Your Global Automation Partner

TURCK

BL20-E-GW-EC
ECO Gateway for EtherCAT

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 EtherCAT-Gateway of the product line BL20-ECO (BL20-E-GW-EC).

The following chapter contain a short BL20-description, a description of the field bus system EtherCAT, exact information about function and structure of the field bus specific BL20-gateway for EtherCAT 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.

2 Notes on the Product

2.1 Product identification

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

2.2 Scope of delivery

- BL20-E-GW-EC
- 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-EC is part of the BL20 system. It forms the interface to an EtherCat network and forwards the data collected by the BL20 I/O modules within the BL20 station from the field to the higher-level EtherCat 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 EtherCAT features supported by BL20

4.1 EtherCAT according to the Modular Device Profile

The EtherCAT gateway for BL20-ECO complies to the EtherCAT Modular Device Profile (MDP) according to EtherCat-standard ETG 5001.

The BL20-ECO gateway for EtherCAT supports CANopen over EtherCAT (CoE).

NOTE

File Access over EtherCAT (FoE), Servo Profile over EtherCAT (SoE) and Ethernet over EtherCAT (EoE) are not be supported, yet.

A Modular Device is a device with physically connectable modules and/or several functional modules. Therefore only one object dictionary exists in the gateway.

Each BL20-I/O-module has corresponding entries for inputs, outputs, configuration, information, RxPDOs and TxPDOs.

According to the MDP, two defined areas exist in the object dictionary:

- Communication Area
- Device Parameter Area

The object dictionary is dynamic and always depends on the modules, which are physically connected to the gateway. The object dictionary is created in the device's RAM on each power cycle.

There is only one object dictionary for the complete station.

4.1.1 EtherCAT State Machine

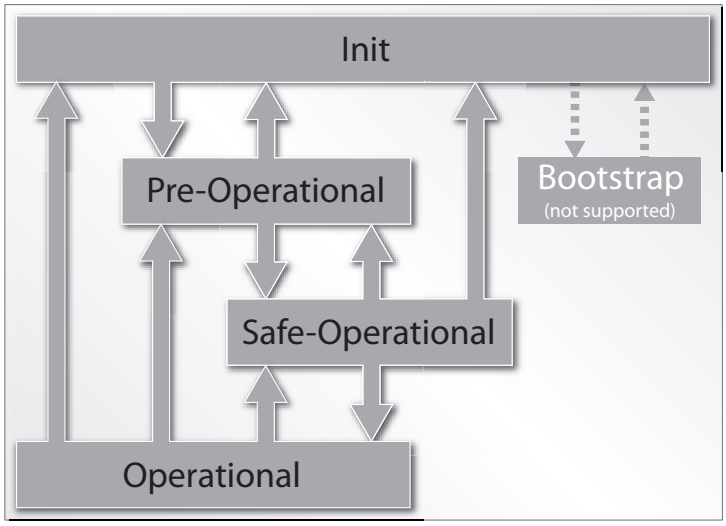

Fig. 1: EtherCAT-State Machine

Status	Meaning
Init	Device starts, no SDO and no PDO transfer
Pre-Operational	SDO transfer, no PDF transfer
Safe Operational	SDO and PDO transfer The input data are cyclically updated, all slave outputs switch to the safe state, for BL20 "0".
Operational	SDO and PDO transfer, in- and output data valid

4.1.2 SDO services

All SDO-services are integrated according to ETG 1000.5.

4.1.3 Communication area

All mandatory objects in the Communication Area are supported. Some of them are conditional and only appear in the object dictionary, if the modules connected to the gateway need them (e. g: RxPDO Mapping Objects only exist, if output modules are connected to the gateway).

Index	Use M = mandatory O = optional C = conditional	Description (Value)
0×1000	M	Device Type (0×00001389)
0×1001	O	Error Register, see s. p. 14
0×1008	M	Device Name (BL20-E-GW-EC)
0×1009	M	Hardware Version
0×100A	M	Software Version
0×1018	M	Identity (Device identification), see s. p. 14
0×10F3	O	Diagnosis History, see s. p. 14
0×1600 - 0×17FF	C	RxPDO Mapping, see s. p. 14 Mandatory if Outputs are connected (see below)
0×1A00 - 0×1BFF)	C	RxPDO Mapping, see s. p. 14 Mandatory if Inputs are connected (see below)
0×1C00	C	Sync Manager Communication Type, see s. p. 15
0×1C12	C	Sync Manager 2 PDO Assignment Mandatory if outputs are connected, see s. p. 15
0×1C13	C	Sync Manager 3 PDO Assignment Mandatory if inputs are connected, see s. p. 15
0×1C32	C	Sync Manager 2 Synchronization, see s. p. 15
0×1C33	C	Sync Manager 3 Synchronization, see s. p. 15

Error register (0×1001)

The Error Register is structured as follows:

Error Register	M = mandatory O = optional	Meaning
Bit 0	M	generic error message
Bit 1	O	Current error
Bit 2	O	voltage error
Bit 3	O	temperature error
Bit 4	O	communication error (overrun, error state)
Bit 5	O	device profile specific error
Bit 6	O	reserved
Bit 7	O	manufacturer specific error

Identity object (0×1018)

The Identity Object contains the Vendor ID (Turck 0×0000009C), the Product Code (6827380), the revision- and serial number. This mandatory object with its four sub-objects contains the values found in the Slave Information Interface (SII EEPROM). The object is read only.

Diagnosis hsitory object (0×10F3)

The Diagnosis History object up to 50 diagnostic messages from the gateway and the I/O modules can be stored.

Eventually additional explanations for the diagnostic messages of the gateway can be found under **Device Control Object (0×F200) (page 22)**. For the I/O modules they can be found in **chapter 5**, **I/O module diagnosis (page 37)**.

RxPDO and TxPDO mapping objects (0×1600 - 0×17FF and 0×1A00 - 0×1BFF)

- Access: RO

The PDO Mapping Objects are used to define the structure of the PDOs as described in ETG1000.6 (Application Layer protocol specification).

The PDO numbering depends on the module‘s slot-number in the BL20-station and is generated as follows:

Index = 0×1600 + (slot-number -1) for output modules

and

Index = 0×1A00 + (slot-number -1) for input modules.

Each object consist of one or several sub-objects.

Each sub-object represents a module channel and points to input- or output-objects, see **Input data object area (0×6xxx) (page 16)** and **Output data object area (0×7xxx0) (page 16)**.

Two special RxPDO and TxPDO mapping-objects for each module are created and named based on the module name and direction.

For Example: „Mapping RxPDO BL20-E-4AO-U/I“

The corresponding subjects are named based on the channel count.
For Example: "Output Mapping Area 2" for channel 2.

Sync Manager Communication Type (0×1C00)

This object describes the use of the Sync Manager channels.

Sync Manager Channel	Description
0	Mailbox Write (EtherCAT Master view)
1	Mailbox Read (EtherCAT-Master view)
2	Process output data (EtherCAT-Master view)
3	Process input data (EtherCAT-Master view)

Sync Manager PDO Assign (0×1C12 and 0×1C13)

The PDO Assign objects are used to describe which PDO shall be transmitted with the EtherCAT input and output data.

- Access: RO

The sub-objects of the Assign objects point to the RxPDO and TxPDO Mapping objects.

The mapping for both, for input and output data, is done as follows:

1. The PDOs of all analog and technology modules are mapped at first
2. followed by the PDOs of the digital modules.
3. To get a word boundary for the process data an additional gap PDO may be present after the digital modules. The gap PDO is not visible in the object dictionary.
4. After the process data PDOs, the gateway status PDO and gateway control PDO follow. These special PDOs represent the objects 0×F100 (status, see **Device Status Object (0×F100) (page 22)**) and 0×F200 (control, see**Device Control Object (0×F200) (page 22)**).

The structure of the process data image thus always depends on the modules connected to the gateway and is constant for that specific station configuration.

Example-Mapping

An example mapping can be found in **chapter 6, Adding a device specific *.xml-file (page 66)**.

Sync Manager Synchronization (0×1C32 and 0×1C33)

These objects contain the information about the synchronization behavior of the device as described in the ETG1020 (EtherCAT Protocol Enhancements). **Device Status Object (0×F100) (page 22)**

BL20 supports Free Run synchronization, which means, that the EtherCAT-slave is not running synchronously with EtherCAT. The slave does not work synchronously with the EtherCAT-cycle, but has it's own cycle.

- Access: RO

4.1.4 Module object area (0×6000 - 0×AFFF)

Object area	Index Range	Modular Device
Input data, see s. p. 16	0×6xxx	Conditional
Output data, see s. p. 16	0×7xxx	Conditional
Configuration data, see s. p. 16	0×8xxx	Optional
Information data, see s. p. 18	0×9xxx	Optional
Diagnostic data, see s. p. 18	0×Axxx	Optional

Input data object area (0×6xxx)

Each module has one input data object with several sub-objects depending on the channel count of the connected module.

The input data objects are mapped to TxPDOs which are read cyclically by the Master. There is one TxPDO per module defined.

The index of the input data object depends on the module's slot-number within the BL20-station: from:
Index = 0×6000 + (slot number-1) x 0×0010
module 1 = 0× 6000, module 2 = 0×6010, module 3 = 0×6020, etc.)

The input data area and the TxPDOs of a module only exist if input data of the module is available.

Output data object area (0×7xxx0)

Each module has one output data object with several sub-objects depending on the channel count of the connected module.

The output data objects are mapped in a RxPDO so that it is read cyclically. There is one RxPDO per module defined.

The index of the output data object depends on the module's slot-number within the BL20-station: from:
Index = 0×7000 + (slot number-1) x 0×0010
module 1 = 0× 7000, module 2 = 0×7010, module 3 = 0×7020, etc.)

The output data area and the RxPDOs of a module only exist if output data of the module is available.

Configuration data object area (0×8xxx)

Each module has one configuration data object with several sub-objects depending on the channel count of the connected module.

The index of the configuration data object depends on the module's slot-number within the BL20-station:
Index = 0×8000 + (slot number-1) x 0×0010
module 1 = 0× 8000, module 2 = 0×8010, module 3 = 0×8020, etc.)

Some sub-indices contain module-parameters.

The EtherCAT-Master can write them to the gateway or the modules during the state transition from PRE-OP to SAFE-OP (see **EtherCAT State Machine (page 12)**).

The module-parameters are defined in the EtherCAT device description file (ESI-file) (page 23).

Sub-index	Name	Data Type	Use M = mandat. O = optional C = conditional	Details
0×01	Module address	UNSIGNED 16	C	
0×02	Type string	VISIBLE STRING	O	not supported
0×03	Name string	VISIBLE STRING	O	Contains the name of the module
0×04	Device type	UNSIGNED 32	C/M	Mandatory for modules which support CoE or a vendor specific profile (BL20).
0×05	Vendor ID	UNSIGNED 32	C	not supported
0×06	Product code	UNSIGNED 32	C	Contains the product code. Mandatory if supported.
0×07	Revision number	UNSIGNED 32	C	Contains the revision no. Mandatory if supported.
0×08	Serial number	UNSIGNED 32	C	not supported
0×09	Module PDO group	UNSIGNED 16	C	Used for modular devices which have a different mapping order. Defines the mapping order. For BL20 the following modules groups are defined: 0 = gateway 1 = analog and technology modules 2 = digital modules
0×0A	Module ident	UNSIGNED 32		Used to identify each module in the device.
0×0B	Slot	UNSIGNED 16		Defines the position of the module within the device.
0×0C	Slot group	UNSIGNED 16		not supported
0×0D… 0×1D	reserved			
0×1E	Network segment address	OCTET-STRING[6]		not supported
0×1F	Network port	UNSIGNED 32		not supported
0×20…0×FF	Vendor /profile specific		O	Parameters of the modules. Depending on the modules connected to the gateway. If a module supports parameterization, then the parameters start at subindex 0×20 in object 0×8000.

Information data object area (0×9xxx)

Each module has one information data object.

The index of the information data object depends on the module's slot-number within the BL20-station:
from:
Index = 0×9000 + (slot number-1) x 0×0010
module 1 = 0× 9000, module 2 = 0×9010, module 3 = 0×9020, etc.)

This object has the same structure as Configuration Data objects and supports the same sub-indexes except for the ones for the parameters. (0×20 to 0×FF).

Diagnosis data object area (0×Axxx)

Each module in a BL20-station has one diagnosis data object.

The index of the diagnosis data object depends on the module's slot-number within the BL20-station:
from:
Index = 0×A000 + (slot number-1) x 0×0010
module 1 = 0×A000, module 2 = 0×A010, module 3 = 0×A020, etc.)

Each channel of a module has one sub-object in the diagnosis data area starting with sub-index 1.

Here, only the last diagnosis message of a channel can be read.

NOTE

Older diagnosis messages can be read from the Diagnosis History Object (see **Diagnosis hsitory object (0×10F3) (page 14)**).

This objects and the corresponding sub-objects only exists if the corresponding module supports diagnosis data.

4.1.5 Device Parameter Area

The device parameter area contains all parameters which belong to the EtherCAT device (gateway). The BL20 gateway supports the mandatory objects of the Modular Device Profile as well as the objects 0×F100 and 0×F200 which are mapped into the process data.

Index	Name
0×F000	**Modular Device Profile,** see s. p. 19.
0×F002	**Detected Module Command** Scan of the module bus for the actually connected modules after a possible module exchange, see s. p. 20.
0×F030	**Configured Module Ident List** List of the configured modules, see s. p. 21
0×F040	**Detected Address List** List of the slot-numbers of the I/O modules at the gateway. An empty slot is shown as "0" s. p. 21.
0×F050	**Detected Module Ident List** List of the detected modules, see s. p. 22
0×F100	**Device status** (T×PDO mappable), see s. p. 22
0×F200	**Device status** (T×PDO mappable), see s. p. 22
0×2000	**Module List Handling Object**, see s. p. 23

Modular Device Profile (0×F000)

The modular device profile object contains all information to interpret the objects of the object area of the modules.

