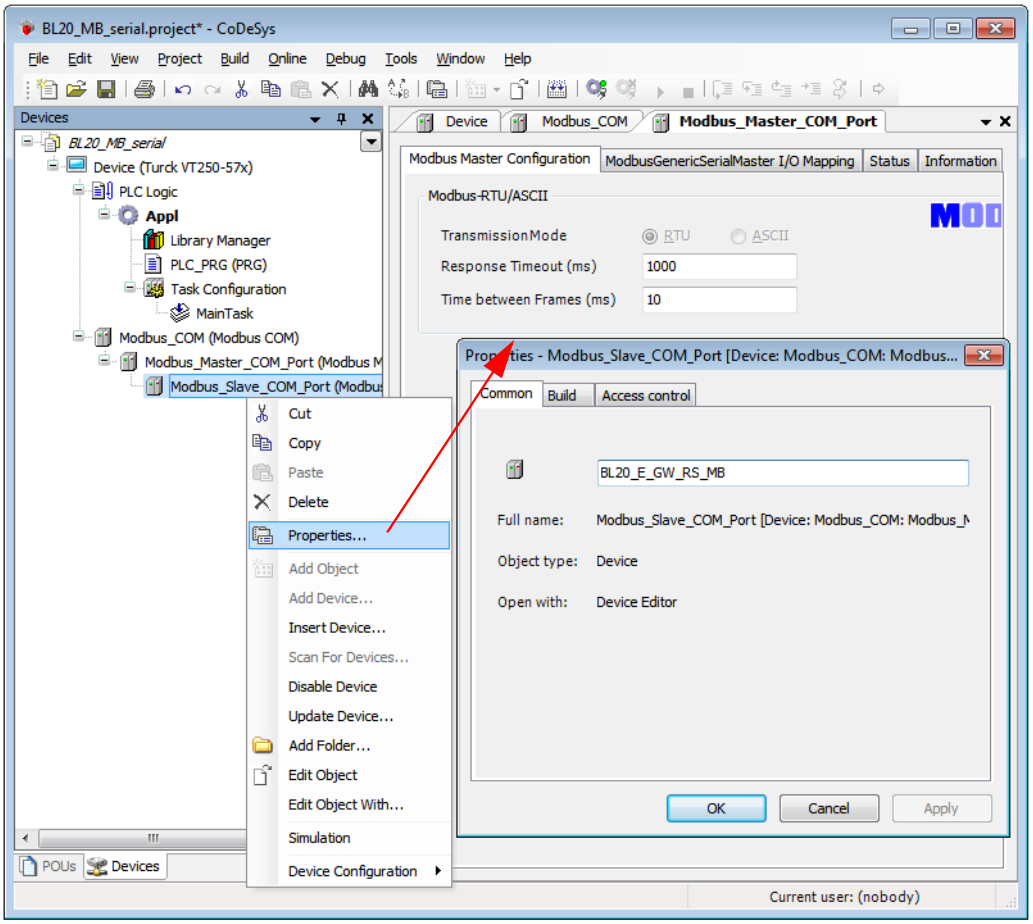

Fig. 29: Adapting the slave-properties

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

4 In the "Modbus Slave configuration"-tab, set the node address (in this example: Address **16**). All other settings can be kept.

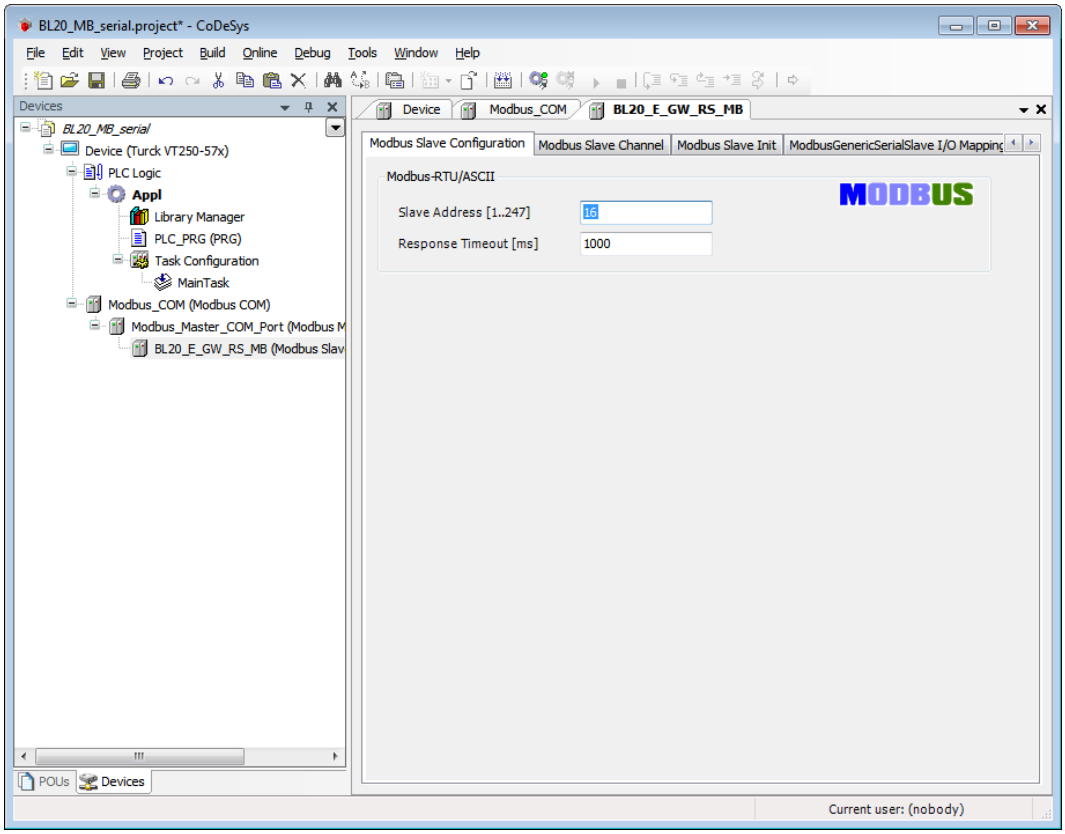

Fig. 30: Setting the node address at the slave

6.3.7 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 9)**.

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. 20**)

NOTE

The status of process values is only shown in the process image if a program refers to them or if the function "Always update variables" in the "MobusTCPSlave I/O Mapping" (see **Reading out the process data (page 35)**) is enabled.

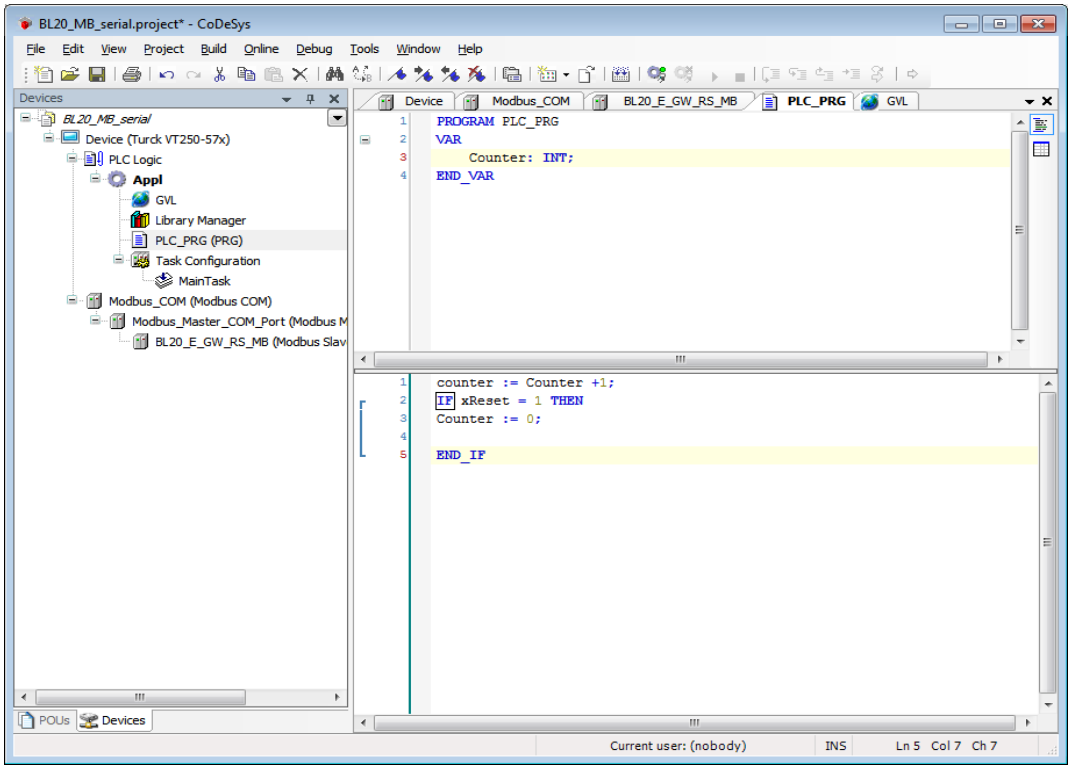

Fig. 31: Example program

6.3.8 CODESYS: Global variables

Global variables are defined either in the Global Variable List (see s. p. 20) or directly in the I/O Mappings of the single stations.

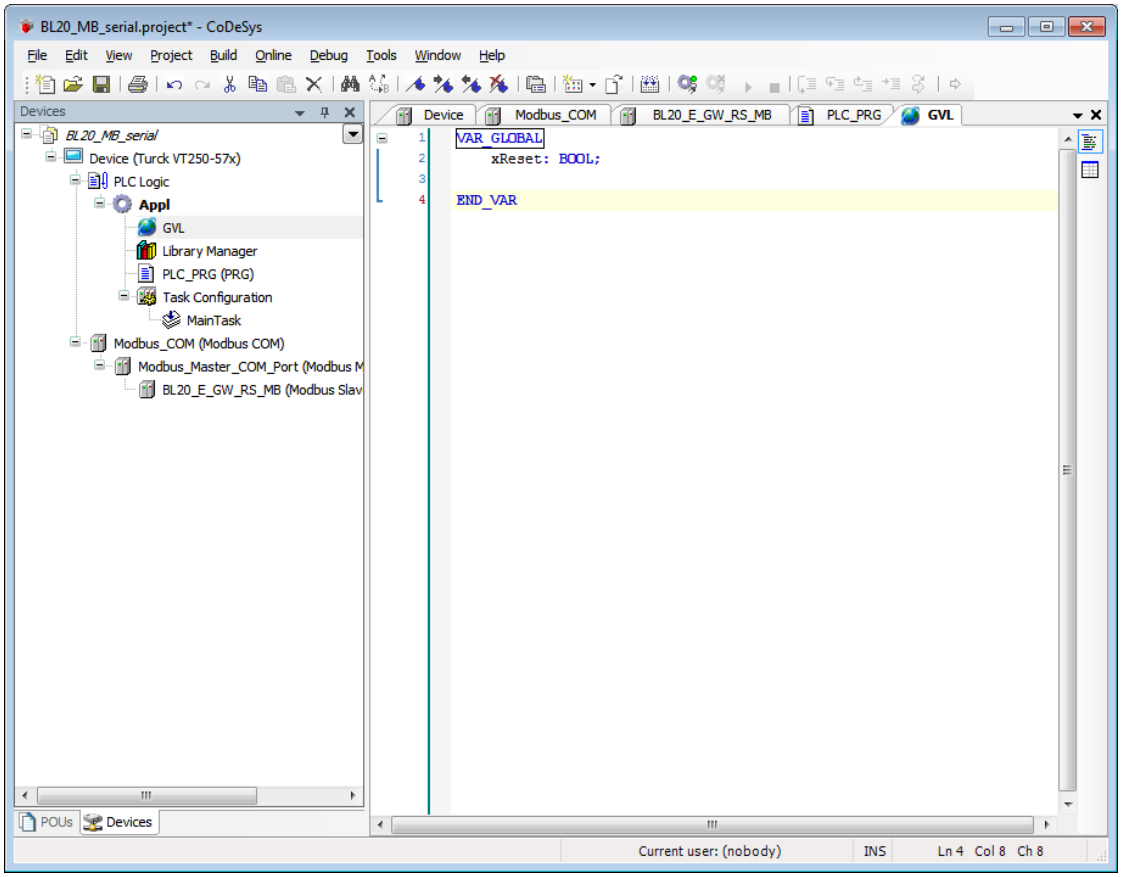

Fig. 32: Example for the definition of a global variable

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 7)**).