- Access: RO
- not PDO-mappable

Sub-index	Name	Data Type	Use M = mandat. O = optional C = conditional	Details
0	Number of entries	UNSIGNED8	M	BL20 = 5
	Padding	UNSIGNED8		
1	Index distance	UNSIGNED16	M	Maximum number of objects per module BL20 = 10
2	Maximum number of modules	UNSIGNED16	M	BL20 = 72 modules

Sub-index	Name	Data Type	Use M = mandat. O = optional C = conditional	Details
3	General configuration	UNSIGNED32	C	Available sub-indices in General configuration objects 0×8xx0, see also **Configuration data object area (0×8xxx) (page 16)**) Bit 0 = 1 0×8xx0:sub-index 1 Bit 1 = 1 0×8xx0:sub-index 2 etc.
4	General information	UNSIGNED32	C	Available sub-indices in General information objects 0×9xx0, see also **Information data object area (0×9xxx) (page 18)**) Bit 0 = 1 0×9xx0:sub-index 1 Bit 1 = 1 0×9xx0:sub-index 2 etc.
5	Module PDO group of device	UNSIGNED16	C	BL20 = 0

Detected Module Command (0×F002)

This object allows a directed scanning of the module bus in case of a necessary module exchange.

The object has 3 sub-indices:

Sub-index	Meaning
0×F002:01	Command
0×F002:02	Status
0×F002:03	Response

Executing a Detected Module Command

1. Writing any value to sub-index 0×F002:01 activates the scan of the module bus.
2. The scan was successful, if sub-index 0×F502:03 (Response) contains "0" after the scan.
3. If new or missing modules are detected, the list of module IDs **Detected Module Ident List (0×F050)**as well as the list of slot-numbers **Detected Address List (0×F040)** are updated.
4. All other objects remain static and are only updated following a power-reset.

Configured Module Ident List (0×F030)

Contains the module ident numbers of the modules configured in the master for the BL20-station.

The EtherCAT Master downloads the module ident list to the BL20-gateway and the gateway compares this list to the expected module configuration.

In case of a difference between this list and the list in object 0×F050, see **Detected Module Ident List (0×F050) (page 22)**, the write request on the specific sub-object will be denied with SDO Abort Code 0×08000020.

Sub-index	Data Type	Description
1	UNSIGNED32	Module ident number of the module configured at slot 1 after the gateway.
2	UNSIGNED32	Module ident number of the module configured at slot 2 after the gateway.
…		…
72	UNSIGNED32	Module ident number of the module configured at slot 72 after the gateway.

Detected Address List (0×F040)

This object contains a list of slot-numbers (addresses) of the modules actually connected to the gateway during a gateway-restart or if a **Detected Module Command (0×F002)** has been executed.

An empty slot is shown as "0".

Sub-index	Data Type	Description
1	UNSIGNED16	Address (slot-no.) number of the module detected at slot 1 after the gateway.
2	UNSIGNED16	Address (slot-no.) number of the module detected at slot 2 after the gateway.
…		…
72	UNSIGNED16	Address (slot-no.) number of the module detected at slot 72 after the gateway.

Detected Module Ident List (0×F050)

Contains the module ident numbers of the modules physically present in the BL20-station.

Sub-index	Data Type	Description
1	UNSIGNED32	Module ident number of the module detected at slot 1 after the gateway.
2	UNSIGNED32	Module ident number of the module detected at slot 2 after the gateway.
…		…
72	UNSIGNED32	Module ident number of the module detected at slot 72 after the gateway.

Device Status Object (0×F100)

This object contains the gateway status word. It is mapped in a TxPDO and can thus be read cyclically by the EtherCAT Master.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Under voltage U_L		-	I/O configuration changed	-	Module bus error	Diagnosis message available	Summarized module diagnosis
1	Module bus failure	Force mode active		Master configuration error	-	-	Under voltage U_{sys}	Over voltage U_{sys}

Further information can be found in section **Device Status Object (0×F100) (page 22)**.

Device Control Object (0×F200)

Not supported, yet. Reserved for future use.

Module List Handling Object (0×2000)

This object serves for manual synchronization of the two module lists in the gateway (**Configured Module Ident List (0×F030)** and **Detected Module Ident List (0×F050)**).

- **Sub-index 01:**
  Writing any value to this sub-index activates the copying of the**Detected Module Ident List (0×F050)** into the **Configured Module Ident List (0×F030)**.
- **Sub-index 02:**
  Writing any value to this sub-index activates the deleting of the **Configured Module Ident List (0×F030)**.

NOTE

Please observe, that a power-reset has to be executed after writing to the Module Handling object.

Changes will *not* be accepted without a power-reset.

4.2 EtherCAT device description file (ESI-file)

EtherCAT uses an *.xml-file, the EtherCAT Slave Information (ESI) to represent a device. This file can be imported to the EtherCAT PLC program.

5 Technical features

5.1 Function

BL20-gateways for EtherCAT are used to connect BL20 IO modules to an EtherCAT-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.

5.2 Technical data

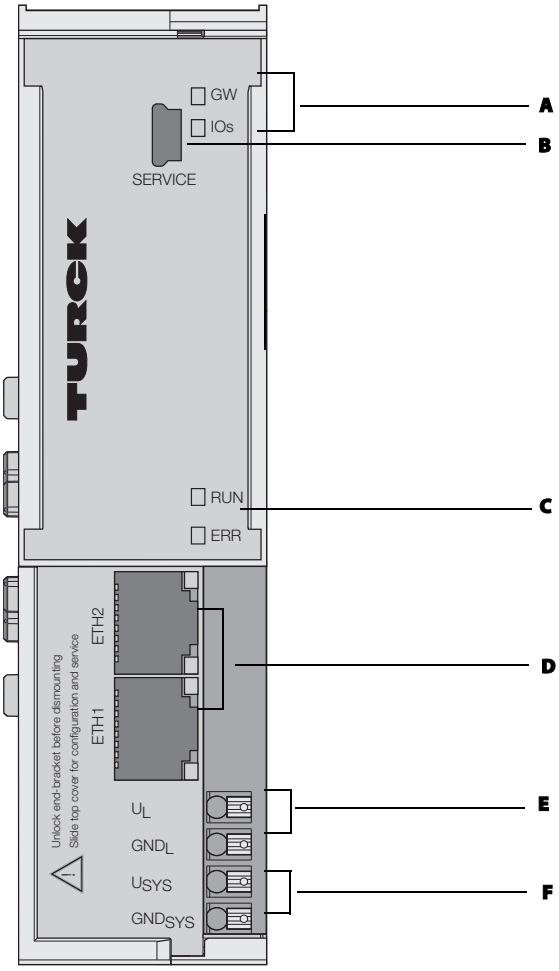

Fig. 2: Front view

A LEDs for BL20 module bus
B service interface
C 2 LEDs for the EtherCAT communication
D EtherNet-switch with EtherNet-LEDs
E terminals for field supply
F terminals for system supply

5.2.1 Block diagram

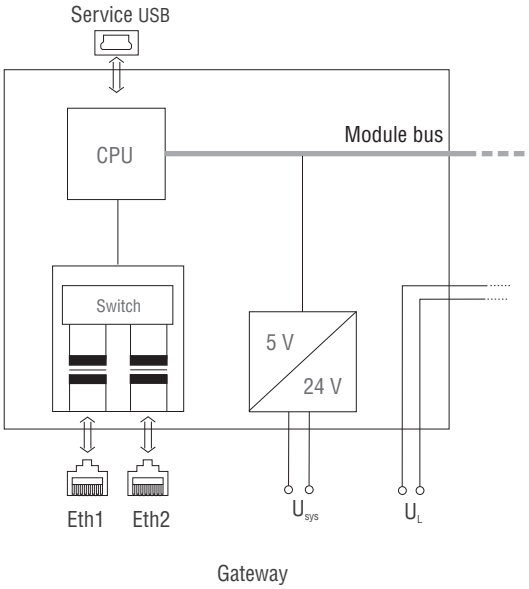

Fig. 3: Block diagram BL20-E-GW-EC

5.2.2 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 VDC
I_{sys} (on maximum system extension)	Approx. 0.5 A
U_L nominal value	24 VDC
I_{Lmax} (maximum field supply current)	8 A
Permissible range	According to EN 61131-2 (18 to 30 V DC)
Residual ripple	According to EN 61 131-2
Isolation voltage (U_L to U_{SYS})	500 V_{eff}
Voltage anomalies	According to EN 61 131-2
I_{MB} (supply of module bus nodes)	700 mA
Connection technology	Push-in tension clamp terminals, LSF from Weidmueller

Technical data	
Physical interfaces	
Field bus	Ethernet
Transmission rate	100 Mbps
Passive fiber-optic-adapters can be connected	Current consumption max. 100 mA
Fieldbus connection technology	2 × RJ45 female connector
Fieldbus shielding connection	Via Ethernet cable
Service interface	Mini USB
Address setting	Not necessary for EtherCAT, address switches without function
Isolation voltages	
U_{BL} (U_{sys} against service interface)	-
U_{ETH} (supply voltage against Ethernet)	500 V AC
U_{USB} (supply voltage against U_{SB})	-
U_{ETHETH} (ETH1 against ETH2)	500 V AC
Ambient conditions	
Ambient temperature	
$t_{Ambient}$	0 … +55 °C For vertical installation, the gateway can be positioned both at the top and bottom. Sufficient ventilation and heat dissipation must be ensured.
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, 1 g	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 according to IEC 68-2-29	1 000 shocks, half-sinus 25 g peak value/6 ms, in each case in ± direction per space coordinate

Technical data	
Drop and topple	
Height of fall (weight < 10 kg)	1.0 m
Height of fall (weight 10…40 kg)	0.5 m
Test runs	7
Device with packaging, electrically tested printed-circuit board.	
Electromagnetic compatibility (EMC) according to EN 50 082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
Discharge through air (direct)	8 kV
Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61 000-4-6	10 V
Fast transients (Burst) according to EN 61 000-4-4	
Emitted interference according to EN 50 081-2 (industry)	according to EN 55 011 Class A, Group 1

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 to IEC 529/EN 60529	IP20 (not evaluated by UL)
MTTF	224 years according to SN 29500 (Ed. 99) 20 °C

5.2.3 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 inch
Max. wire range	0.14…1.5 mm^2/0.0002…0.0023 $inch^2$/ 26…16 AWG
Crimpable wire	
"e" solid core H 07V-U	0.14…1.5 mm^2/0.0002…0.0023 $inch^2$/ 26…16 AWG
"f" flexible core H 07V-K	0,5…1,5 mm^2/0.0008…0.0023 $inch^2$/ 25…16 AWG
"f" with ferrules according to DIN 46 228/1 (ferrules crimped gas-tight)	0.25…1.5 mm^2/0.0004…0.0023 $inch^2$/ 30…16 AWG

5.3 Connection options at the gateway

The fieldbus connection is realized via two RJ45 sockets, the connection of the power supply via push-in tension clamps.

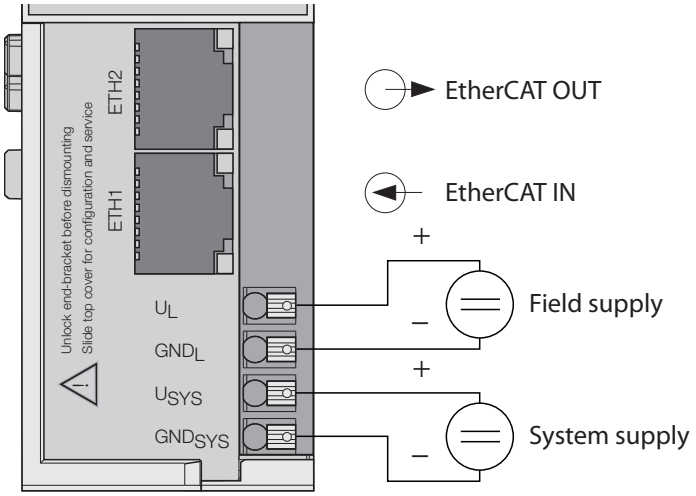

Fig. 4: Connection options at the gateway

NOTE

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

5.3.1 Power supply

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

- field supply (U_L, GND_L)

and

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

NOTE

The gateway only changes to data exchange if both voltages are connected.

5.3.2 Field bus connection via RJ45 sockets

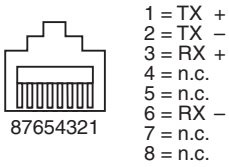

Fig. 5: RJ45 female connector

Pin-no.	Signal		Color	
1	TX+	Transmit data +	YE	yellow
2	TX–	Transmit data -	OG	orange
3	RX+	Receive data +	WH	white
4	not connected		-	-
5	not connected		-	-
6	RX–	Receive data –	BU	blue
7	not connected		-	-
8	not connected		-	-

Ethernet Port properties:

- Data rate: 100 Mbps

Ethernet LED-states

See LEDs LNK- and ACT in section **Diagnostic messages via LEDs (page 34)**.

5.3.3 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.

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.

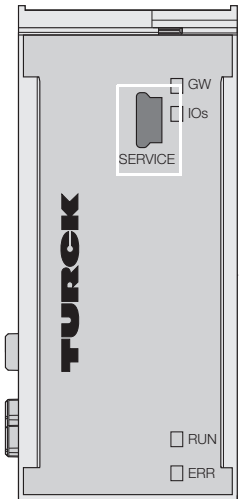

Fig. 6: Mini-USB female connector at the gateway

5.4 Address assignment

EtherCAT provides automatic addressing of the network nodes by the EtherCAT-master.

Hardware address assignment at the BL20-gateway is not necessary.

5.5 ESI-file

The actual ESI-file (ESI = EtherCAT Slave Information) for gateway BL20-E-GW-EC (BL20-E-GW-EC.xml) can be downloaded from our homepage **www.turck.de.**

Concerning the usage of the *.xml-file in TwinCAT, please read **Adding a device specific *.xml-file (page 66)**.

5.6 Synchronization of the station configuration

In EtherCAT, saving the current configuration (**Configured Module Ident List (0×F030)**) of the BL20-station as actual configuration (**Detected Module Ident List (0×F050)**) to the non-volatile memory of the gateway is done either via object access in the software (see **Module List Handling Object (0×2000) (page 23)**) or via the DIP-switch no. 1 at the gateway.

5.6.1 Synchronization via software using object access

See **Module List Handling Object (0×2000) (page 23)**.

5.6.2 Synchronization via hardware using the CFG-switch

The DIP-switches are located under the gateway's upper label.

For setting the DIP-switch pull out the label.

Front view with label:

q

Fig. 7: Gateway-front view

A DIP-switch (CFG, no. 1) for storing the station configuration

Switching to ON starts the storage of the Current Configuration as the Required Configuration (Reference configuration).

Procedure:

➤ Switch the DIP-switch no. 1 to ON

➥ The storage process is started.

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

➥ The storage is process active.

➤ Set back the DIP-switch.

➥ 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 will terminate this process.

5.7 Status indicators/diagnostic messages gateway

Diagnostics messages are indicated in two different ways:

- via the LEDs
- via the software of the respective field bus master (for example PLC)

5.7.1 Diagnostic messages via LEDs

Every BL20 gateway displays the following statuses via LEDs:

- 2 LEDs for the module bus communication (module bus-LEDs): GW and IOs
- 2 LEDs for the EtherCAT communication (field bus-LEDs): RUN and ERR
- 4 LEDs for the EtherNet-Link: LNK and ACT (at both female connectors of the EtherNet-switch).

LED displays

LED	Status	Meaning	Remedy
GW	OFF	No power supply of the CPU.	Check the system power supply at the gateway.
	green	Firmware active, gateway ready	-
	green flashing, 1 Hz	Firmware not active	If LED "**IOs**" red, then firmware-download necessary
	green flashing, 4 Hz	Firmware active. gateway-hardware-failure	Replace the gateway.
	red	hardware-failure, no communi-cation possible	Replace the gateway.
	red/green flashing, 4 Hz	WINK	WINK-Command active (serves for the identification of the device)
IOs	OFF	No power supply of the CPU.	Check the system power supply at the gateway.
	green	Module bus is running if LED MS green	Configured modules match plugged modules
	green flashing, 1 Hz	Station is in the Force Mode of I/O-ASSISTANT.	Deactivate the Force Mode of the I/O-ASSISTANT
	red	Hardware error	Replace the gateway.
	red flashing, 1 Hz	The actual and the configured module list do not match, no communication	Check the physical station for pulled or new but not planned 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.
IOs	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.

LED	Status	Meaning	Remedy
RUN	OFF	The device is in state INITIALIZATION	see **EtherCAT State Machine (page 12)**
	green, flashing 200 ms on/ 200 ms off (blinking)	The device is in state PRE-OPERATIONAL	
	green, flashing 200 ms on/1000 ms off (single flash)	The device is in state SAFE-OPERATIONAL	
	green	The device is in state OPERATIONAL	
ERR	OFF	Process data exchange	
	red	Critical communication error or controller error occurred	Execute a power-rest, eventually the device has to be changed.
	red, flashing: 200 ms on/ 200 ms off (blinking)	Invalid configuration	Check if the hardware configuration of your device matches the configured
	red, flashing: 200 ms on/ 1000 ms off (single flash)	local error The device switches to the SAFE-OPERATIONAL state due to an internal error (see **EtherCAT State Machine (page 12)**).	
LNK/ ACT (left LED)	green	Link established,100 Mbps	
	green, flashing	Data exchange (Ethernet-Traffic 100 Mbps)	
	OFF	no link	Check the Ethernet-connection.

5.7.2 Device Status Object

The gateway sends a gateway Status Word.

This can be tread from the Device Status object, object 0×F100.

It is mapped in a TxPDO and can thus be read cyclically by the EtherCAT Master.

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	Under voltage U_L	-	-	-	I/O configuration changed	Module bus error	Diagnosis message available	Summarized module diagnosis
1	Module bus failure	Force mode active	-	-	Master configuration error	-	Under voltage U_{sys}	Over voltage U_{sys}

Diagnostic message	Meaning
Summarized module diagnosis	Diagnosis message available At least one module has a diagnostic message.
Diagnosis message available	New diagnosis message available. The Diagnosis History Object contains a new message.
Module bus error	module bus error No modules connected or the communication to the modules is disturbed.
I/O configuration changed	Station configuration changed The **Configured Module Ident List (0×F030) (page 21)** differs from the **Detected Module Ident List (0×F050) (page 22)** in the gateway. Process data can still be exchanged with the module bus stations which are at present connected to the module bus.
Undervoltage U_L	Undervoltage at U_L The field supply is not within the permissible range.
Undervoltage U_{sys}	Undervoltage U_{sys} The system supply is not within the permissible range.
Overvoltage U_{sys}	Undervoltage U_{sys} The system supply is not within the permissible range.
Master configuration error	Master configuration error The **Configured Module Ident List (0×F030) (page 21)** differs in such a manner from the **Detected Module Ident List (0×F050) (page 22)**, that no process data can be exchanged with the module bus stations which are at present connected to the module bus. The gateway changes to the PRE-OPERATIONAL state (see also **EtherCAT State Machine (page 12)**.
Force mode active	I/O-ASSISTANT Force Mode active The force mode has been activated via the service interface (by I/O-ASSISTANT). This separates the fieldbus master from the outputs of the module bus stations. No process data exchange is taking place from the fieldbus master to the output modules. Parameterization of the modules through the master is not possible as well.
Module bus failure	module bus breakdown The module bus is not running or can not be started.

5.7.3 Emergency telegrams

Structure of the Emergency frames

In the event of a communication error, not only the Emergency Error Code but also the Error register (see also **Error register (0×1001) (page 14)**) and additional information will be transmitted, so that the error can be more precisely identified.

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Data content	Error Code		Error-Register	slot-no.		channel-no. **or** Gateway Status information		reserved

Data content	Value	Meaning	
Error Code	0×0000	Error-reset/no error	
	0×FF00	Device specific error	
Error Register	0×00	no error	
	0×81	manufacturer specific error/generic error (see also Error register (0×1001) (page 14))	
slot-no.	0×0000	Gateway sends an Emergency-frame	
	0×0100 to 0×0148	slot-no. of the module which sends an emergency-frame.	
channel-no.	0×0000 to 0×0020	Number of the channel at which a diagnosis is present.	
Gateway status-information	0×0100	Summarized module diagnosis	Content from Device Status Object (page 35)
	0×0101	Diagnosis message available	
	0×0102	Module bus error	
	0×0103	I/O configuration changed	
	0×0107	Undervoltage U_L	
	0×0108	Overvoltage U_{sys}	
	0×0109	Undervoltage U_{sys}	
	0×010B	Master configuration error	
	0×010E	Force mode active	
	0×010F	Module bus failure	
	0×0110	no valid I/O configuration stored	
	0×0111	missing U_L inhibits I/O configuration storage	
	0×0112	undervoltage U_{sys} inhibits I/O configuration storage	

5.7.4 I/O module diagnosis

- BL20-BR-24VDC-D

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

- BL20-PF-24VDC

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

- BL20-PF-120/230VAC-D

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

- BL20-4DI-NAMUR

Diagnostic byte	Bit	Diagnostic
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

- BL20-1AI-I(0/4…20MA)

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

- BL20-2AI-I(0/4…20MA)

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

- BL20-1AI-U(-10/0…+10VDC)

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

- BL20-2AI-U(-10/0…+10VDC)

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

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

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

- BL20-2AI-THERMO-PI

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

- BL20-4AI-U/I

Diagnosis Byte	Bit	Diagnostic	
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
	1	open circuit	threshold: 3 mA (only in value range 4…20 mA)
	2 to 7	reserved	

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

Diagnosis Byte	Bit	Diagnostic	
n	0	Measurement value range error (Out of Range, OoR)	Thresholds, see IO-manual D300717
	1	Wire Break (WB)	In 3-wire measurement with PT100- sensor and at temperatures of below -177°C, the module can not distinguish between short-circuit and wire break. In this case a "short-circuit"- diagnostic is generated.
	2	Short circuit (SC)	
	3	Overflow/Underflow (OUFL)	
	4-6	reserved	
	7	hardware failure	

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

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

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

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

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

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

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

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

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

Diagnosis Byte	Bit	Diagnostic
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

Diagnosis Byte	Bit	Diagnostic
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)

- BL20-E-4AO-U/I

Diagnosis Byte	Bit	Diagnostic	
n	0	Measurement value range error (Out of Range, OoR)	Thresholds, see IO-manual D300717
	1 + 2	reserved	
	3	Overflow/Underflow, OUFL (Overflow/Underflow, OUFL)	
	4-6	reserved	
	7	hardware failure	

- BL20-1RS232

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

- BL20-1RS485/422

Diagnosis Byte	Bit	Diagnostic
n	0	parameterization error
	1	hardware failure
	3	data flow control error (only in RS422-mode)
	4	frame error
	5	buffer overflow

- BL20-1SSI

Diagnosis Byte	Bit	Diagnostic
n	0	SSI group diagnostics
	1	open circuit
	2	sensor value overflow
	3	sensor value underflow
	4	parameterization error

5.8 Parameters of the modules

Default values ore shown in **bold**.

5.8.1 Digital input modules

- BL20-4DI-NAMUR

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

5.8.2 Analog input modules

- BL20-1AI-I(0/4…20MA)

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

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

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

- BL20-1AI-U(-10/0…+10VDC)

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

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

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

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

Byte	Bit	Parameter name	Value
0/2	0	Mains suppression	**0 = 50 Hz**
			0 = 60 Hz
	1	value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnostic	**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
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	Diagnostic	**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
0 to 3	0	range	**0 = 0…10 V/0…20 mA**
			1 = -10…+10 V/4…20 mA
	1	value representation	**0 = Integer (15 bit + sign)**
			1 = 12 bit (left-justified)
	2	Diagnostic	**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
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
5	HART-Variable B		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
6	HART-variable C		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)
7	HART-variable D		Defines the channel of which the HART-variable is read.
	0	channel mapping	0 = channel 1
			1 = channel 2
	6 + 7	variable mapping	Defines which HART-variable of the connected sensor is mapped into the module's process data.
			0= PV (primary variable)
			1= SV (2nd variable)
			2 = TV (3rd variable)
			3 = QV (4th variable)

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

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

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

5.8.3 Analog output modules

- BL20-1AO-I(0/4…20MA)

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

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

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

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

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

- BL20-2AOH-I

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

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

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

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

Byte	Bit	Parameter name	Value	Meaning
			1110	reserved
			1111	deactivated
	4	value representation Kx	0	**0 = Integer (15 bit + sign)**
			1	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		
2/5/8/11		substitute value Ax high byte		

5.8.4 Technology modules

- BL20-1RS232

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

Byte	Bit	Parameter name	Value
0	7	Diagnostic	**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 even.
	3	Data bits	**0 = 7** – The number of data bits is 7.
			1 = 8 – The number of data bits is 8.
1	4 to 5	Flow control	00 = none A – 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 stop the transmission of data from the data terminal device if the software handshake is active.

- BL20-1RS485/422

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

Byte	Bit	Parameter name	Value
3		XOFF character	0 – 255 (**19**) only in the RS422-mode: XOFF character: This character is used to stop the transmission of data from the data terminal device if the software handshake is active.

- BL20-1SSI

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

Byte	Bit	Parameter name	Value – Meaning
2	3 to 0	Data rate	0000 = 1000000 bps **0001 = 500000 bps** 0010 = 250000 bps 0011 = 125000 bps 0100 = 100000 bps 0101 = 83000 bps 0110 = 71000 bps 0111 = 62500 bps … reserved
	7 to 4	reserved	
3	5 to 0	Number of data frame bits	00000 to 100000 Number of bits of the SSI data frame. SSI_-FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19hex
	6	reserved	
	7	Data type	**binary coded** SSI encoder sends data in binary code
			GRAY coded SSI encoder sends data in GRAY code

- BL20-E-1SWIRE

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

The following table shows the meaning of the parameter bits:

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

Parameter name	Value	
Byte 1		
MNA active/passive	Configuration check Bus or slave-oriented configuration check (without function if MC = 1)	
	0 = Bus based	If the PLC configuration check is activated, data exchange is only started if the configuration stored in the BL20-E-1SWIRE fully matches the SET configuration stored in the PLC. Modifying the bus during operation causes the system to be aborted.
	1 = Slave based	If the PLC configuration check is activated, data exchange is started with all SWIRE slaves that match the SET configuration stored in the PLC. The SWIRE slaves that do not match the SET configuration stored in the PLC do not perform any data exchange.
MC	Moeller conformance (from version VN 01-04) Behavior of the BL20-E-1SWIRE in accordance with SWIRE Conformance criteria.	
	0 = inactive	Default behavior
	1 =active	The BL20-E-1SWIRE master responds according to the Moeller SWIRE Conformance criteria (see manual for the IO-modules D300717).
SDINFO	Slave error field Activate slave diagnostics info field SDERRSx. 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 = inactive	Single diagnostics is activated
	1 =active	Single diagnostics is not activated
Byte 2		
SDERR	Group error - slave error Activate slave diagnostics SDERRSx. 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
PKZINFO	PKZ error field Activate slave diagnostics info field PKZERRSx. 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		
PKZERR	Group PKZ error field Activate slave diagnostics PKZERR. 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	
TYPINFO	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
TYPERR	Group configuration error field Activate slave diagnostics TYPERRSx. 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		
UAUXERR	Error message Voltage UAUX Activate system diagnostics UAUXERR. UAUXERR 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 UAUXERR activated
	1 = inactive	Error message UAUXERR not activated
Byte 3	reserved	
Byte 4		
reserved (Lifeguarding time only up to version VN01-03)	Was up to version VN 01-03: Lifeguarding time of the SWIRE slaves. Lifeguarding time of the SWIRE slaves	
	0x02-0xFF **0x64**	Lifeguarding time of the SWIRE slaves Setting of lifeguarding time of SWIRE slaves, timeout time up to automatic reset of the slaves in the event of communication failure. (n * 10ms) (Default 1s) 0xFF: 0xFF: Lifeguarding off
Byte 5 - 6		
SDDIAGSx	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	SDDIAGSx
	1 = inactive	SDDIAGSx is not accepted
Byte 7 - 8	reserved	
Byte 9 to 24		
Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus	
	0x20	SWIRE-DIL-MTB (: 0xFF)
	0xFF	Basic setting (no slave)

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

6 Connection of the EtherCAT-gateway to the TwinCAT Soft-PLC

6.1 Application example

In order to configure the connection of a BL20-gateway for EtherCAT to an EtherCAT network, the software TwinCAT from Beckhoff Automation is used.

The hardware is configured in the TwinCAT System Manager, programming is done by means of the tool TwinCAT PLC Control.

The integrated Soft-PLC (runtime system) is used as PLC

Used software

- TwinCAT, V2.11
  - TwinCAT System Manager
  - TwinCAT PLC Control

Used hardware

- Bl20-station for EtherCAT
  - BL20-E-GW-EC, FW-version 1.0.0.0
  - I/O-modules
  - Example station

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

6.1.1 Adding a device specific *.xml-file

In order to enable an xml-based configuration of the devices, the device-specific *.xml-file (for the BL20-gateway "BL20-E-GW-EC.xml") has to be copied to the installation directory of TwinCAT.