6.3.9 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 **Reading out the process data (page 35)**)

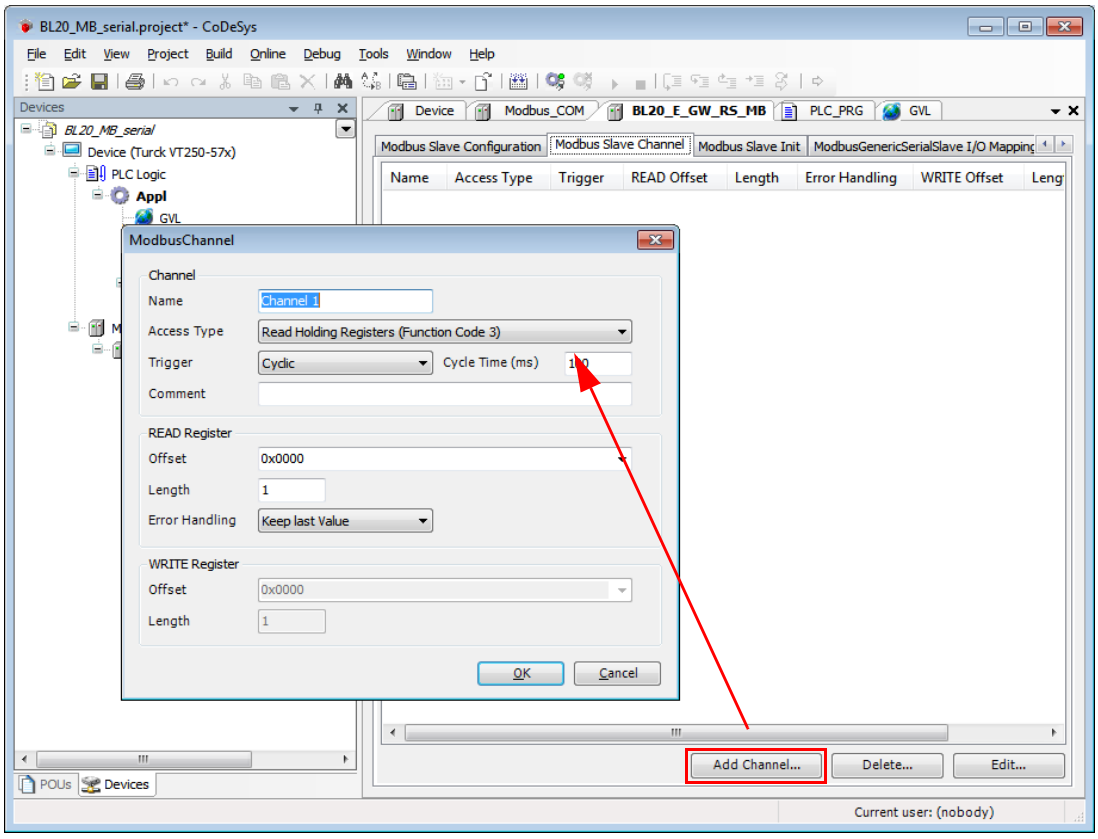

Fig. 33: Setting the Modbus channels, examples

The Modbus communication channels are defined by:

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

Modbus data mapping

The mapping for the input and output data of a 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)

1. Modbus report

1.1. Station description

Station address: 16

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-RS-MB/ET	16/BL20-E-GW-RS-MB/ET	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		5 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.

1.2. 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)

1.3. 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. 34: Modbus report - Mapping of in- and output data

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1.4. Map for parameter data

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

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. 35: Modbus report - Mapping of parameter and diagnostic data

Setting the Modbus-channels (examples) and data mapping

1 Write:
Writing of **%QW0** and mapping of the counter value (VAR "Counter", see PLC_PRG, s. p. 19) 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.

1.3. 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. 36: Mapping of output data acc. to Modbus-report

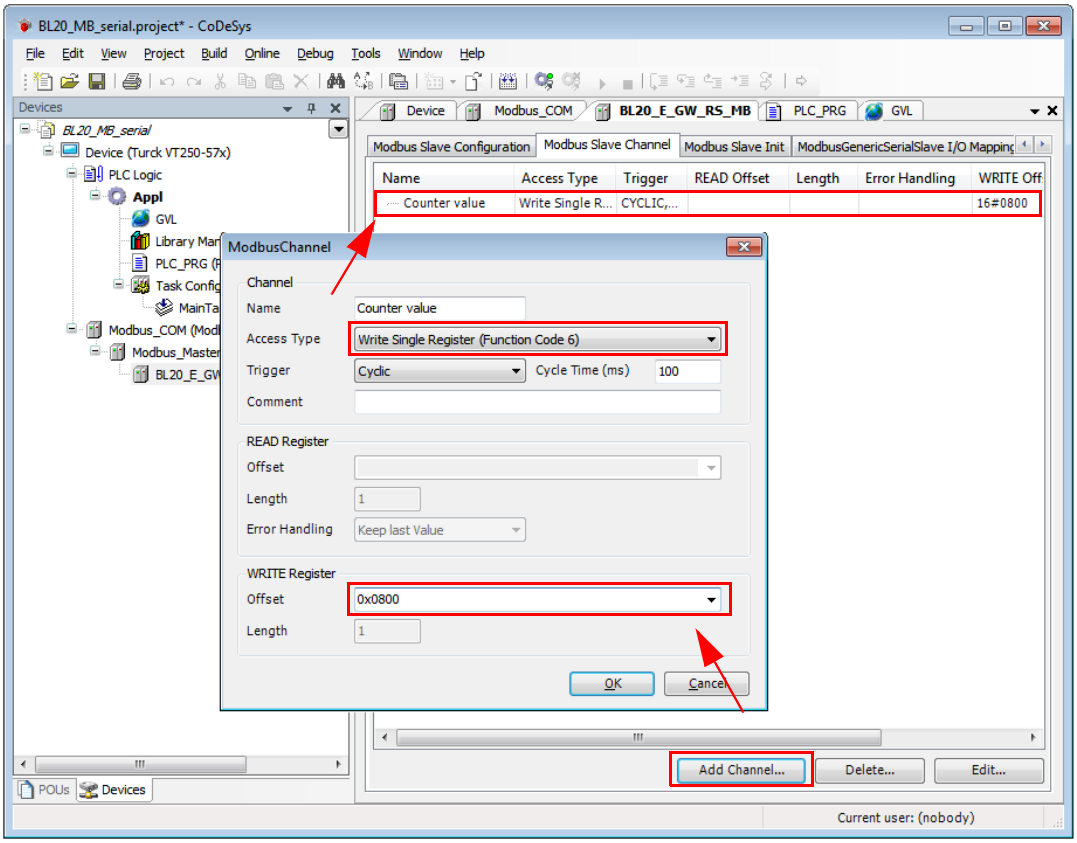

Fig. 37: Modbus channel, counter value, FC06

1.2 Mapping: counter value to %QW0

– The mapping of the counter value (VAR "Counter") to the station 's output register is done via 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 19)**, it can be found there.

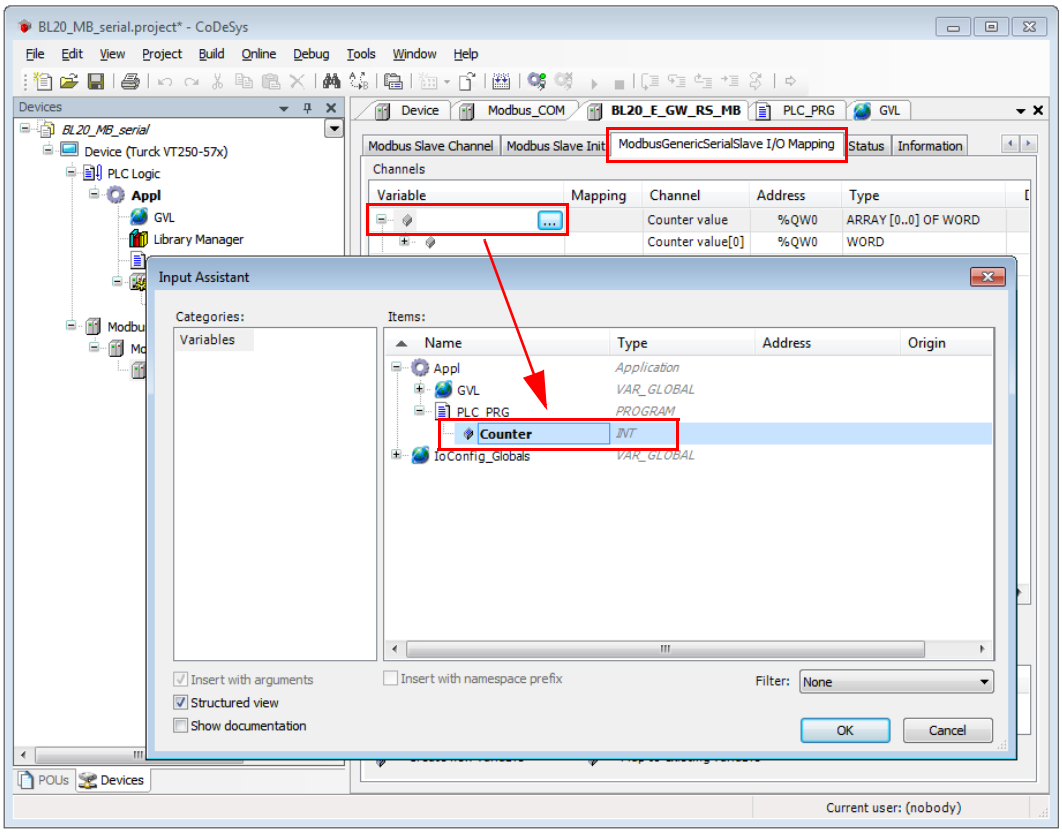

Fig. 38: Mapping of the counter value to %QW0

– 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)

2.3 Read: %IW0

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

– Read Register, Offset:
0x0003 (see below)

1. Modbus report

1.1. Station description

Station address: 16

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-RS-MB/ET	16/BL20-E-GW-RS-MB/ET	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		5 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.