Path:

x:\TwinCAT\Io\EtherCAT

6.1.2 Hardware configuration in the TwinCAT System Manager

1 Open the "TwinCAT System Manager“ and create a new project.

2 Add an EtherCAT-interface to the I/O configuration.

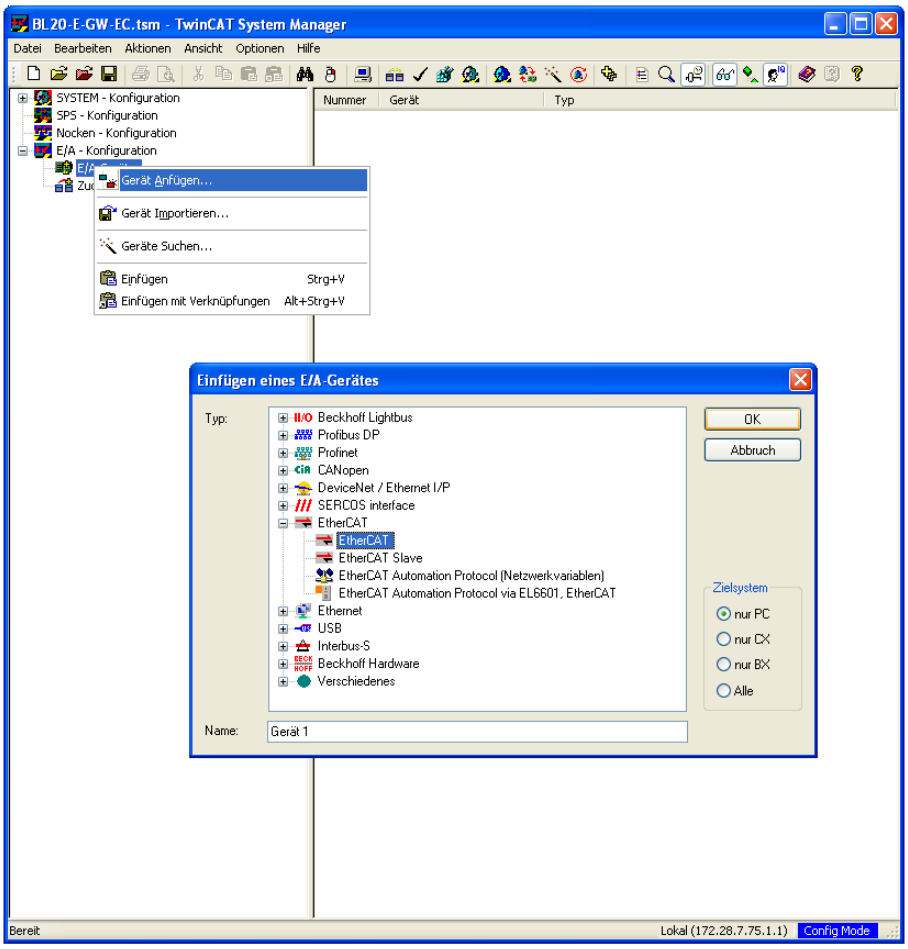

Fig. 8: Adding an EtherCAT-interface

3 In order to establish communication between your PC and the EtherCAT-network, an EtherCAT-driver for the network card is needed.

4 If the driver is already installed, the following dialog pops up after having added the EtherCAT-interface.

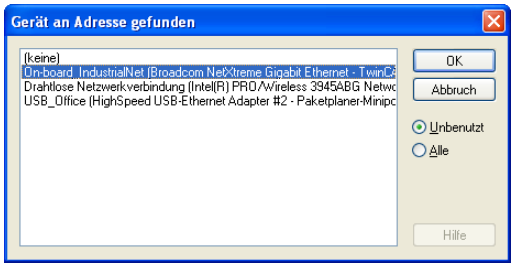

Fig. 9: Selecting the network interface card

5 Select the network interface card to be used.

NOTE

If the driver has not been installed, yet, close the dialog box and first of all install the Beckhoff EtherCAT-driver for the network interface card to be used.
To do so, please follow the instructions under **Install EtherCAT-driver (page 83)**.

6 Now, scan the network for EtherCAT-nodes.

7 Confirm the dialog box for reloading the devices with "OK".

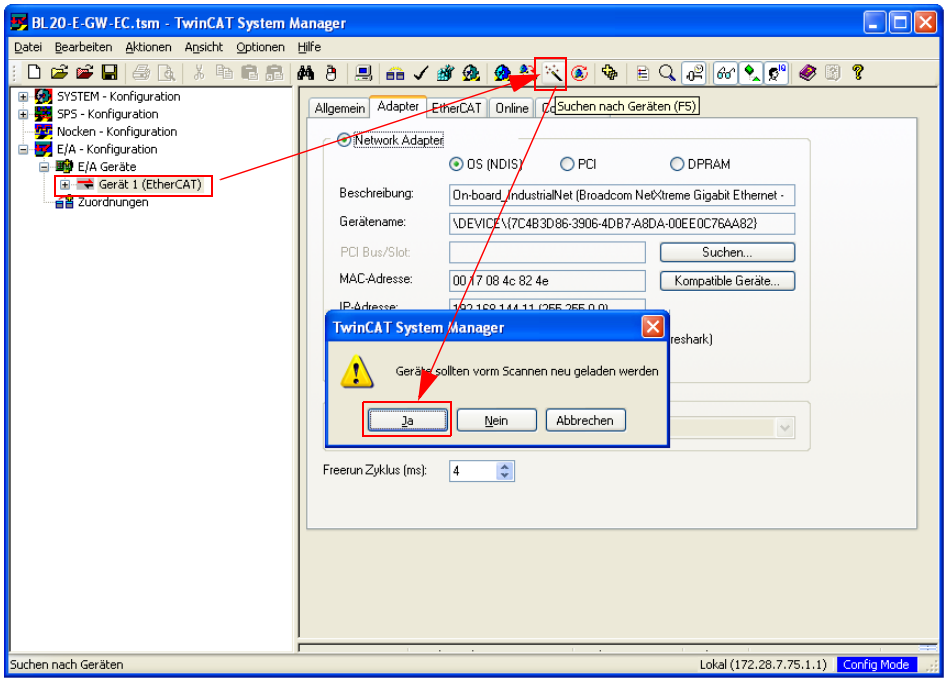

Fig. 10: Scanning the EtherCAT-network

8 The EtherCAT-nodes are now read in and added automatically to the I/O-Configuration.

9 If the *.xml-file has been installed as described in **Adding a device specific *.xml-file (page 66)**, the BL20-station is read in as follows.

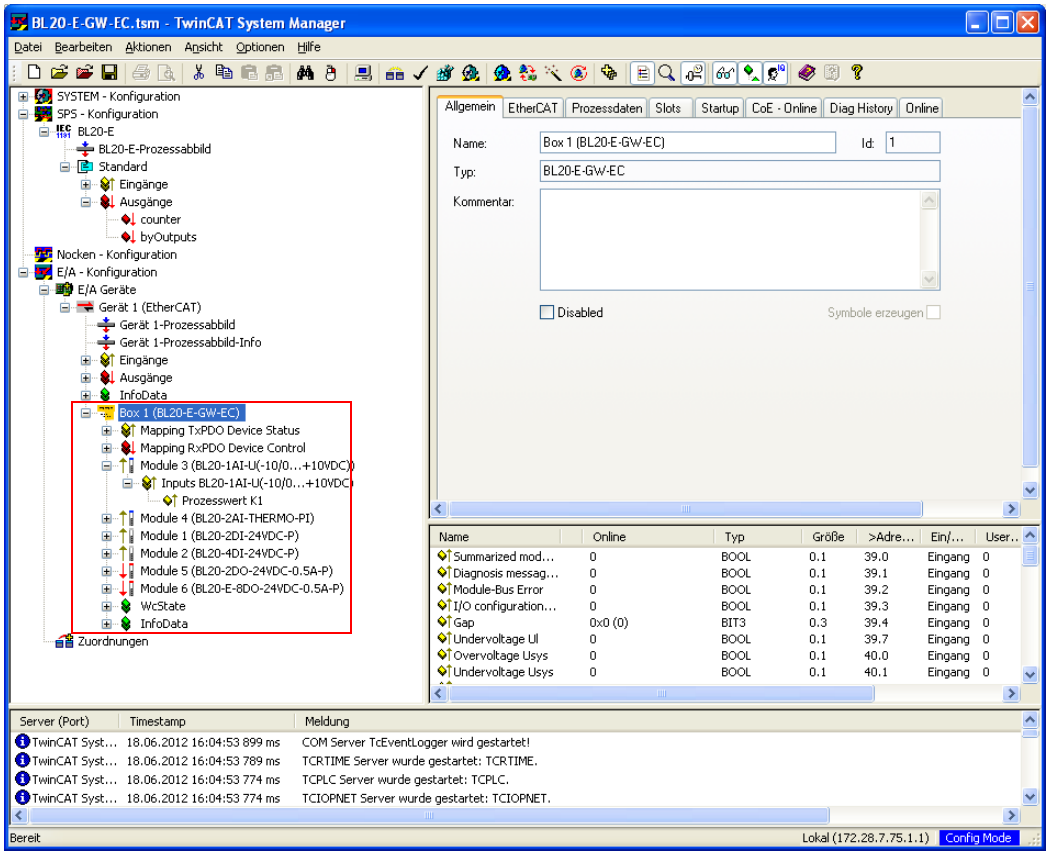

Fig. 11: BL20-station with *.xml-file

10 If the device-specific *.xml-file is installed, TwinCAT reads the stations information from the gateway.
Information about the modules' position in the station are not shown.

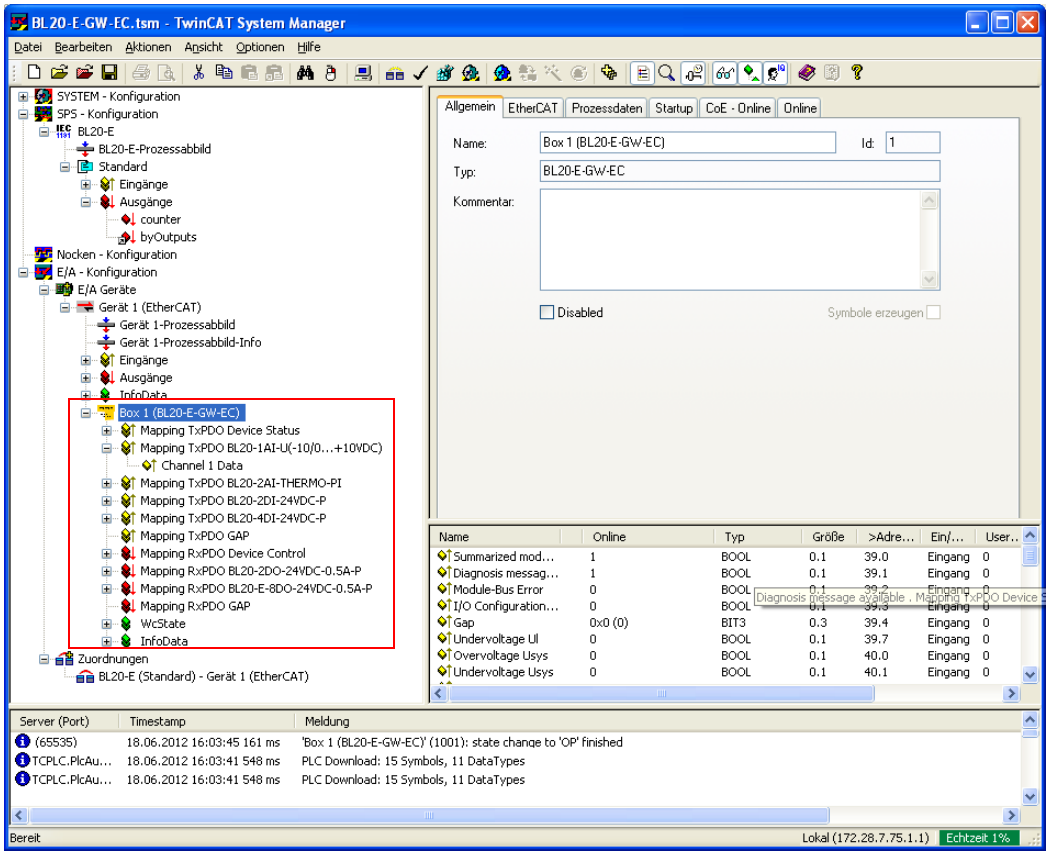

Fig. 12: BL20-station without *.xml-file

11 In both cases, TwinCAT arranges the I/O-modules automatically as follows (see also **Sync Manager PDO Assign (0×1C12 and 0×1C13) (page 15)**):

- analog input modules
- analog output Modules
- technology modules
- digital input modules
- digital output modules

6.1.3 Parameterization of BL20 I/O-modules

The parameterization of the I/O-modules in the BL20-station is done in the register-tab "CoE-Online" of the BL20-gateway.

1 In the module-specific parameter-object, open the parameter entry via double-click and set the parameter to the desired value.

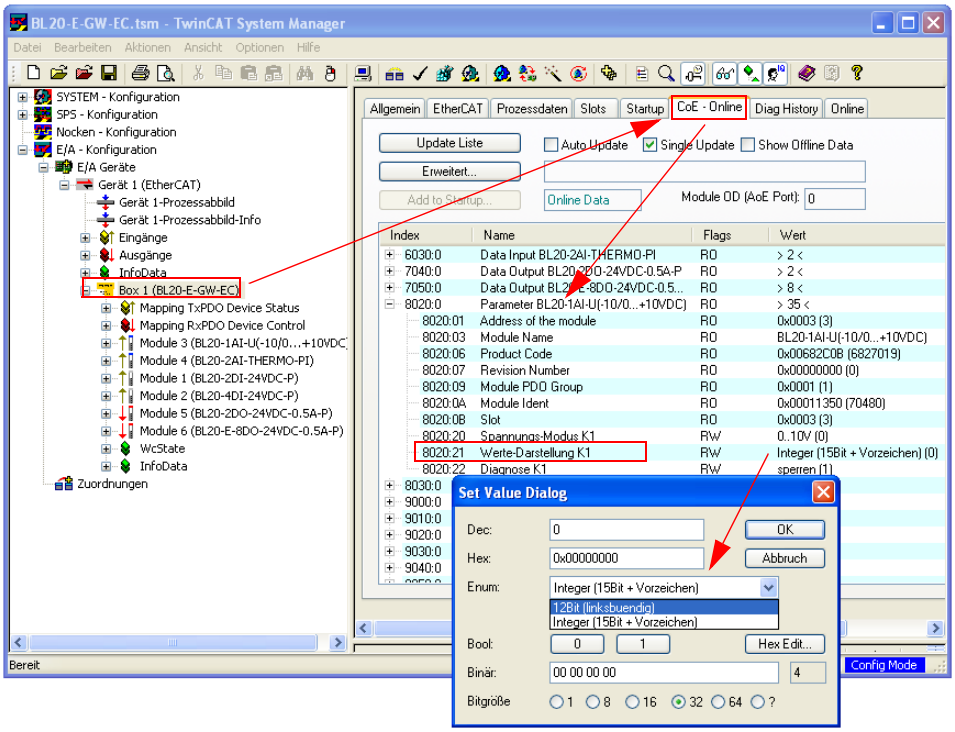

Fig. 13: Parameterization of a BL20-module

6.1.4 Programming the Soft-PLC

1 Create a new project in "TwinCAT PLC Control“.

2 If the TwinCAT-PLC is used, the TwinCAT-integrated runtime system installed on the PC has to be used as target platform.

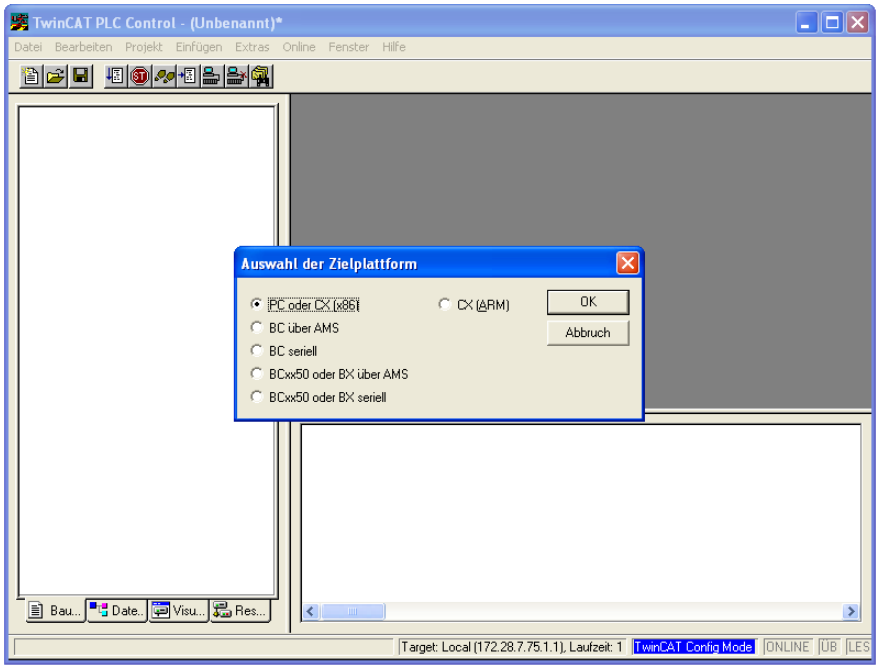

Fig. 14: Select runtime system

3 Programming the Soft-PLC is done in the register-tab "POUs".

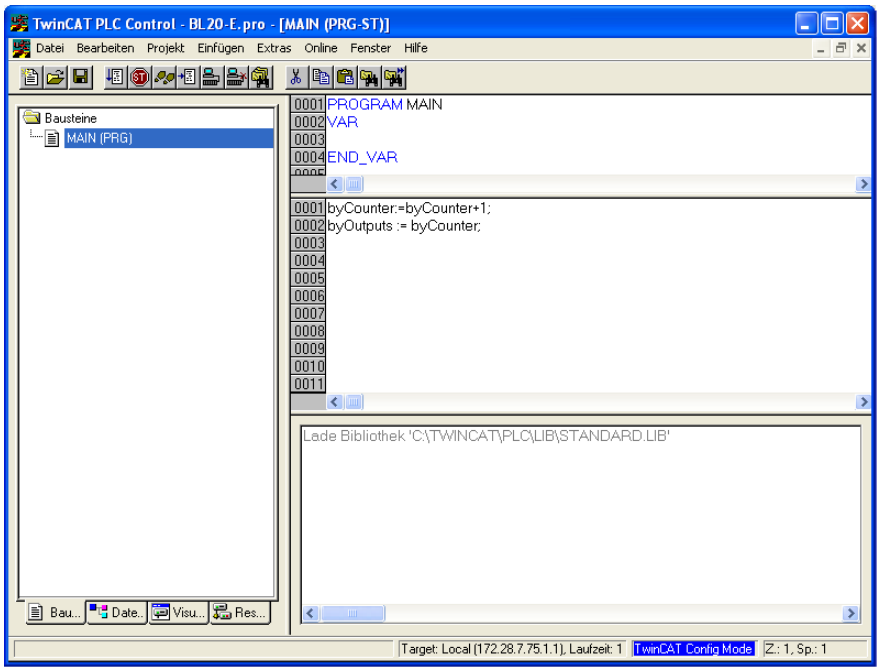

Fig. 15: Program in TwinCAT-PLC Control

4 Program variables which are to be mapped to the hardware-configuration in the "TwinCAT System Manager“ have to be defined as "global variables".

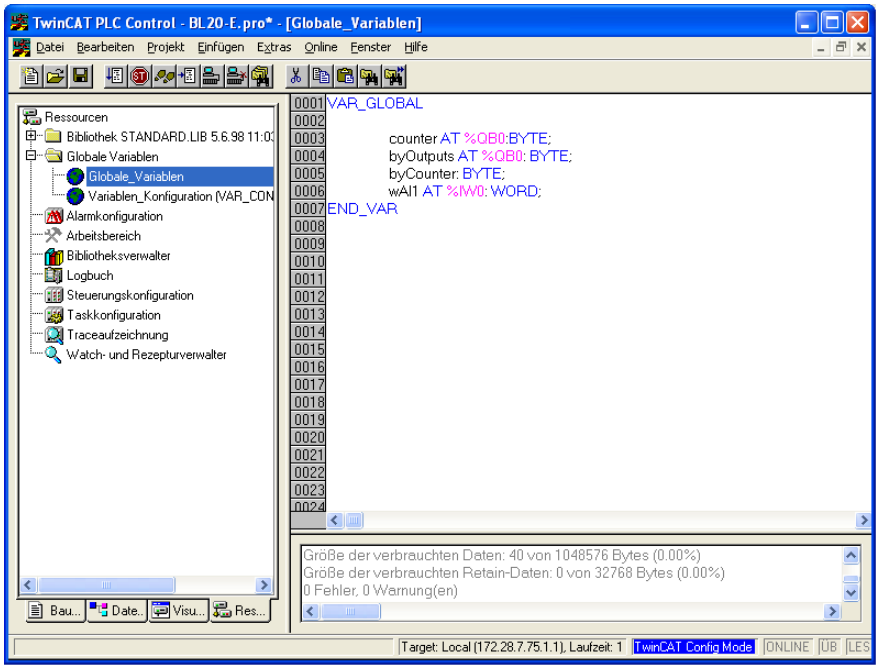

Fig. 16: Definition of the Global Variables

5 Build and store the program, log-in and start the PLC for example via the TwinCAT-symbol in the task bar of your PC.

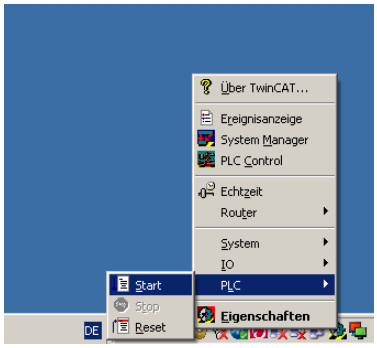

Fig. 17: Starting the PLC

6 The TwinCAT-system has to be started as well.

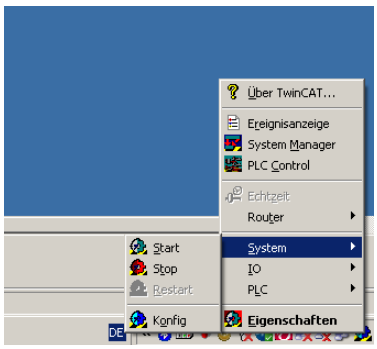

Fig. 18: Starting the system

6.1.5 "Connection" of hardware and program

1 Add the PLC-project from the "TwinCAT System Control" to the "PLC-Configuration" in the "TwinCAT System Manager".

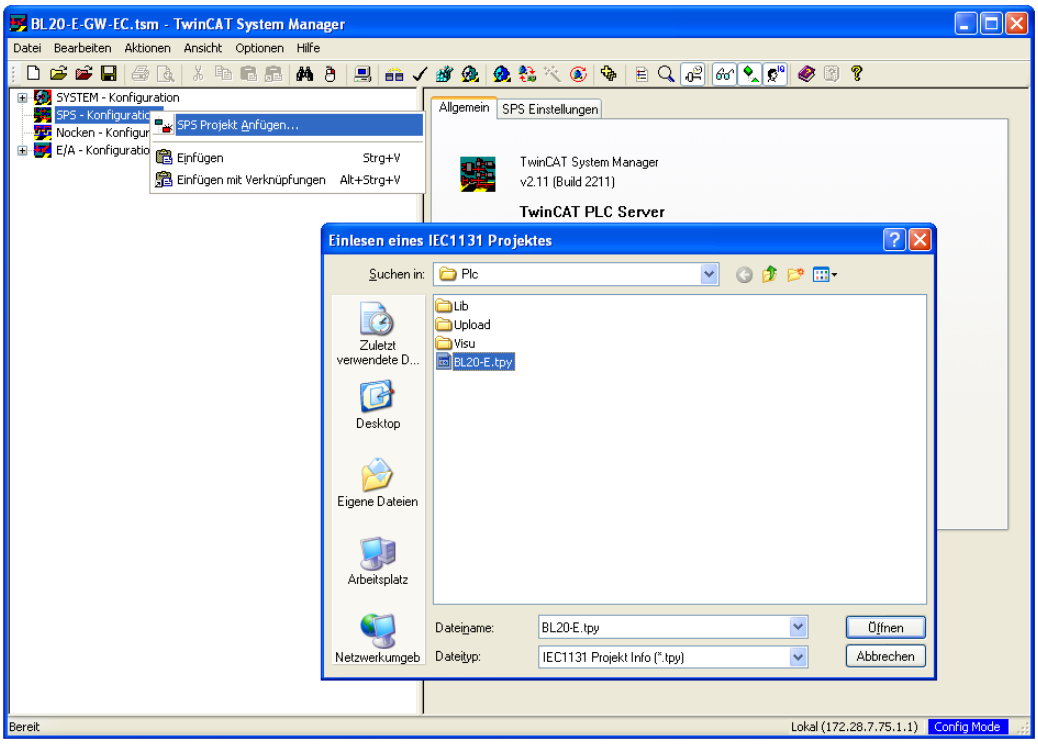

Fig. 19: Adding the PLC-program to the hardware-configuration.

2 The global variables from the PLC-program are listed in the configuration and can now be linked to the inputs and outputs of the hardware.

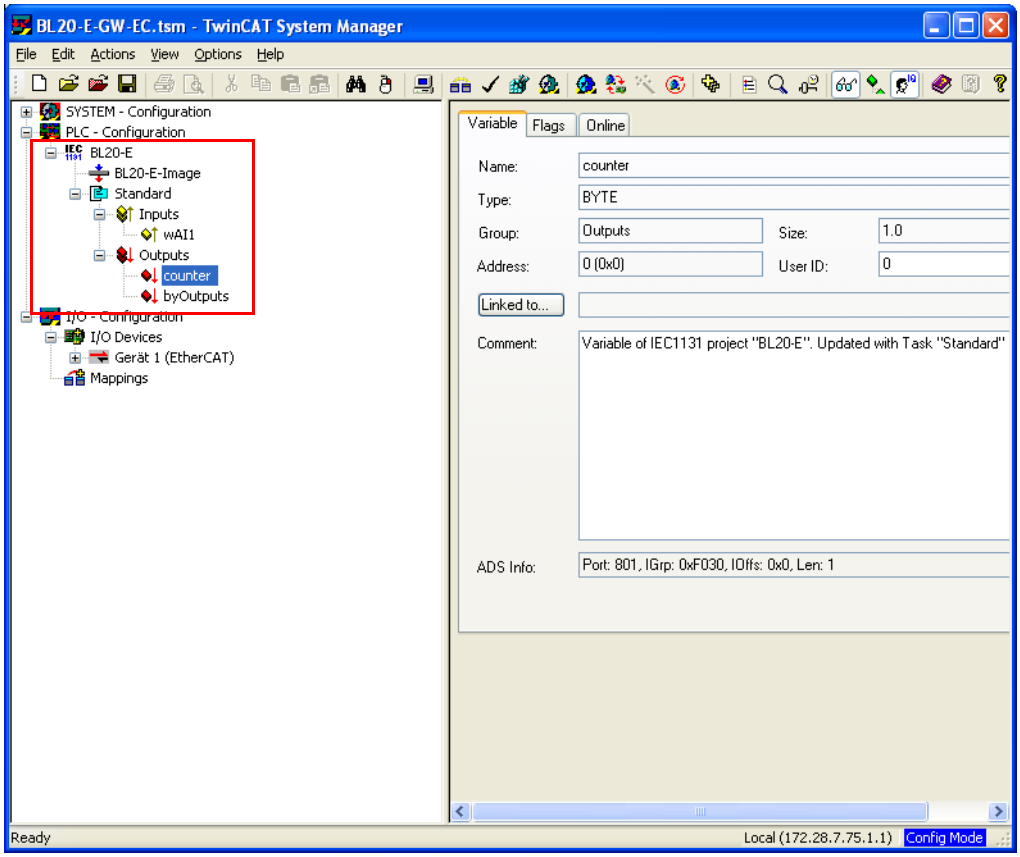

Fig. 20: Variables from PLC-program

3 Define the process data which have to be linked and link the hardware to the variables using „right-click → Change Single Links or Change Multi Link and define the respective program variable.