1.2. 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)

1.3. 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. 39: Mapping of input data acc. to Modbus-report

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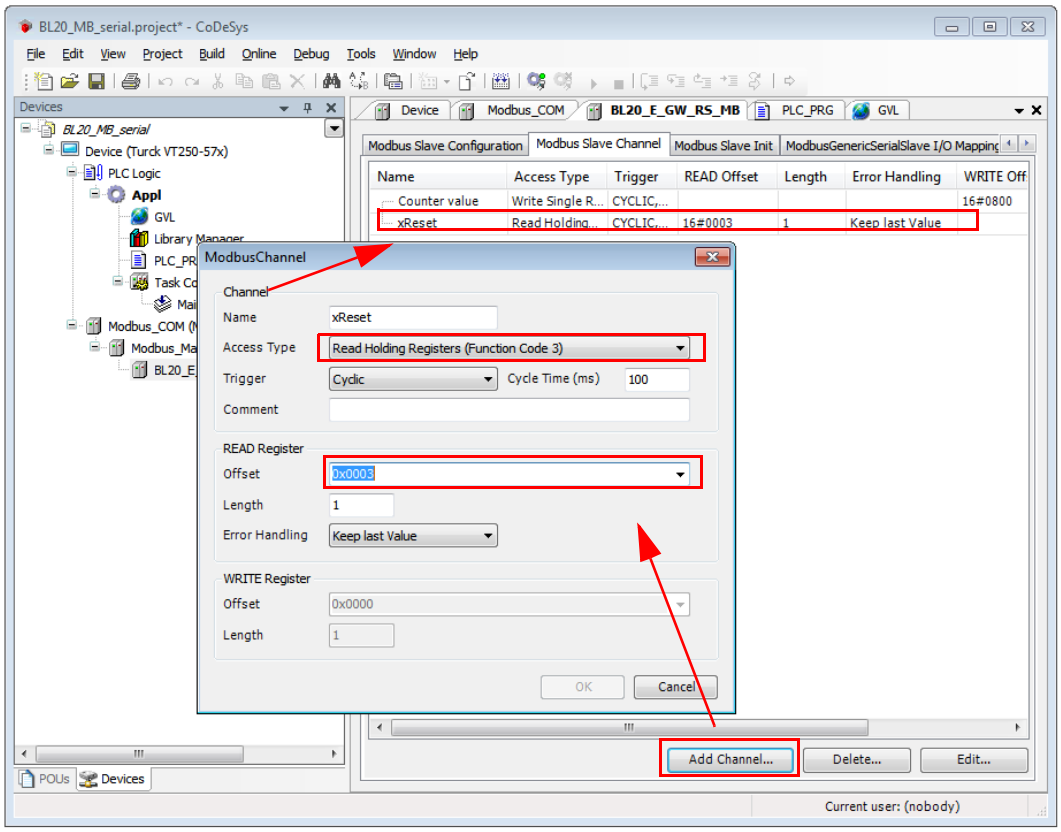


Fig. 40: Modbus channel, read "xReset", FC03

2.4 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 20)**.

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

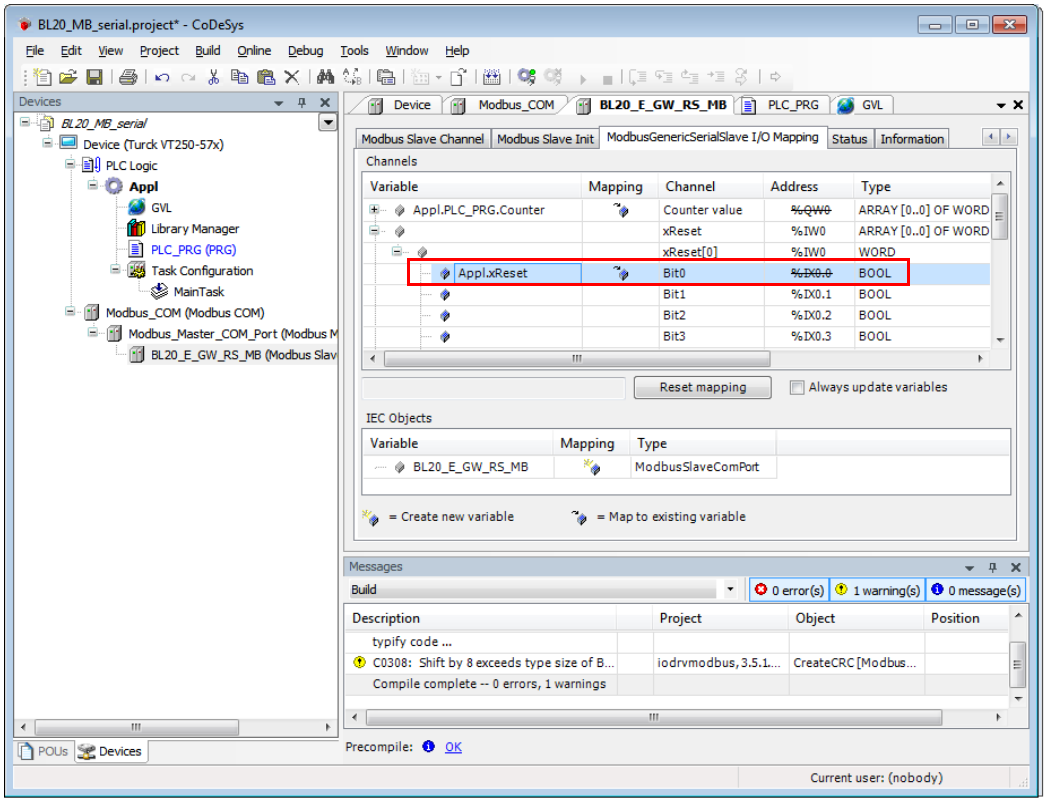


Fig. 41: Mapping of "xReset" to bit %IX0.0

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 Modbus TCP Slave I/O Mapping.

1.2. 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)

Fig. 42: Status Word mapping acc. to Modbus-report

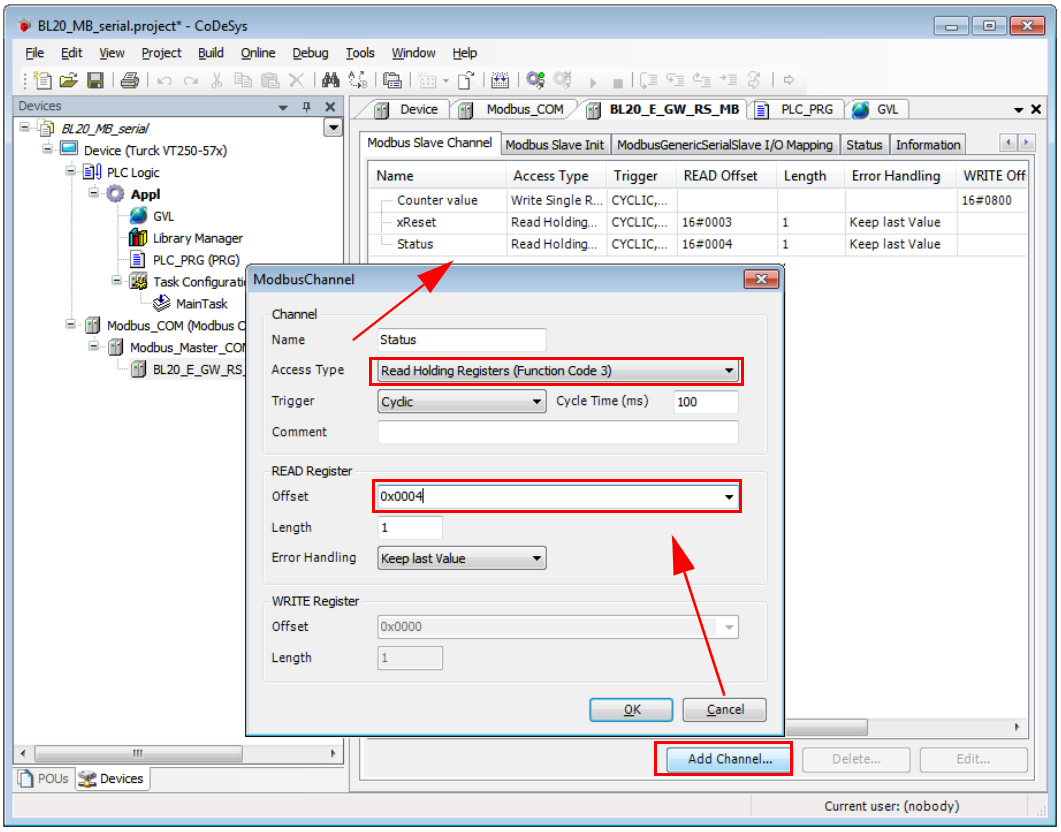


Fig. 43: Setting the Modbus channel for reading the status word

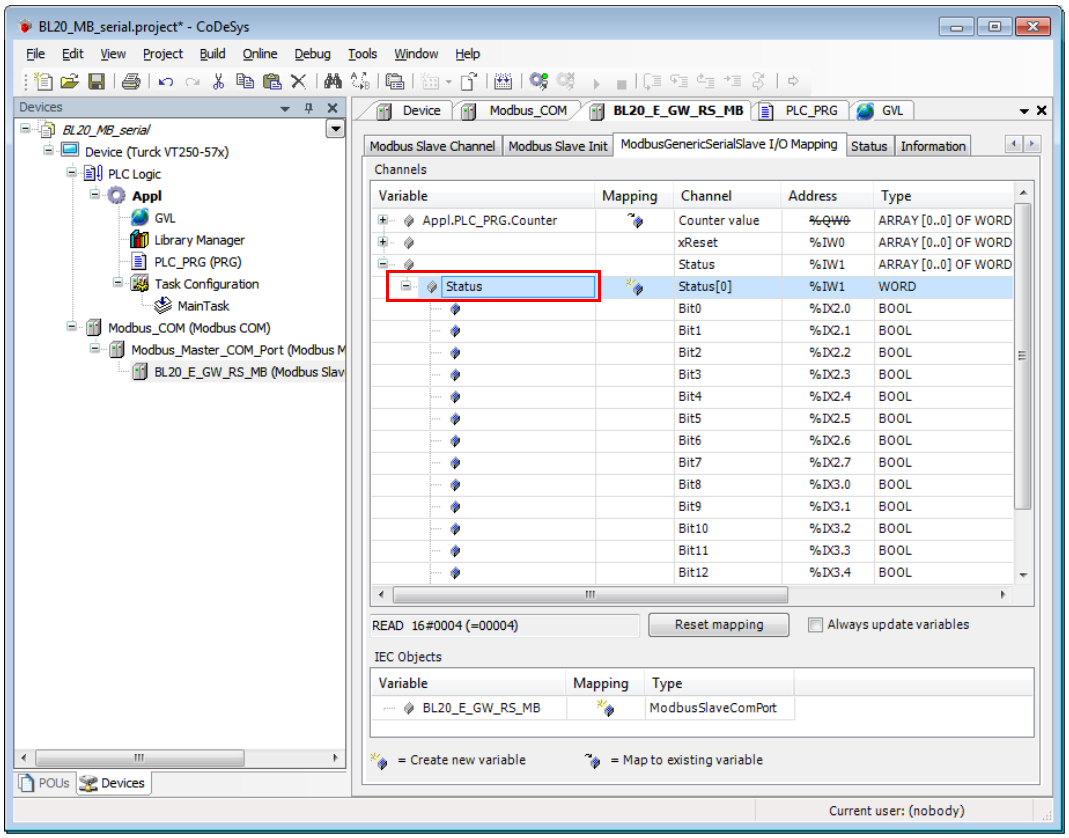


Fig. 44: Status Word in the process image

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 "Modbus Slave Channel", but as an Initialization channel under "**Modbus Slave Init**" (see **Setting the initialization channel for the parameterization (page 32)**).