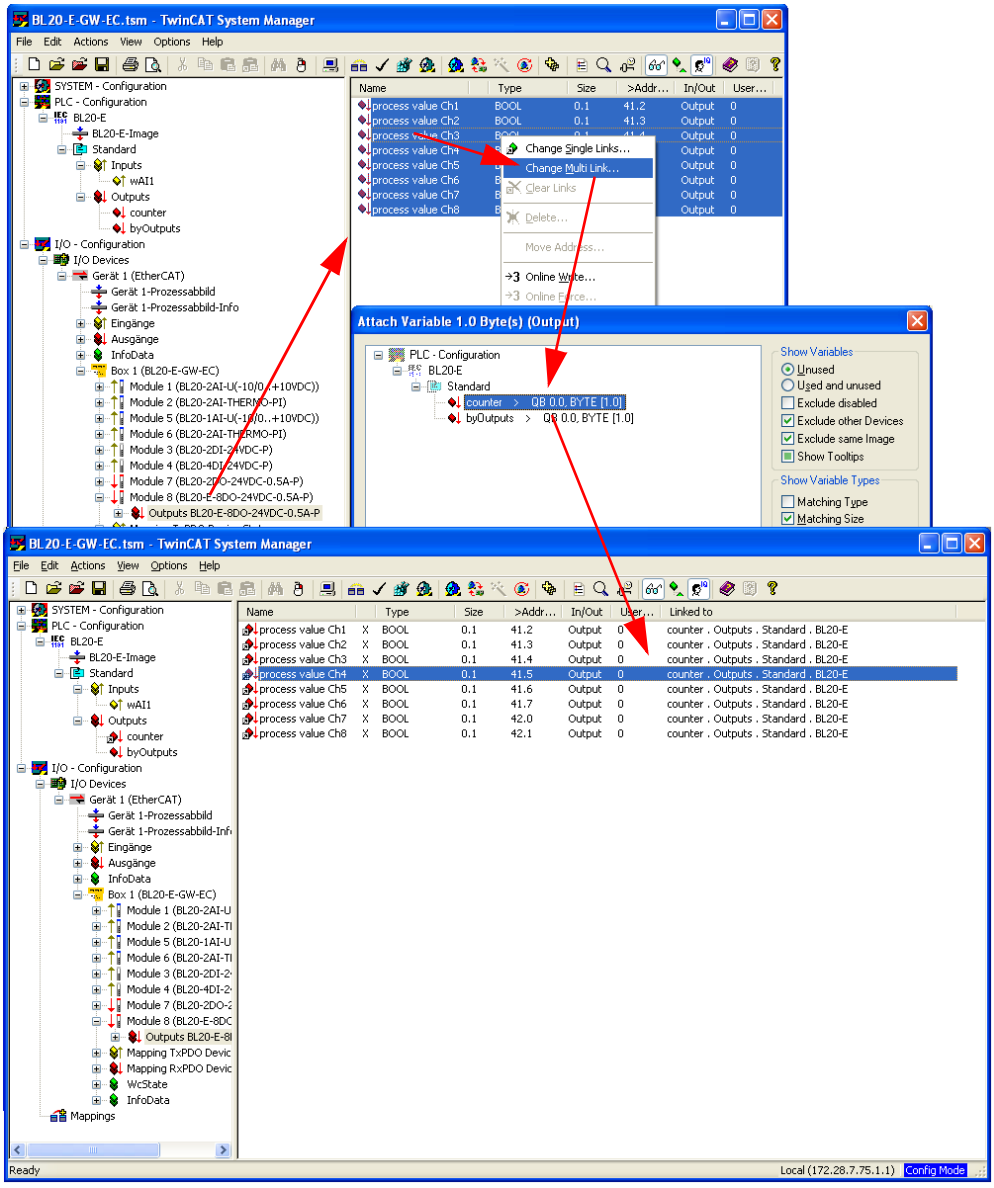

Fig. 21: Linking of variables

Generate Mappings

TwinCAT allows a graphical representation of the variable mappings.

1 Create the mappings to show the graphical mappings.

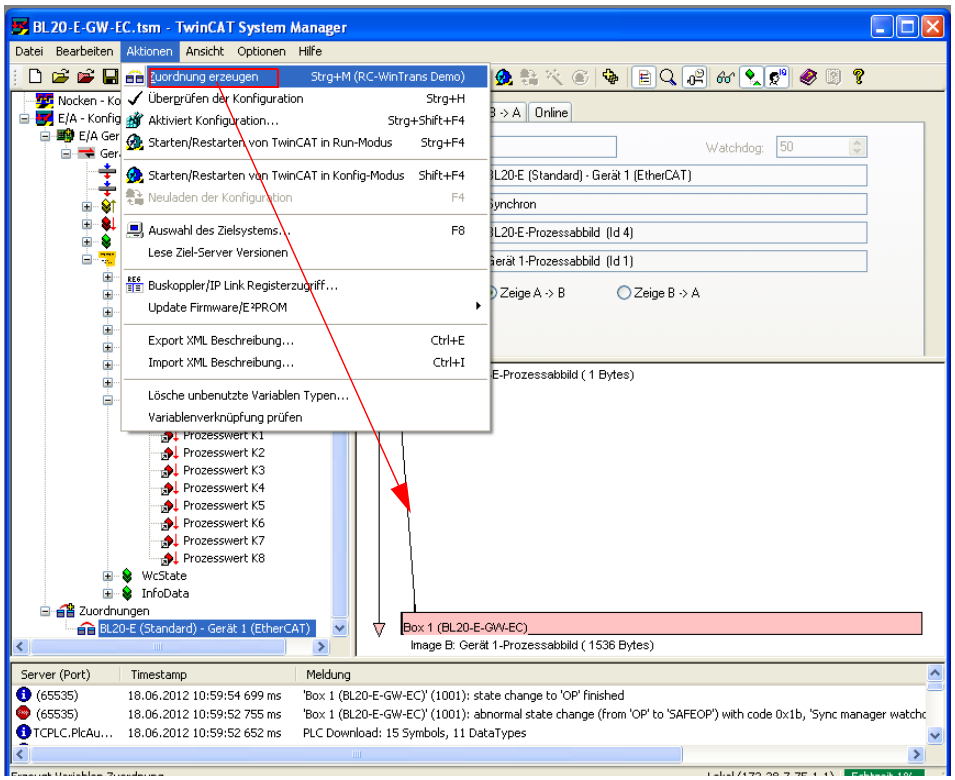

Fig. 22: Generate Mappings

6.1.6 Process data exchange

1 The actual I/O-configuration is downloaded to the gateway using the "activate configuration"-button.

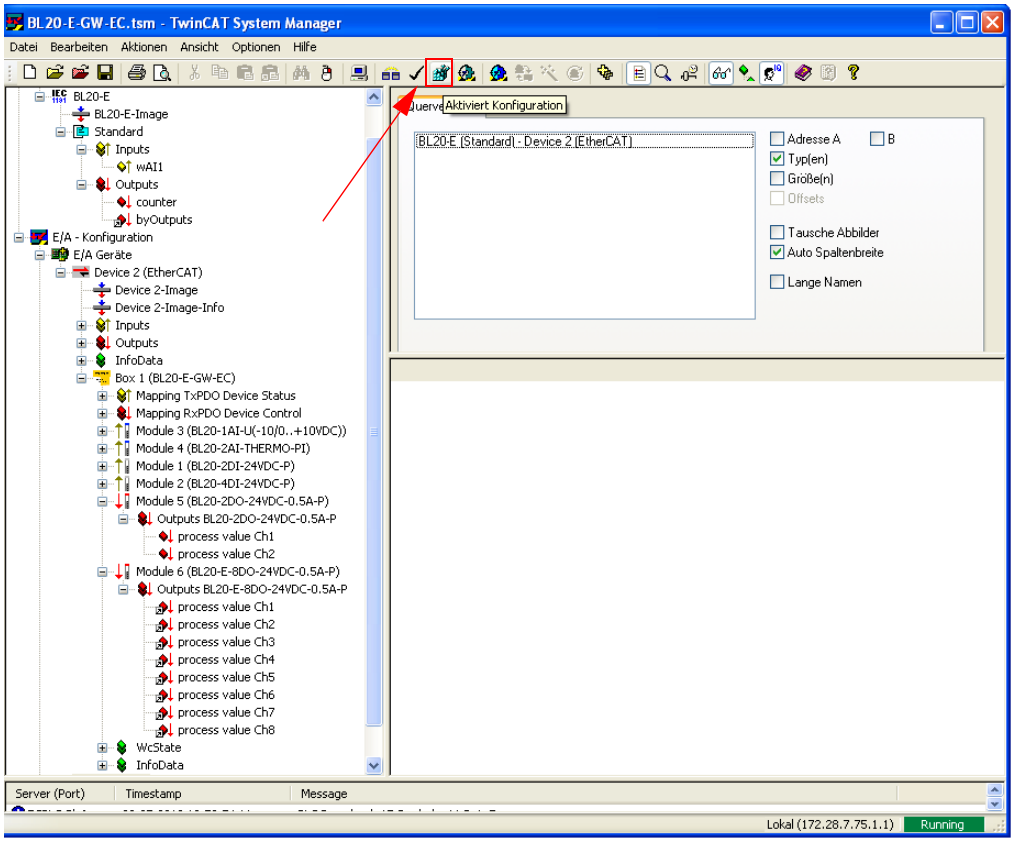

Fig. 23: Activate I/O-configuration

2 TwinCAT is automatically restarted in Run mode.

3 Open the monitoring of the process data using the "View → Show Online Data"-command.

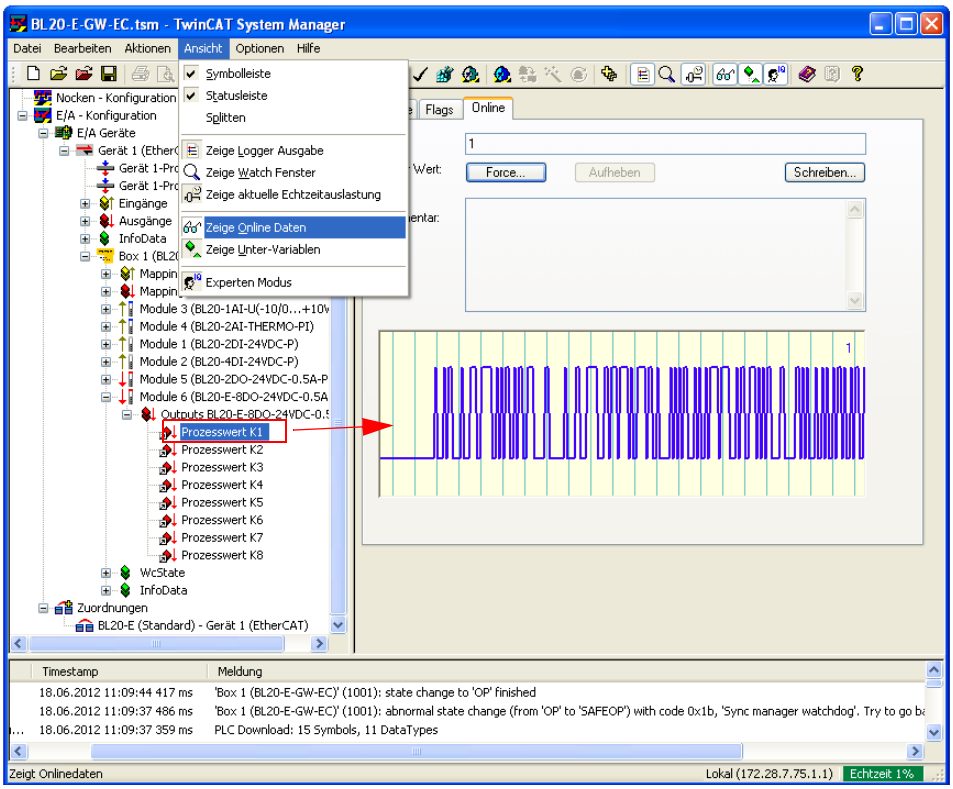

Fig. 24: Monitoring of process data

6.1.7 Diagnosis in TwinCAT

Diagnosis messages of the gateway and the I/O-modules are shown in the "Diag History" of the BL20-Gateway.

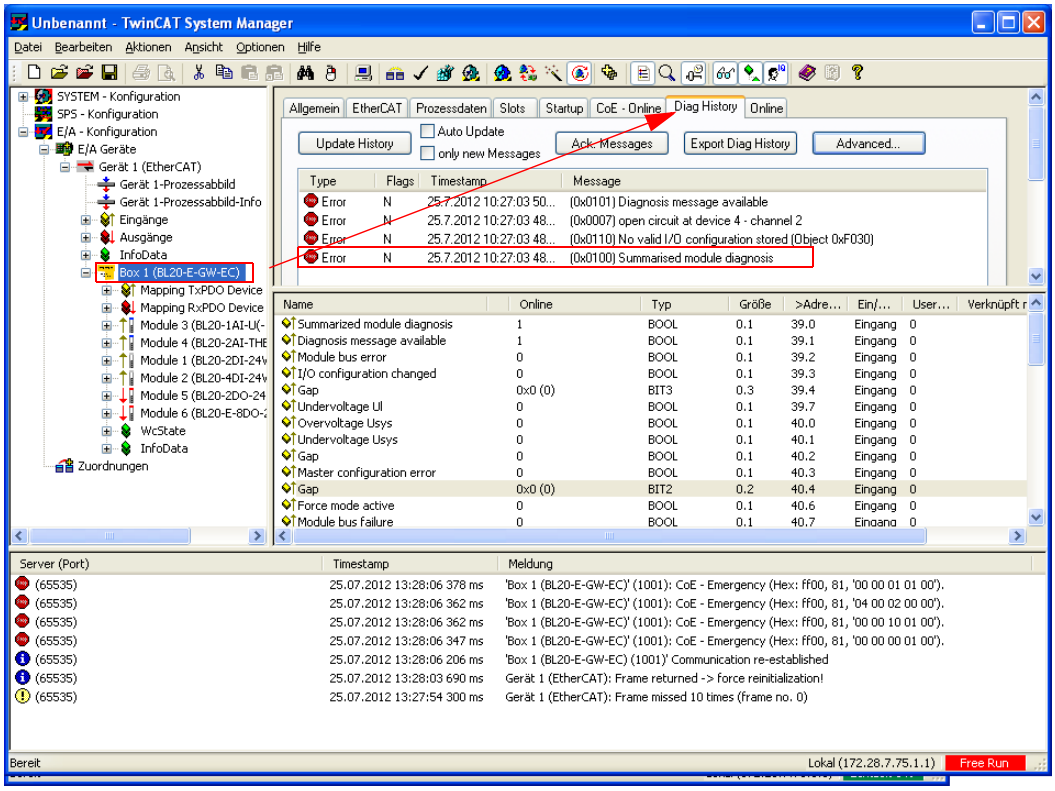

Fig. 25: Diag History

The sending of diagnosis messages and Emergencies can be en- or respectively disabled via the "Advanced"-button in the "Diag History"-dialog box.