– 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:

1.4. Map for parameter data

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

Fig. 45: 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.

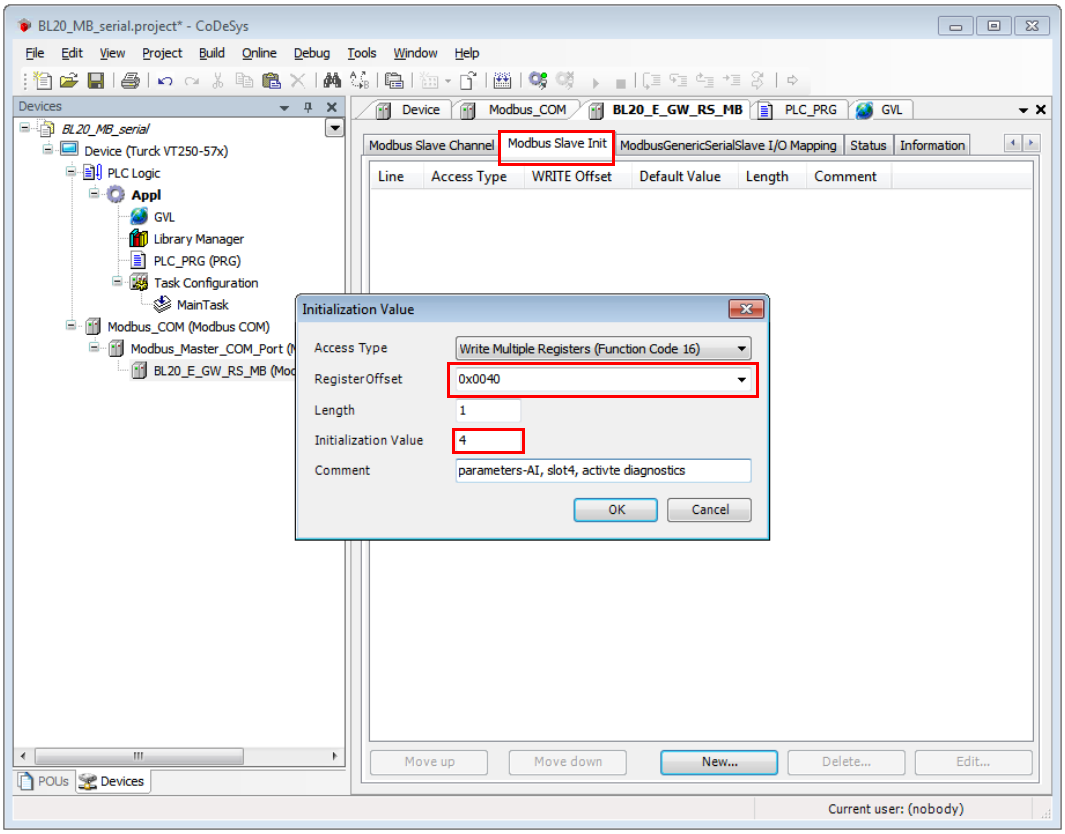


Fig. 46: Setting the initialization channel for the parameterization

6.3.10 Building, login and start

1 Building the program:

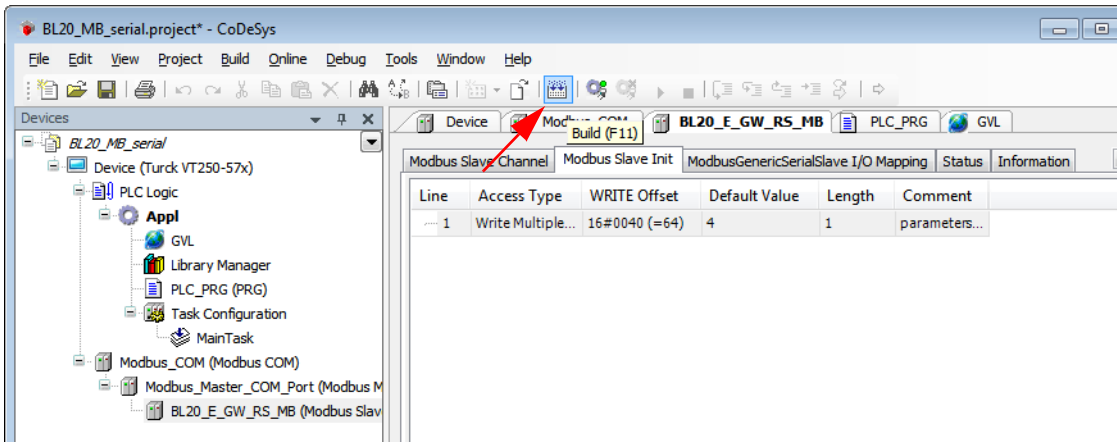
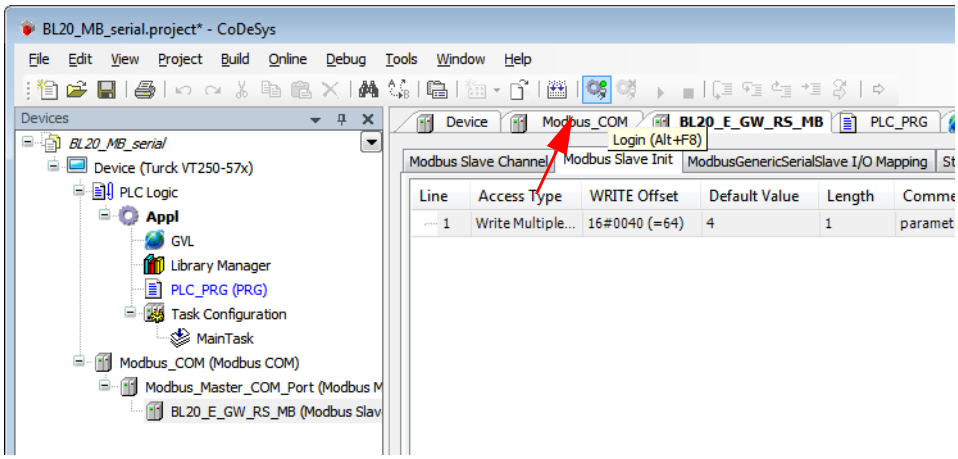


Fig. 47: Building the program

2 Login:



Login

Fig. 48:

3 Start the program:

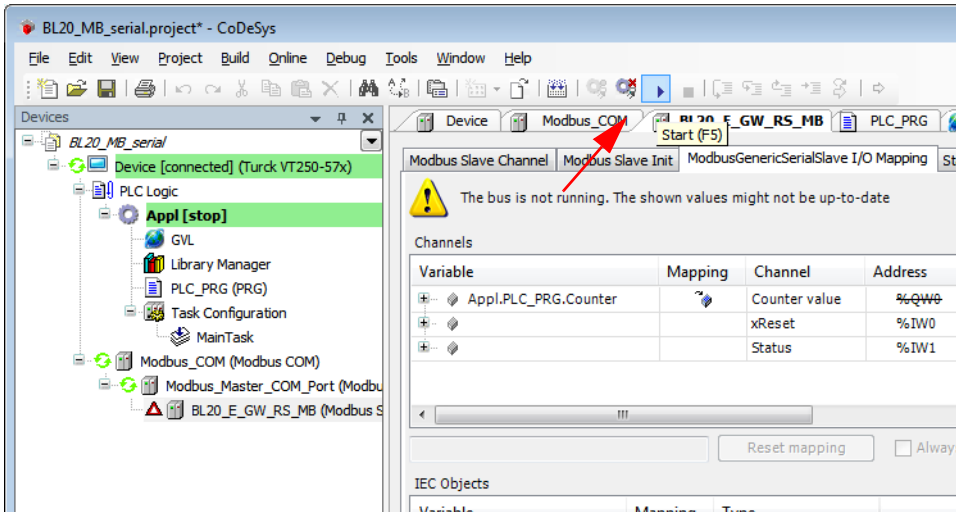


Fig. 49: Starting the program

6.3.11 Reading out the process data

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

NOTE

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

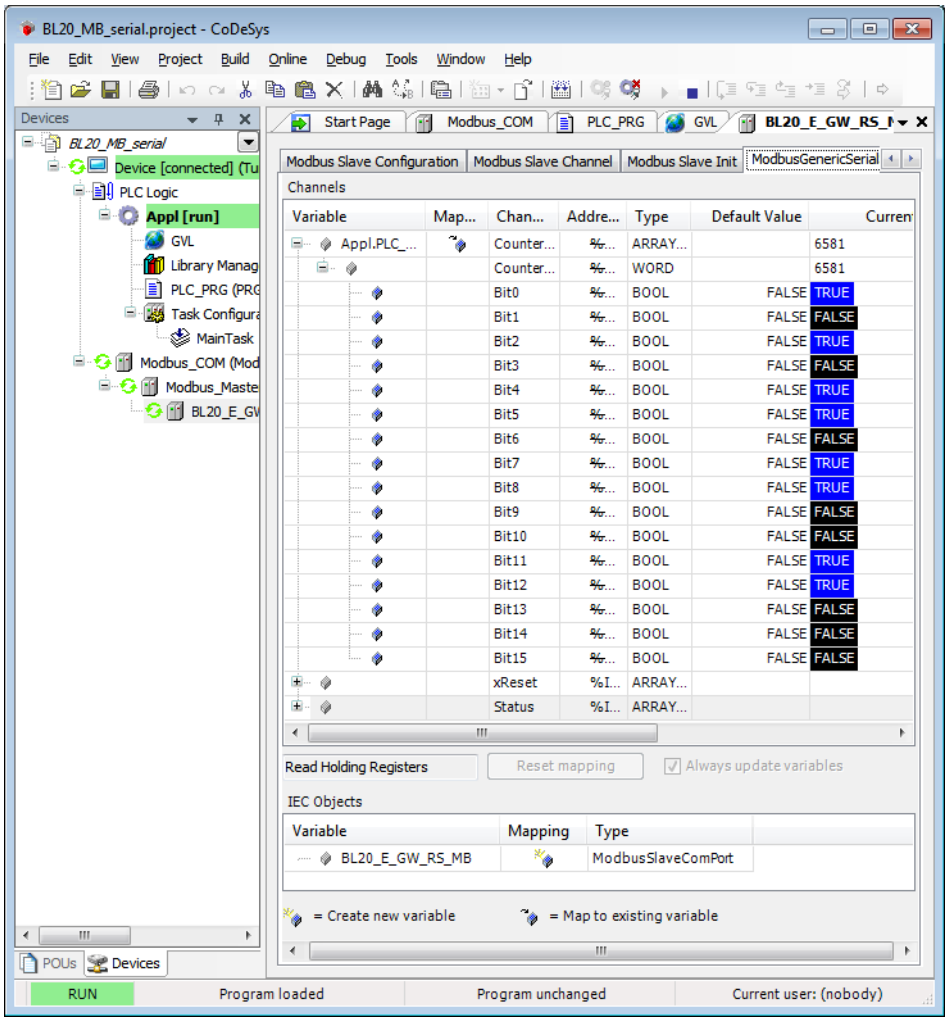


Fig. 50: Modbus Slave I/O mapping with process data

6.3.12 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 22)**).

According to the definition of the Modbus communication channel (see **Setting the Modbus-channels (examples) and data mapping (page 24)**, it is read from **%IW1** of the station image.

1.2. 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

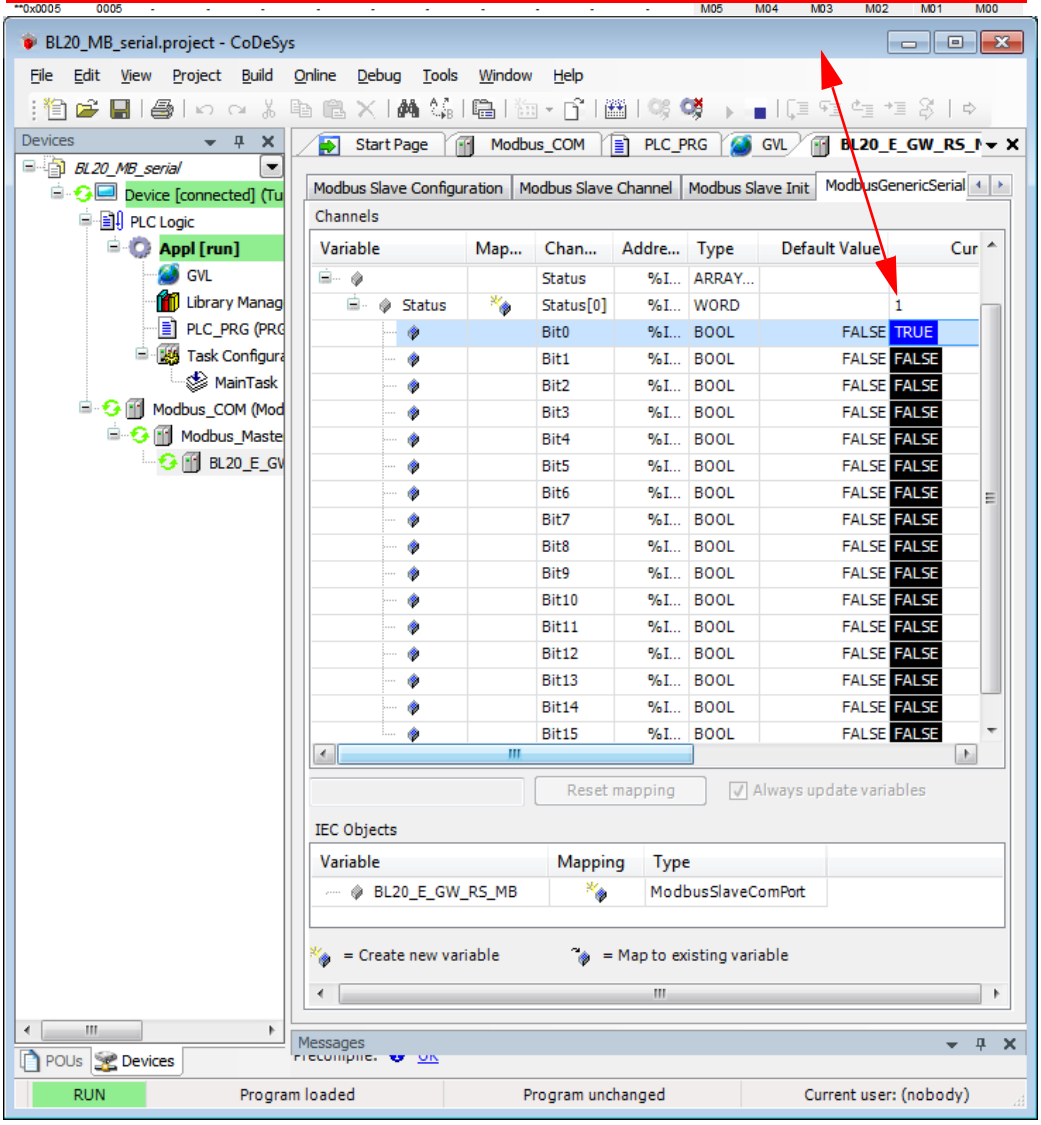


Fig. 51: Status Word of the station

the message is to be interpreted as follows:

Status-register
→ %IW 1, bit 0 = 1

→ status message: "DiagWarn" = active diagnosis

at least one module at the gateway sends a diagnostic message (see also **Register 0×100C: "Gateway status" (page 16)**).

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.

1. Modbus report

1.1. Station description

Station address: 16

Adr./Slot	Name	TAG	Data Size In	Data Size Out
0*	BL20-E-GW-RS-MB/ET	16/BL20-E-GW-RS-MB/ET	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		5 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.

1.2. 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)

Fig. 52: Group diagnosis register

According to the examples for setting the Modbus channels (see **Setting the Modbus-channels (examples) and data mapping (page 24)**), the following channel is add to read out the group diagnosis register.

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

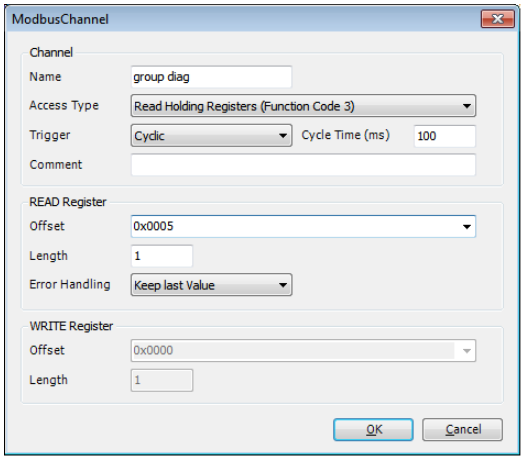


Fig. 53: Channel for reading out the group diagnosis

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

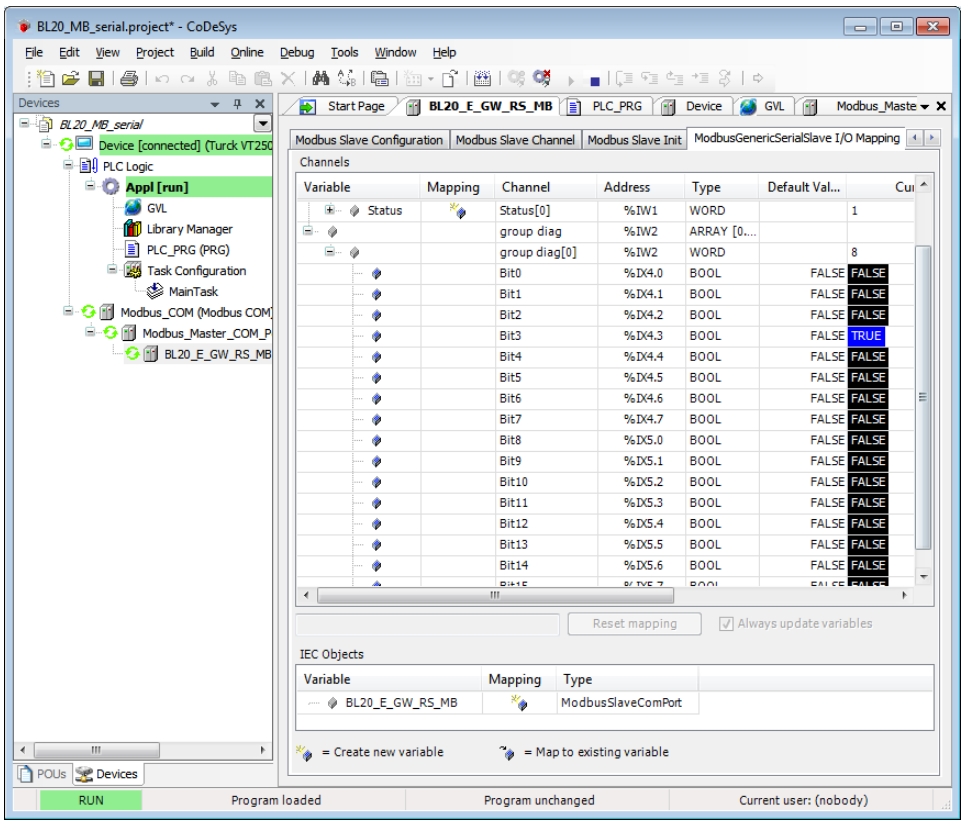


Fig. 54: Group diagnosis

→ bit 3 = 1 → slot 4 sends diagnosis information
→ BL20-2AI-THERMO-PI (see also **Used hard-/software (page 5)**)

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 (**Modbus report - Mapping of parameter and diagnostic data (page 23)**), 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 24)**), the following channel is add to read out the module diagnosis.