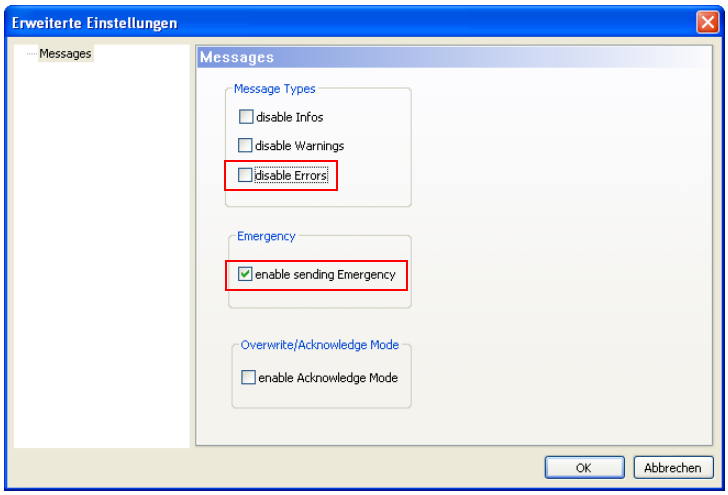

Fig. 26: Diagnosis settings "Advanced"

NOTE

The settings for the device's diagnosis behavior are stored as non valid in the device and can thus only be changed again via a controller access.

Emergencies are only sent once and are shown in the Message-window of the software..

NOTE

Further information about the structure of emergencies can be found in section **Emergency telegrams (page 36)**.

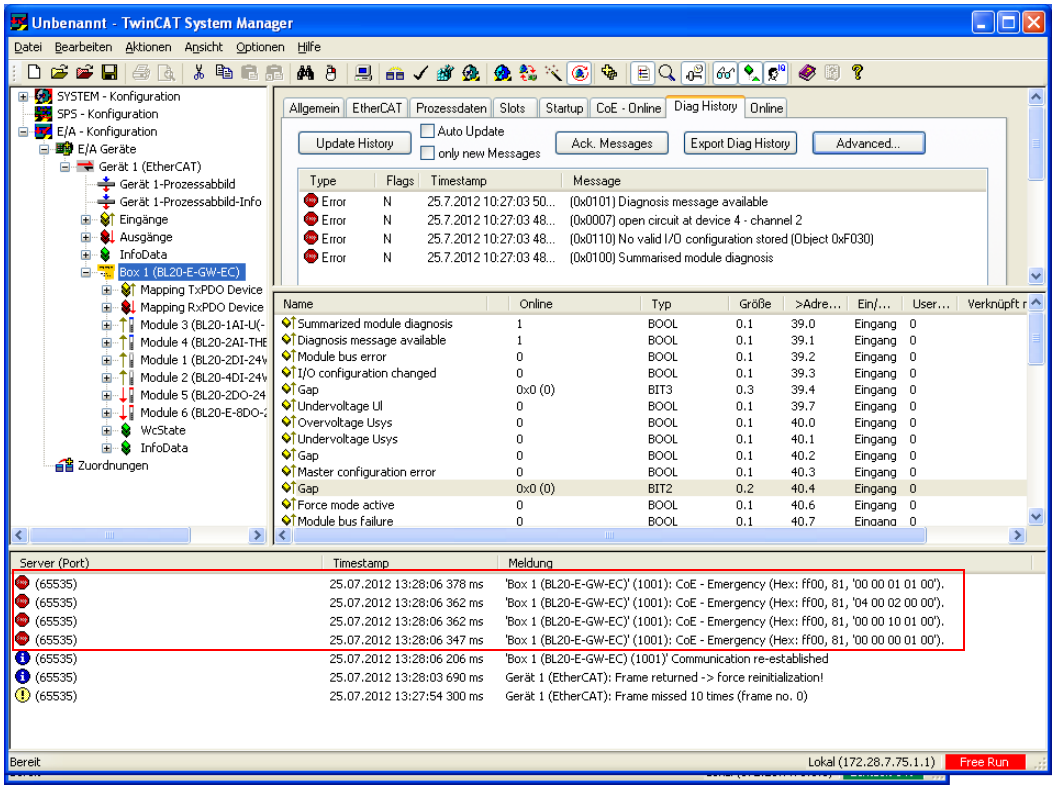

Fig. 27: Emergencies in TwinCAT

6.1.8 Install EtherCAT-driver

1 Search your system for EtherCAT-Real Time compatible network interface cards.

2 Open the dialog box "Installation of TwinCAT RT-Ethernet Adapters" via the "Compatible device"-button in the register-tab "Adapter" of the EtherCAT-device.

3 Select the network interface card to be used and install the EtherCAT-driver via the "Install"-button.

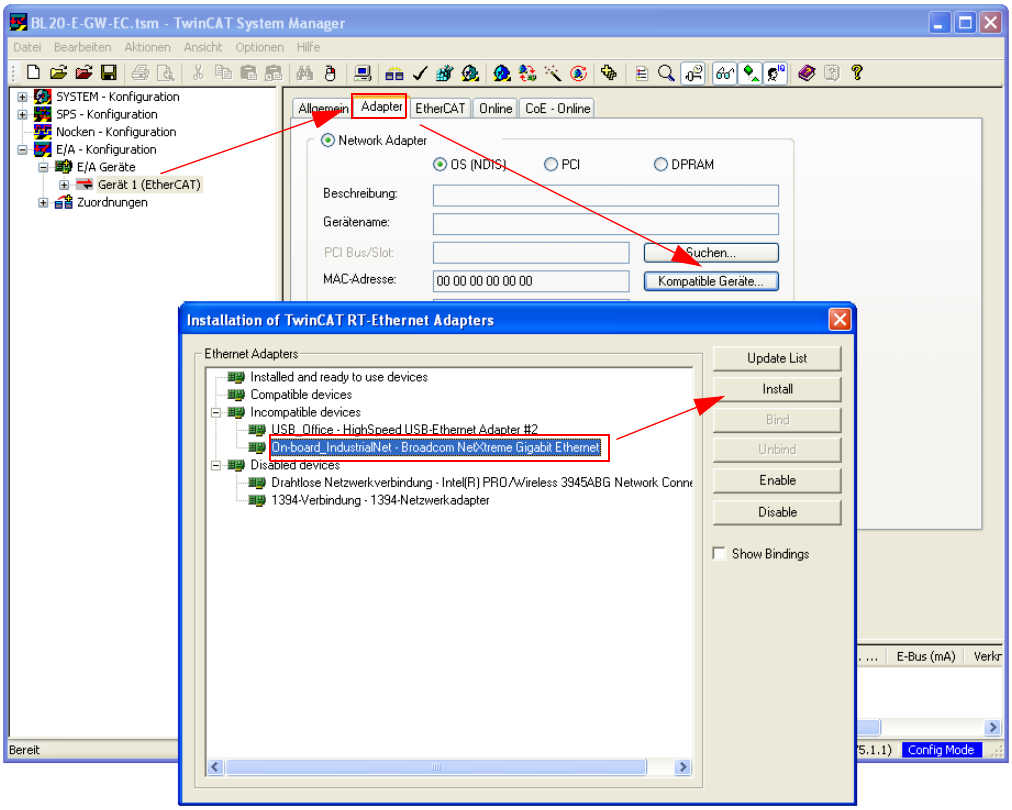

Fig. 28: Installation of the EtherCAT-driver

4 The network interface card to be used can now be chosen in the TwinCAT System Manager using the "Search…"-button.

7 Integration of the technology modules

7.1 Integration of the RS232-module

7.1.1 Data image

Process input data (PZDE)

Process input data is data from the connected field device that is transmitted via the BL20-1RS232 module to the PLC. The BL20-1RS232-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 SPS.

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

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

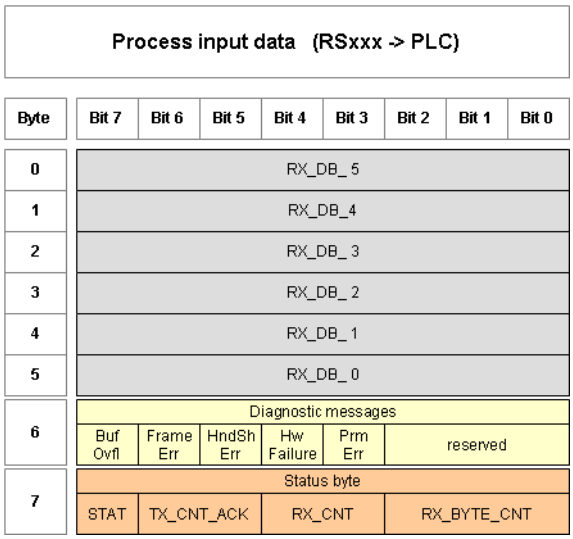

Fig. 29: Process input data SPS

Meaning of the data bits (process input)

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.

Designation	Value	Description
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 (PZDA)

Process output data are data which are sent from the PLC via the gateway and the BL20-1RS232-module to a connected field device.

The data received from the PLC are loaded into the 64-bit transmit-buffer in the BL20-1RS232-module.

The fieldbus specific transmission for EtherCAT is realized in a 8-byte format which is structured as follows:

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

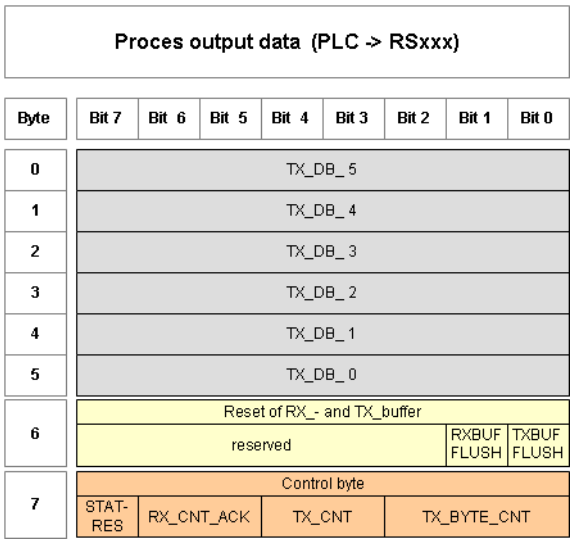

Fig. 30: Process output data SPS

Meaning of the data bits (process output)

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.
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.

Designation	Value	Description
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. In EtherCAT, the data segments contain a maximum number of 6 bytes of user data.

7.2 Integration of the RS485/422-module

7.2.1 Data image

Process input data (PZDE)

The BL××-1RS485/422-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 SPS.

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

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

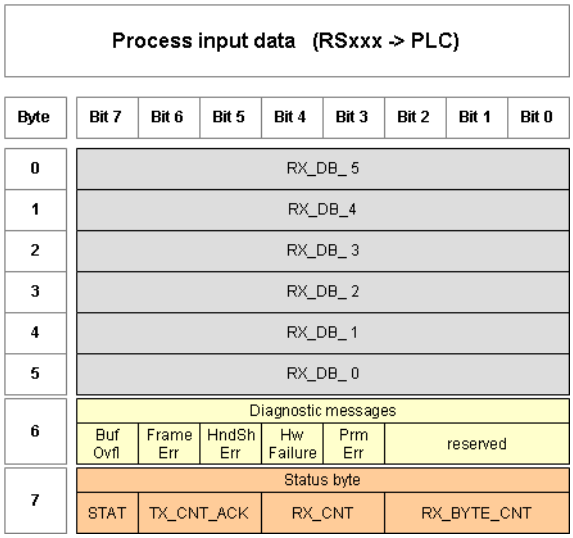

Fig. 31: Process input data SPS

Meaning of the data bits (process input)

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.

Designation	Value	Description
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. In EtherCAT, the data segments contain a maximum number of 6 bytes of user data.

Process output data (PZDA)

The data received from the PLC are loaded into a transmit-buffer in the BL××-1RS485/422 module.

The fieldbus specific transmission for EtherCAT is realized in a 8-byte format which is structured as follows:

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

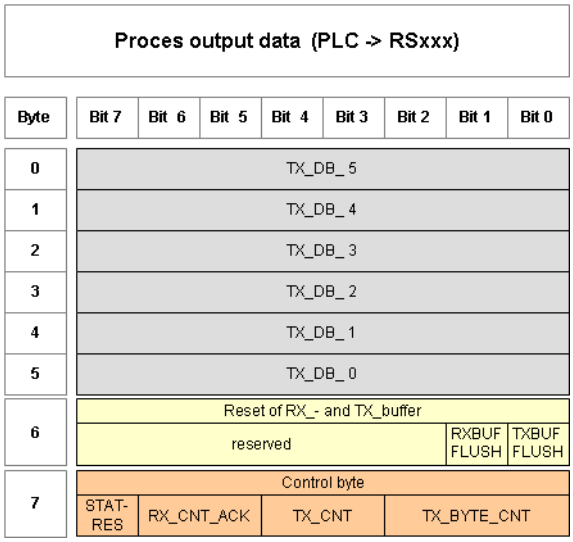

Fig. 32: Process output data SPS

Meaning of the data bits (process output)

Designation	Value	Description
RXBUF FLUSH	0 - 1	The RXBUF FLUSH bit is used for clearing the receive buffer. If STATRES = 0, 1 or 0 1: A request with RXBUF FLUSH = 1 will be ignored. If RXBUF FLUSH = 1, a rising edge 1 0 at STATRES clears the transmit buffer.
TXBUF FLUSH	0 -1	The TXBUF FLUSH bit is used for clearing the transmit buffer. If STATRES = 0, 1 or 0 1: A request with TXBUF FLUSH = 1 will be ignored. If TXBUF FLUSH = 1, a falling edge 1 0 at STATRES clears the transmit buffer.

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). The clearing of the receive and transmit buffer by RXBUF FLUSH/TXBUF FLUSH is possible. If this bit is 0, all changes in TX_BYTE_CNT, TX_CNT and RX_CNT_ACK are ignored. The value 1.0 or the transition from 0 to 1 disables the clearing of the receive and transmit buffer by the RXBUF FLUSH/TXBUF FLUSH.
RX_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.
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. In EtherCAT, the data segments contain a maximum number of 6 bytes of user data.

7.3 Integration of the SSI-module

7.3.1 Data image

Process input data (PZDE)

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.

Process input data (SSI -> PLC)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	DB_3							
1	DB_2							
2	DB_1							
3	DB_0							
	Status messages							
4	REG RD ABORT	X	REG RD ADR (MSB bis LSB)					
5	REG WR ACEPT	REG WR AKN	X	X	SSI STS3	SSI STS2	SSI STS1	SSI STS0
6	STS UP	STS DN	REL CMP2	FLAG CMP2	STS CMP2	REL CMP1	FLAG CMP2	STS CMP2
	Diagnostic messages							
7	STS STOP	X	X	ERR PARA	STS UFLW	STS OFLW	ERR SSI	SSI DIAG

Fig. 33: Process input data

Meaning of the data bits (process input)

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, i.e. REG_WR = 1 chapter „Process output (PZDA)“. 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.