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

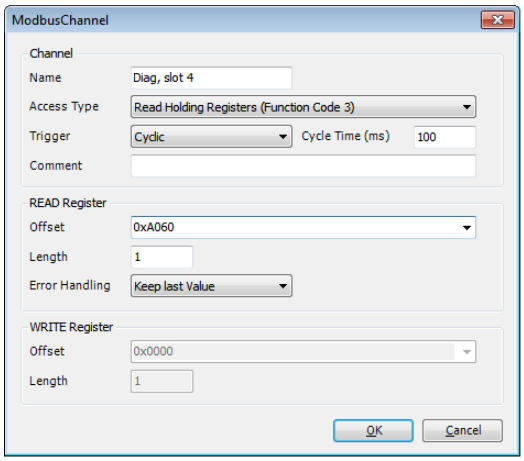


Fig. 55: Diagnosis channel

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

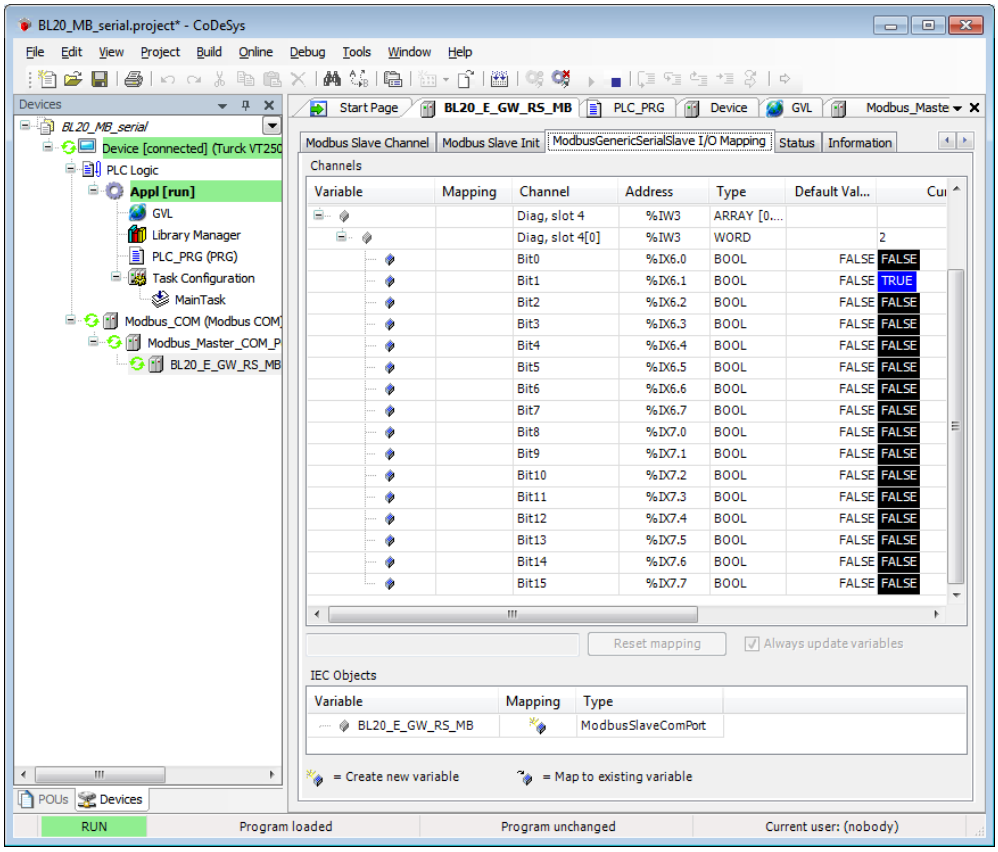


Fig. 56: Diagnosis data at slot 4

Meaning:
Bit 1: Open circuit at channel 1

(see also **Diagnostic messages of the modules (page 40)**)

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. 57: Mapping of diagnosis data according to Modbus report

7 Guidelines for station planning

7.1 Module arrangement

7.1.1 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.

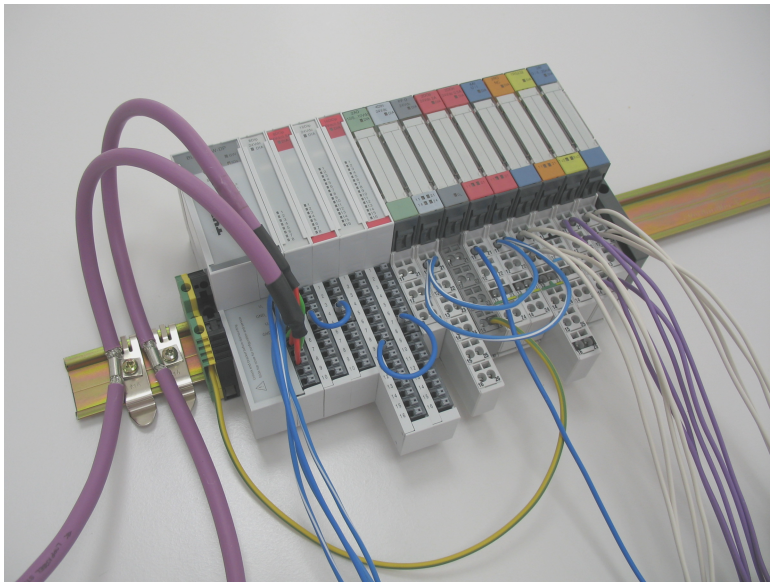


Fig. 58: Example of a station structure with ECO gateway (here for CANopen), ECO and standard I/O modules

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.

7.1.2 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 power to BL20 systems is supplied from a common external source. This avoids the occurrence of potential compensating currents within the BL20 station.

7.1.3 Maximum system extension

The maximum number of modules connected to the gateway BL20-E-GW-RS-MB/ET 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} = **600 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' 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-BR-24VDC-RED	1	-
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

Module	Communication bytes (on the module bus)	Nominal current consumption at the module bus
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
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-N	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

7.2 Power supply

7.2.1 Power supply to the gateway

The gateway BL20-E-GW-RS-MB/ET offers an integrated power supply (see also **Power supply (page 16)**)

7.2.2 Module bus refreshing

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 600 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-RS-MB/ET 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".

7.2.3 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.

7.2.4 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. 59: C-rail (front view)

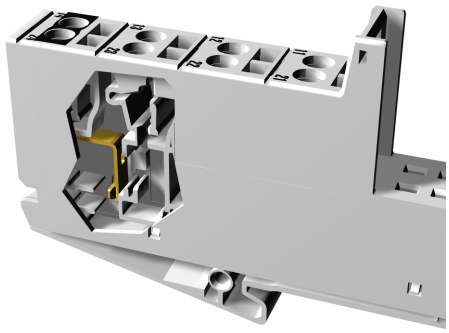


Abb. 60: C-rail front (side view)

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 **chapter 8**.

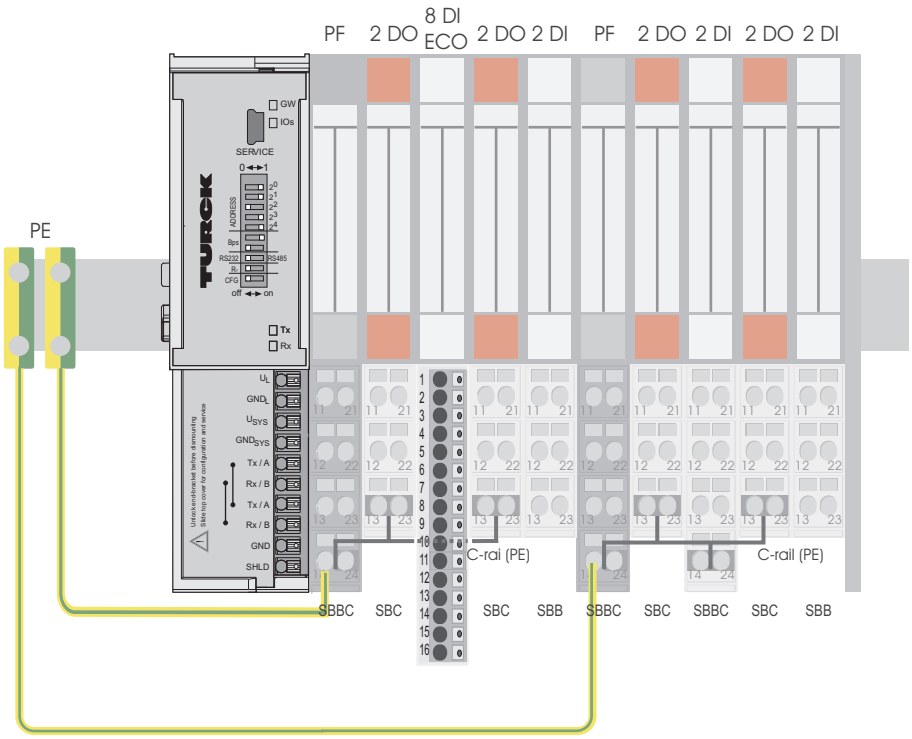


Fig. 61: Using the C-rail as a protective earth

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.

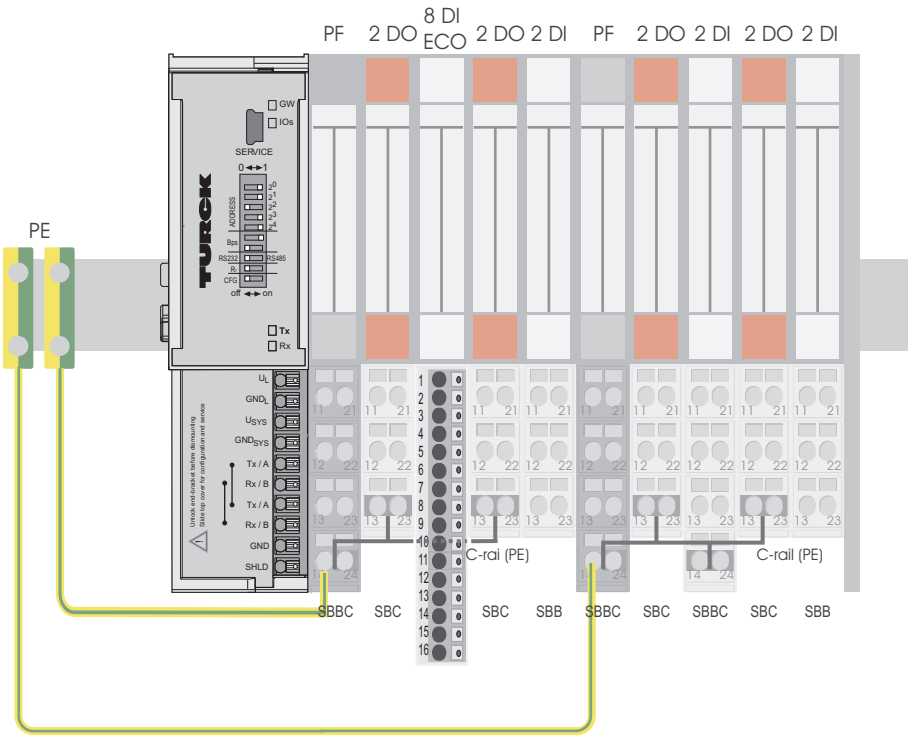


Fig. 62: Using the C-rail as protective earth and for the power supply with relay modules

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).

7.2.5 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.

7.3 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.

7.4 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

7.5 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.

7.6 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.

8 Guidelines for Electrical Installation

8.1 General notes

8.1.1 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.).

8.1.2 Cable routing

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

Cable routing inside and outside of cabinets

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

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

Group 1:

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

Group 2:

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

Group 3:

- unshielded cables for DC and AC voltages > 400 V

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

- Group 1/Group 2

The group combinations:

Group 1/Group 3 and Group 2/Group 3

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

Cable routing outside buildings

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

WARNING

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.

8.1.3 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.

8.1.4 Transmission media

NOTE

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

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

8.2 Potential relationships

8.2.1 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.

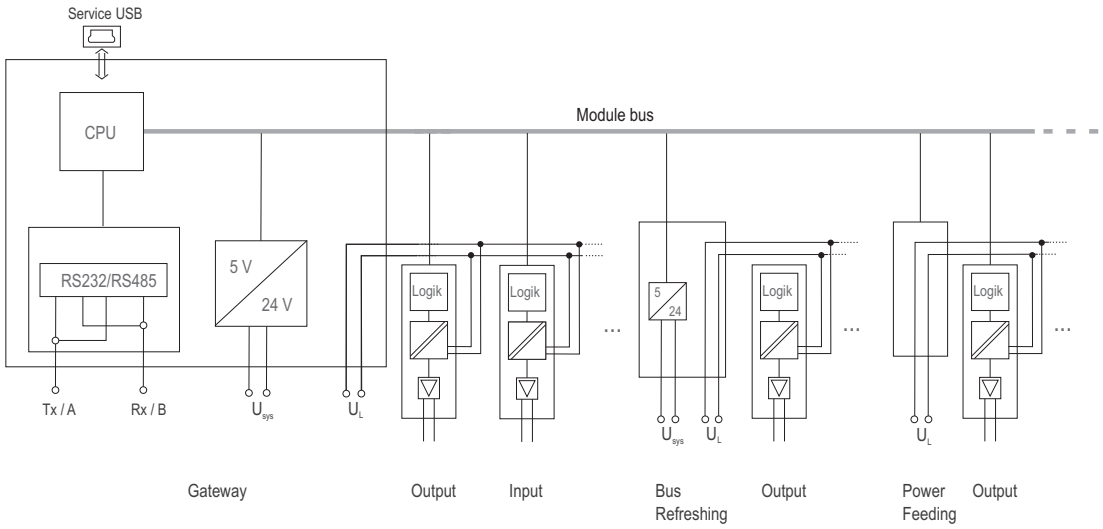


Fig. 63: Block diagram of a BL20 station with Modbus gateway

8.3 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.

8.3.1 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.

8.3.2 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

8.3.3 PE connection

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

8.3.4 Earth-free operation

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

8.3.5 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

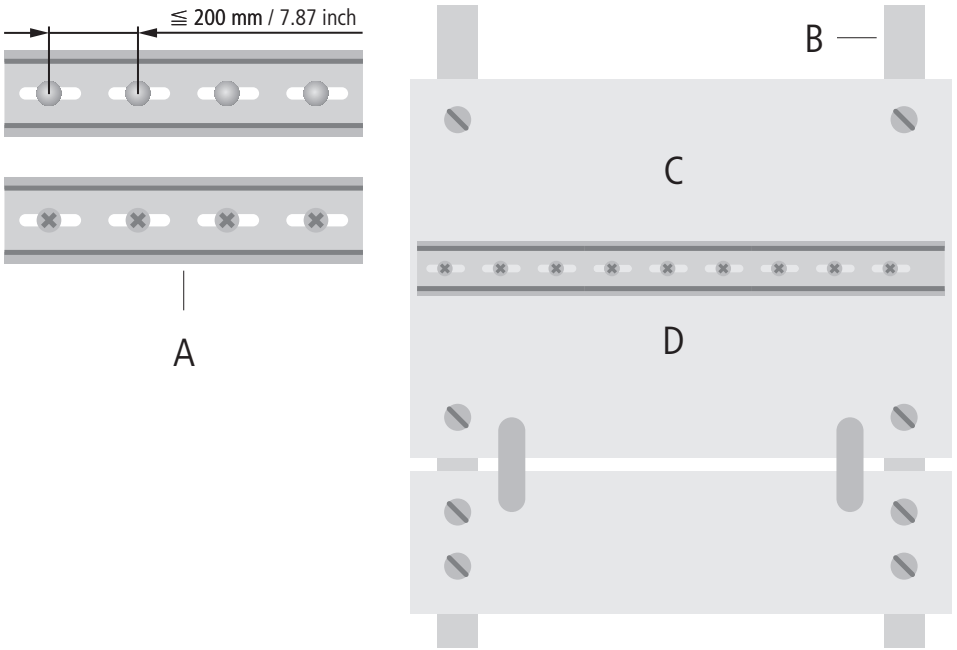


Abb. 64: Mounting options
A *TS 35*
B *mounting rail*
C *mounting plate*
D *TS 35*

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 com-

ponents at the connection point. Protect the connection point against corrosion (for example with grease; caution: use only suitable grease).

8.3.6 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.

8.3.7 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.

8.3.8 Switching inductive loads

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

8.3.9 Protection against Electrostatic Discharge (ESD)

NOTICE

Exposed metal contacts

Material damage due to electrostatic discharge

➤ Avoid to touch the metallic contacts with bare hands

9 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** at**www.turck.de**.

10 Appendix

10.1 Data image of the technology modules

10.1.1 1RS232/1RS485-module

Process input data

Process input data is data from the connected field device that is transmitted via the BL××-1RS×××-module to the PLC. The BL××-1RS×××-module sends the data, received by the device, into a 128-byte receive-buffer. The module then transmits the data segmented via the module bus and the gateway to the PLC.

The transmission is realized in a 8-byte format which is structured as follows:

- 1 status byte is required to ensure trouble-free transmission of the data.
- 1 byte contains the diagnostics data.
- 6 bytes are used to contain the user data.

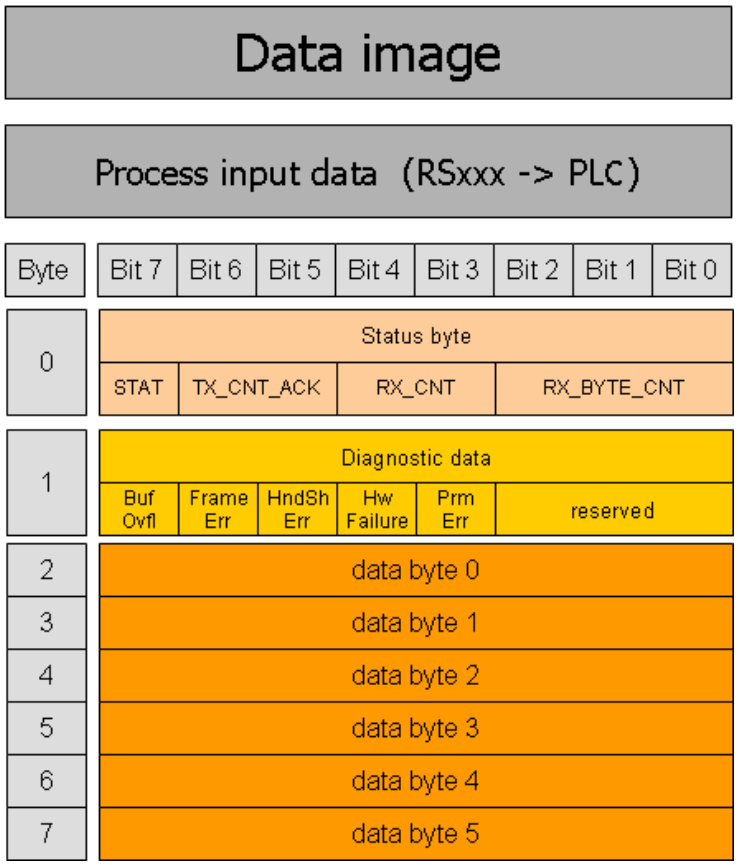


Fig. 65: Process input data of RS××× modules

Designation	Value	Description
BufOvfl; FrameErr; HndShErr; HwFailure; PrmErr	0 - 255	Diagnostic information (correspond to the diagnostic information in the diagnosis telegram). These diagnostics are always displayed and independent to the setting of the parameter "Diagnostics".
STAT	0-1	1: The communication with the data terminal equipment (DTE) is not disturbed. 0: The communication with the data terminal equipment (DTE) is disturbed. A diagnosis message is generated if the parameter "Diagnostics" is set to "0" = release. The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. The value TX_CNT was transferred together with the last data segment of the process output data. The value TX_CNT_ACK is a confirmation of successful acceptance of the data segment using TX_CNT.
RX_CNT	0-3	This value is transferred together with every data segment. The RX_CNT values are sequential: The RX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
RX_BYTE_CNT	0-7	Number of the valid bytes in this data segment.

Process output data

Process output data are data which are sent from the PLC via the gateway and the BL××-1RS×××-module to a connected field device.

The data received from the PLC are loaded into the 64-bit transmit-buffer in the BL××-1RS×××-module.

The transmission is realized in a 8-byte format which is structured as follows:

- 1 control byte is required to ensure trouble-free transmission of the data.
- 1 byte contains, signals to start the flushing of transmit- and receive buffer.
- 6 bytes are used to contain the user data.

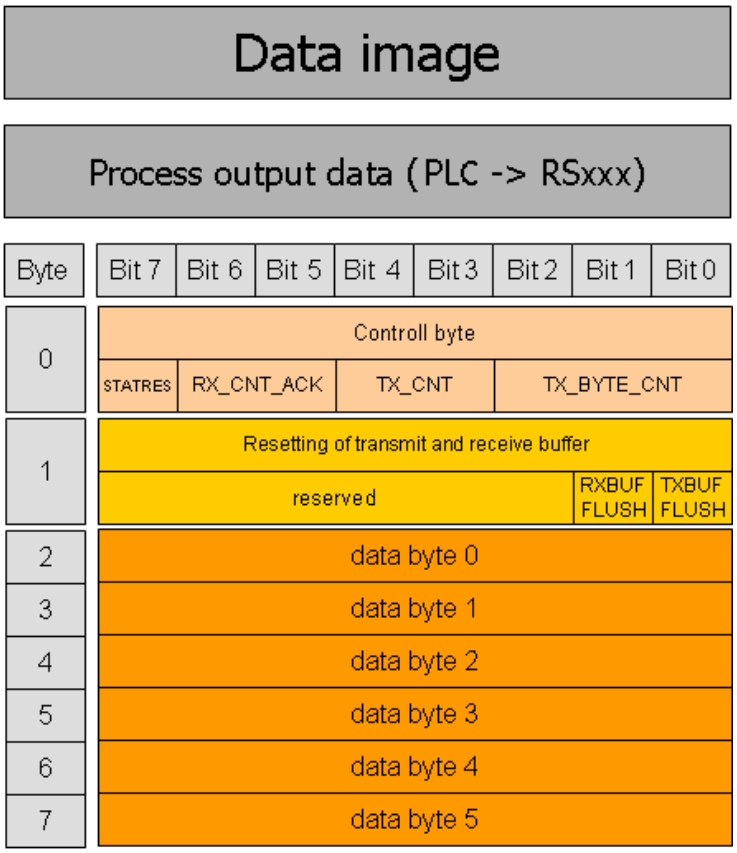


Fig. 66: Process output data of RS×××-modules

Designation	Value	Description
STATRES	0-1	This bit is set to reset the STAT bit in the process input data. With the change from 1 to 0 the STAT bit is reset (from 0 to 1). If this bit is 0, all changes in TX_BYTE_CNT, TX_CNT and RX_CNT_ACK are ignored. The clearing of the receive and transmit buffer by RXBUF FLUSH/ TXBUF FLUSH is possible. The value 1 or the transition from 0 to 1 disables the clearing of the receive and transmit buffer by the RXBUF FLUSH/TXBUF FLUSH.
RXBUF FLUSH	0 - 1	The RXBUF FLUSH bit is used for clearing the receive buffer. If STATRES = 1: A request with RXBUF FLUSH = 1 will be ignored. If STATRES = 0: RXBUF FLUSH = 1 will clear the receive buffer.

Designation	Value	Description
TXBUF FLUSH	0-1	The TXBUF FLUSH bit is used for clearing the transmit buffer. If STATRES = 1: A request with TXBUF FLUSH = 1 will be ignored. If STATRES = 0: TXBUF FLUSH = 1 will clear the receive buffer.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. The value TX_CNT was transferred together with the last data segment of the process output data. RX_CNT_ACK has to be set analog to RX_CNT (in the status byte). RX_CNT_ACK is an acknowledge for the successful transmission of the data segment with RX_CNT. New data can now be received.
TX_CNT	0-3	This value is transferred together with every data segment. The TX_CNT values are sequential: The TX_CNT values are sequential: 00->01->10->11->00… (decimal: 0->1->2->3->0…) Errors in this sequence show the loss of data segments.
TX_BYTE_CNT	0 - 7	Number of the valid bytes in this data segment.

10.1.2 SSI module

Process input data

The field input data is transferred from the connected field device to BL20-1SSI-module.

The process input data is the data that is transferred by the BL20-1SSI-module via a gateway to the PLC.

The transmission is realized in a 8-byte format which is structured as follows:

- 4 bytes are used for representing the data that was read from the register with the address stated at REG_RD_ADR.
- When necessary, 1 byte represents the register address of the read data and an acknowledgement that the read operation was successful.
- 1 byte can be used to transfer status messages of the SSI encoder. This byte also contains an acknowledgement that the write operation to the register was successful and indication of an active write operation.
- 1 byte contains the results of comparison operations with the SSI encoder value.
- 1 byte contains messages concerning the communication status between the BL20-1SSI module and the SSI encoder, as well as other results of comparison operations.

The following table describes the structure of the 8 x 8 bits of the process input data.

STS (or ERR) contains non-retentive status information, i.e. the bit concerned indicates the actual status.

FLAG describes a retentive flag that is set in the event of a particular event. The bit concerned retains the value until it is reset.

Data Image

Process input data (SSI -> PLC)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Diagnostic data							
	STS STOP	x	x	ERR PARA	STS UFLW	STS OFLW	ERR SSI	SSI DIAG
	Status messages							
1	STS UP	STS DN	REL CMP2	FLAG CMP2	STS CMP2	REL CMP1	FLAG CMP1	STS CMP2
2	REG WR ACEPT	REG WR AKN	x	x	SSI STS3	SSI STS2	SSI STS1	SSI STS0
3	REG RD ABORT	x	REG RD ADR (MSB to LSB)					
4	data byte 0							
5	data byte 1							
6	data byte 2							
7	data byte 3							

Fig. 67: Process input data of the SSI-module

Designation	Value	Description
REG_RD_DATA	0… 2^{32}-1	Content of the register to be read if REG_RD_ABORT=0. If REG_RD_ABORT =1, then REG_RD_DATA=0.
REG_RD_ABORT	0	The reading of the register defined in REG_RD_ADR has been accepted and executed. The content of the register can be found in the user data (REG_RD_DATA, byte 0-3).
	1	Reading of the register defined in REG_RD_ADR has not been accepted. The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_RD_ADR	0…63	Address of the register to be read. If the read operation is successful (REG_RD_ABORT = 0), the user data is located in REG_RD_DATA of the process input data (bytes 0 to 3).
REG_WR_ACEPT	0	Writing the user data from the process output to the register addressed with REG_WR_ADR in the process output could not be done.
	1	Writing the user data from the process output to the register addressed with REG_WR_ADR in the process output was successful.
REG_WR_AKN	0	No modification of the data in the register bank by process output, i.e. REG_WR = 0. A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.)
	1	A modification of the register contents by a process output was initiated, which means REG_WR = 1. A write job would not be accepted with the next telegram of process output data.
SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
REL_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≥ (REG_CMP2)

Designation	Value	Description
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP1 = 1 in the process output data.
STS_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≥ (REG_CMP1)
FLAG_CMP1	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP1) since the last reset.
	1	The contents of the registers match (REG_SSI_POS) = (REG_CMP1). This marker must be reset with CLR_CMP1 = 1 in the process output data.
STS_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
STS_STOP	0	The SSI encoder is read cyclically.
	1	Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≥ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≤ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)

Designation	Value	Description
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1)

Process output data

Field output data is output from an BL20-1SSI-module to a field device.

The process output data is the data that is transferred by the PLC via a gateway to the BL20-1SSI module.

The transmission is realized in a 8-byte format which is structured as follows:

- 1 byte contains a Stop bit for interrupting communication with the encoder.
- 1 byte is used for controlling the comparison operations.
- 1 byte contains the register address of the data to be written to bytes 0 to 3 of this telegram and a write request.
- 1 byte contains the register address for the data that is to be read with the next response telegram.
- 4 bytes are used for representing the data that is to be written to the register with the address specified at REG_WR_DATA.

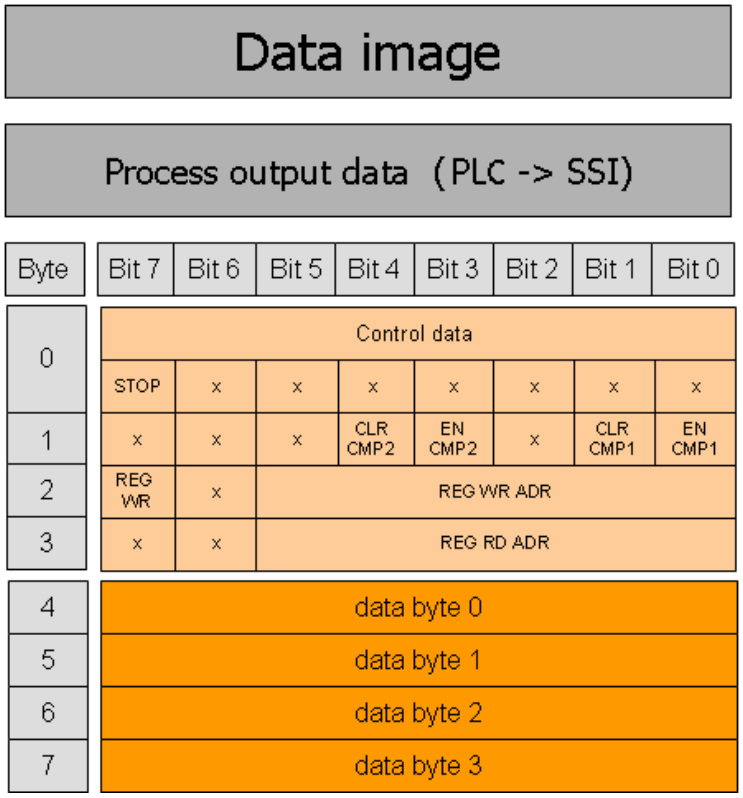


Fig. 68: Process output data of the SSI-module

Designation	Value	Description
REG_WR_DATA	0… 2^{32}-1	Value which has to be written to the register with the address REG_WR_ADR.
REG_RD_ADR	0…63	Address of the register which has to be read. If the reading was successful (REG_RD_ABORT = 0), the user data can be found in REG_RD_DATA in the status interface (bytes 4-7).
REG_WR	0	Default status, i.e. there is no request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_DATA. Bit REG_WR_AKN is reset (0) if necessary.
	1	Request to overwrite the content of the register with address REG_WR_ADR with REG_WR_DATA.
REG_WR_ADR	0…63	Address of the register, which has to be written with REG_WR_DATA.
CLR_CMP2	0	Default status, i.e. no reset of FLAG_CMP2 active.
	1	Reset of FLAG_CMP2 active.
EN_CMP2	0	Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP1	0	Default status, i.e. reset of FLAG_CMP1 not active.
	1	Reset of FLAG_CMP1 active.
EN_CMP1	0	Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have a value based on the result of the comparison with the SSI encoder value.
STOP	0	Request to read the SSI encoder cyclically
	1	Request to interrupt communication with the encoder

10.1.3 SWIRE-module

SWIRE in Modbus

In Modbus, the process data of SWIRE-modules are mapped to the data area for digital In- and output modules **not** to the data area for intelligent modules)

Process input data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n -1	(Data from modules to the left)							
n	SWIRE Slave 2				SWIRE Slave 1			
	SD2		PKZ-ST2	SI2	SD1		PKZ-ST1	SI1
n+1	SWIRE Slave 4				SWIRE Slave 3			
	SD4		PKZ-ST4	SI4	SD3		PKZ-ST3	SI3
n+2	SWIRE Slave 6				SWIRE Slave 5			
	SD6		PKZ-ST6	SI6	SD5		PKZ-ST5	SI5
n+3	SWIRE Slave 8				SWIRE Slave 7			
	SD8		PKZ-ST8	SI8	SD7		PKZ-ST7	SI7
n+4	SWIRE Slave 10				SWIRE Slave 9			
	SD10		PKZ-ST10	SI10	SD9		PKZ-ST9	SI9
n+5	SWIRE Slave 12				SWIRE Slave 11			
	SD12		PKZ-ST12	SI12	SD11		PKZ-ST11	SI11
n+6	SWIRE Slave 14				SWIRE Slave 13			
	SD14		PKZ-ST14	SI14	SD13		PKZ-ST13	SI13
n+7	SWIRE Slave 16				SWIRE Slave 15			
	SD16		PKZ-ST16	SI16	SD15		PKZ-ST15	SI15
n+8 ff.	(Data from modules to the right)							

Design.	Status	Comment		
SIx		Switch status, relay x		
		SIx supplies the switch status of the contactor coil of the SWIRE bus slave as a feedback signal. SIx makes it possible to check whether the set switch status was executed by a mechanical connection. This must take into account the time delay between the setting of an output, a mechanical execution and the subsequent feedback signal.		
	0	off	Off	Contactor coil is switched off
	1	on	On	Contactor coil is switched on
PKZSTx		Switch status, PKZ x		
	0	off	Off	The motor-protective circuit breaker is off or has tripped
	1	on	On	The motor-protective circuit breaker is switched on

Design.	Status	Comment		
SCx		Communication error, slave x		
		Setting the parameter $SC_{DIAG}Sx$ sets the SCx-bit in the process input data. The information is provided as status information in the PLC for the user.		
	0	ON LINE	ON LINE	Status of slave x:
	1	OFF LINE	OFF LINE	Status of slave x: diagnostics available

Process output data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n -1	(Data from modules to the left)							
n	SWIRE Slave 2				SWIRE Slave 1			
				SO2				SO1
n+1	SWIRE Slave 4				SWIRE Slave 3			
				SO4				SO3
n+2	SWIRE Slave 6				SWIRE Slave 5			
				SO6				SO5
n+3	SWIRE Slave 8				SWIRE Slave 7			
				SO8				SO7
n+4	SWIRE Slave 10				SWIRE Slave 9			
				SO10				SO9
n+5	SWIRE Slave 12				SWIRE Slave 11			
				SO12				SO11
n+6	SWIRE Slave 14				SWIRE Slave 13			
				SO14				SO13
n+7	SWIRE Slave 16				SWIRE Slave 15			
				SO16				SO15
n+8 ff.	(Data from modules to the right)							

Design.	Status	Comment		
SOx		relay x		
		SOx is transferred as the switch status of the contactor coil from the SWIRE bus master to the appropriate SWIRE bus slave.		
	0	off	Off	Contactor not switched on
	1	on	On	Contactor switched on

10.1.4 Encoder/PWM-module: BL20-E-2CNT-2PWM

Detailed information about the process image of the module can be found in separate manual, **D301224**, "BL20 – I/O-MODULES BL20-E-2CNT-2PWM", chapter 2)

10.1.5 RFID-module: BL20-2RFID-S

BL20-2RFID-S (see RFID-documentation under **www.turck.de**)

10.2 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

Module	Identifier
BL20-E-8DO-24VDC-0.5A-P	0x610004xx
BL20-16DO-24VDC-0,5A-P	0x413005xx
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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