Designation	Value	Description
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)
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_CMP2)
	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_CMP2)
	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.

Designation	Value	Description
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)
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 (PZDA)

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:

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

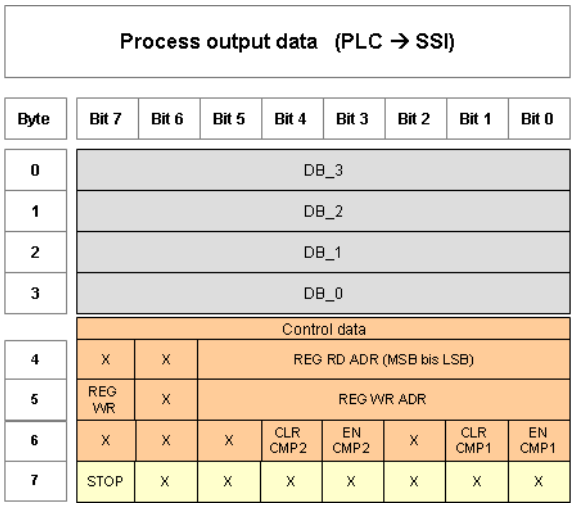

Fig. 34: Process output data

Meaning of the data bits (process output)

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 (chapter process input (PZDE)“) is reset (0).
	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.

Designation	Value	Description
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

7.4 Integration of the SWIRE-module BL20-E-1-SWIRE

The module can be integrated if the gateway firmware is at least Version 1.51.

7.4.1 Data image

Process input

The field input data is transferred from the connected SWIRE-BUS to the BL20-E-1SWIREmodule. The process input data is the data that is transferred by the BL20-E-1SWIRE-module via a gateway to the PLC. The transfer is carried out in 8-byte format. 4 bits are reserved for each SWIRE slave. The following information can be transferred:

- Contactor coil on/off
- Motor-protective circuit-breaker off or tripped/on
- Status of the slave o.k./diagnostics message present

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	SWIRE Slave 2				SWIRE Slave 1			
2	SWIRE Slave 4				SWIRE Slave 3			
3	SWIRE Slave 6				SWIRE Slave 5			
4	SWIRE Slave 8				SWIRE Slave 7			
5	SWIRE Slave 10				SWIRE Slave 9			
6	SWIRE Slave 12				SWIRE Slave 11			
7	SWIRE Slave 14				SWIRE Slave 13			
8	SWIRE Slave 16				SWIRE Slave 15			

The data of SWIRE slave 1 is the data of the first physical slave on the SWIRE bus. he remaining slaves are assigned in consecutive order accordingly. The meaning of the data of an SWIRE slave depends on the product concerned.

The meaning of the data of an SWIRE slave depends on the product concerned.

Bit 7	Bit 6	Bit 5	Bit 4
SDx/free	free	PKZSTx	SIx

The following table shows the meaning of the data bits:

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

Design.	Status	Comment		
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
SDx		Communication error, slave x		
		Setting the NDDIAG parameter copies the slave diagnostics message (input byte 1/bit 3) to the feed-back interface. 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

Field output data is output from an BL20-E-1SWIRE module to a field device. The process output data is the data that is transferred by the PLC via a gateway to the BL20-E-1SWIRE module. The transfer is carried out in 8-byte format. 4 bits are reserved for each SWIRE slave. The following information is transferred:

- Switch status of contactor coil on/off

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1	SWIRE Slave 2				SWIRE Slave 1			
2	SWIRE Slave 4				SWIRE Slave 3			
3	SWIRE Slave 6				SWIRE Slave 5			
4	SWIRE Slave 8				SWIRE Slave 7			
5	SWIRE Slave 10				SWIRE Slave 9			
6	SWIRE Slave 12				SWIRE Slave 11			
7	SWIRE Slave 14				SWIRE Slave 13			
8	SWIRE Slave 16				SWIRE Slave 15			

The data of SWIRE slave 1 is the data of the first physical slave on the SWIRE bus. he remaining slaves are assigned in consecutive order accordingly. The meaning of the data of an SWIRE slave depends on the product concerned.

Meaning of the 4-bit process output data on an SWIRE-DIL device:

Bit 7	Bit 6	Bit 5	Bit 4
free	free	free	SOx

The following table shows the meaning of the data bits:

Design.	Status	Comment		
SOx		relay x 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

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	GENER-AL$_{ERR}$	U$_{SWERR}$	free	COM$_{ERR}$	free	RDY$_{ERR}$	free	SW$_{ERR}$
Byte 2	free	U$_{AUXERR}$	TYP$_{ERR}$	free	PKZ$_{ERR}$	free	SD$_{ERR}$	free
TYP$_{ERR}$ field								
Byte 3	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 4	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 diagnostics bit field								
Byte 5	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 6	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 7	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 8	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:

Design.	Value	Meaning	
Byte 1			
SW$_{ERR}$	SWIRE MASTER		
	The configuration was accepted according to the parameter setting and the SWIRE bus is in data exchange mode.		
	0	Data exchange	The bus is in data exchange mode
	1	Offline	The configuration was not accepted, the bus does not switch to data exchange mode. (SW LED flashing)
RDY$_{ERR}$	SPS SLAVE		
	Parameter setting is faulty. The ACTUAL configuration was accepted according to the SET configuration and the data exchange with the higher-level is o.k.		
	0	Data exchange	The bus is in data exchange mode
	1	Offline	The configuration was not accepted, the bus does not switch to data exchange mode. (SW LED Rdy 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.

Design.	Value	Meaning	
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.
GENE-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 error bit.		
	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 for group diagnostics, this bit indicates an error as soon as the ACTUAL configuration of a slave does not match the SET configuration for this position.		
	0	OK	The ACTUAL configuration fully matches the SET configuration or diagnostics function has been deactivated via the parameter.
	1	faulty	The actual configuration does not fully match set configuration.
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).

Design.	Value	Meaning	
Byte 3.4			
$TYP_{ERR}Sx$	Device configuration, slave x		
	Info field for the individual indication of a configuration error as error message. If the $TYP_{INFO}A$ parameter has been set for single diagnostics, this bit field indicates the error, as soon as the ACTUAL configuration of the slave was not accepted and is therefore not enabled for data exchange. The diagnostics LED of the slave flashes.		
	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 $SD_{INF}OA$ 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.

Parameters

Parameters consist of data that has to be sent to the module so that it can operate correctly in the application concerned.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	reserved	free	free	MC	MNA	configu-ration	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	Life guarding time							
Byte 5	$SD_{DIAG}S8$	$SD_{DIAG}S7$	$SD_{DIAG}S6$	$SD_{DIAG}S5$	$SD_{DIAG}S4$	$SD_{DIAG}S3$	$SD_{DIAG}S2$	$SD_{DIAG}S1$
Byte 6	SD_{DIAG} S16	SD_{DIAG} S15	SD_{DIAG} S14	SD_{DIAG} S13	SD_{DIAG} S12	SD_{DIAG} S11	SD_{DIAG} S10	$SD_{DIAG}S9$
Byte 7	reserved							
Byte 8	reserved							
Byte 9 - 24	Type designation slave 1 - 16							

The following table shows the meaning of the parameter bits:

Parameter name	Value	
Byte 1		
Disable Cfg	Disabling of the acceptance of the physically present configuration as ACTUAL configuration on manual pushbutton actuation.	
	0 = inactive	The physically present configuration of the SWIRE bus is only accepted as the ACTUAL configuration by pressing the CFG button. The comparison with the SET configuration is then carried out.
	1 = active	The physically present configuration is automatically accepted as the ACTUAL configuration and then compared with the SET configuration.
Configuration	PLC configuration check The configuration check parameter enables a comparison of the set and actual configuration based on the device ID.	
	0 = active	Configuration check based on device ID. Only SWIRE slaves with a device ID completely matching the set configuration are accepted on the bus.
	1 = disabled	All slaves are mapped in 4 Bit INPUT/4 Bit OUTPUT without checking the device ID.
Byte 1		
MNA active/passive	Configuration check If the ACTUAL configuration of the SWIRE bus does not match the SET configuration, the master only exchanges data with the correctly configured and functional slaves.	
	0 = Bus based	No data exchange with a slave with an incomplete/incorrect configuration.
	1 = Slave based	The bus also goes into operation with the correctly configured slaves even if the configuration is incomplete. All slaves detected by the daisy chain configuration with a position that matches the set configuration are started up. Slaves that do not match the set configuration are inactive.

Parameter name	Value	
MC	Moeller conformance (from version VN 01-04) Behavior of the BL20-E-1SWIRE in accordance with SWIRE Conformance criteria.	
	0 = inactive	Default behavior
	1 = active	The BL20-E-1SWIRE master responds according to the Moeller SWIRE Conformance criteria. For detailed information please read the manual for the IO-modules (D300717).
SD_{INFO}	Slave error field Activate slave diagnostics info field SDERRSx . 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 = inactive	Single diagnostics is activated
	1 = active	Single diagnostics is not activated
SD_{ERR}	Group error - slave error Activate slave diagnostics SDERR. 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 PKZERRSx . 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
PKZ_{ERR}	Group PKZ error field Activate slave diagnostics PKZERR. 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		
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 TYPERR. 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

Parameter name	Value	
U_{AUXERR}	Error message UAUX- Activate system diagnostics UAUXERR . UAUXERR 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		
Lifeguarding	0x02-0xFF **0x64**	Lifeguarding time of the SWIRE slaves Setting of lifeguarding time of SWIRE slaves , timeout time up to automatic reset of the slaves in the event of communication failure. (n * 10ms) (Default 1s) 0xFF: 0xFF: Lifeguarding off
Byte 5 - 6		
$SD_{DIAG}Sx$	Input bit communication error, slave x Slave diagnostics message from Byte 1/Bit 7 is accepted in the feedback interface as Bit 4	
	0 = active	$SD_{DIAG}Sx$ is accepted
	1 = inactive	$SD_{DIAG}Sx$ is not accepted
Byte 7 - 8	reserved	
Byte 9 to 24		
Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus	
	0x20	SWIRE-DIL-MTB (: 0xFF)
	0xFF	Basic setting (no slave)

7.5 Integration of the 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)

7.6 Integration of RFID-modules BL20-2RFID-S/-A

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

8 Guidelines for station planning

8.1 Module arrangement

8.1.1 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.

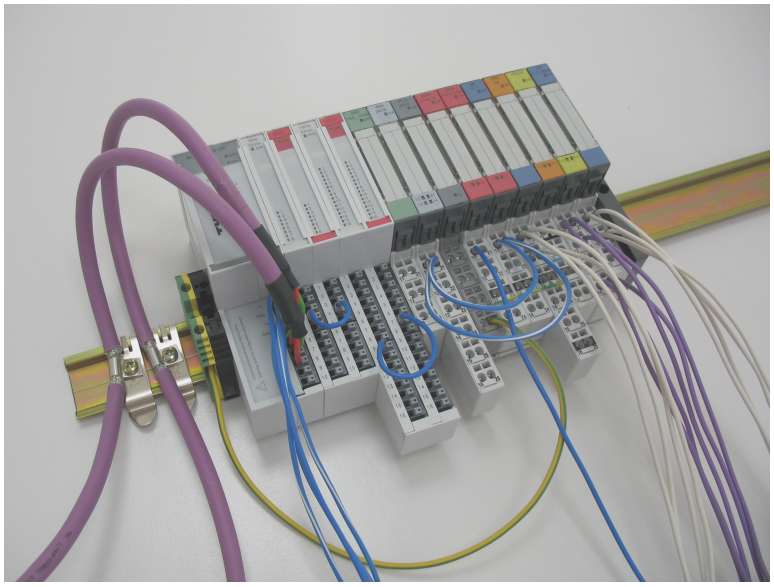

Fig. 35: Example of a station structure with ECO gateway (here for CANopen), ECO and standard I/O modules

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.

8.1.2 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.

8.1.3 Maximum system extension

- The station extension may not exceed the maximum number of **72 modules**.
- If the maximum sum of the modules' nominal current consumptions right to the gateway (max. sum Σ $\mathbf{I_{MB}}$ = **700 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	Nominal current consumption at the module bus
BL20-PF-24VDC-D	28 mA
BL20-PF-120/230VAC-D	25 mA
BL20-2DI-24VDC-P	28 mA
BL20-2DI-24VDC-N	28 mA
BL20-2DI-120/230VAC	28 mA
BL20-4DI-24VDC-P	29 mA
BL20-4DI-24VDC-N	28 mA
BL20-4DI-NAMUR	40 mA
BL20-E-8DI-24VDC-P	15 mA
BL20-E-16DI-24VDC-P	15 mA
BL20-E-16DI-24VDC-N	15 mA
BL20-16DI-24VDC-P	45 mA
BL20-32DI-24VDC-P	30 mA
BL20-1AI-I(0/4…20MA)	41 mA
BL20-2AI-I(0/4…20MA)	35 mA
BL20-1AI-U(-10/0…+10VDC)	41 mA
BL20-2AI-U(-10/0…+10VDC)	35 mA
BL20-2AI-PT/NI-2/3	45 mA
BL20-2AI-THERMO-PI	45 mA
BL20-4AI-U/I	30 mA

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

8.2 Power supply

8.2.1 Power supply to the gateway

The gateways BL20-E-GW-EC offer an integrated power supply (see also **Power supply (page 30)**).

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

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

NOTICE

The sum of the nominal current consumptions of the used BL20 modules may not exceed 700 mA.
If a Bus Refreshing module is mounted, the sum of the current consumptions which follow the Bus Refreshing module must not exceed 1,5 A.

NOTE

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

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

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

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

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

8.2.3 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.

8.2.4 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. 36: C-rail (front view)

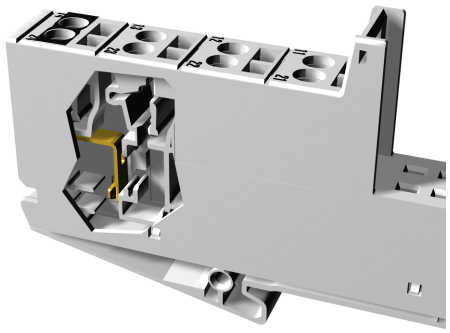

Abb. 37: C-rail front (side view)

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 9**.

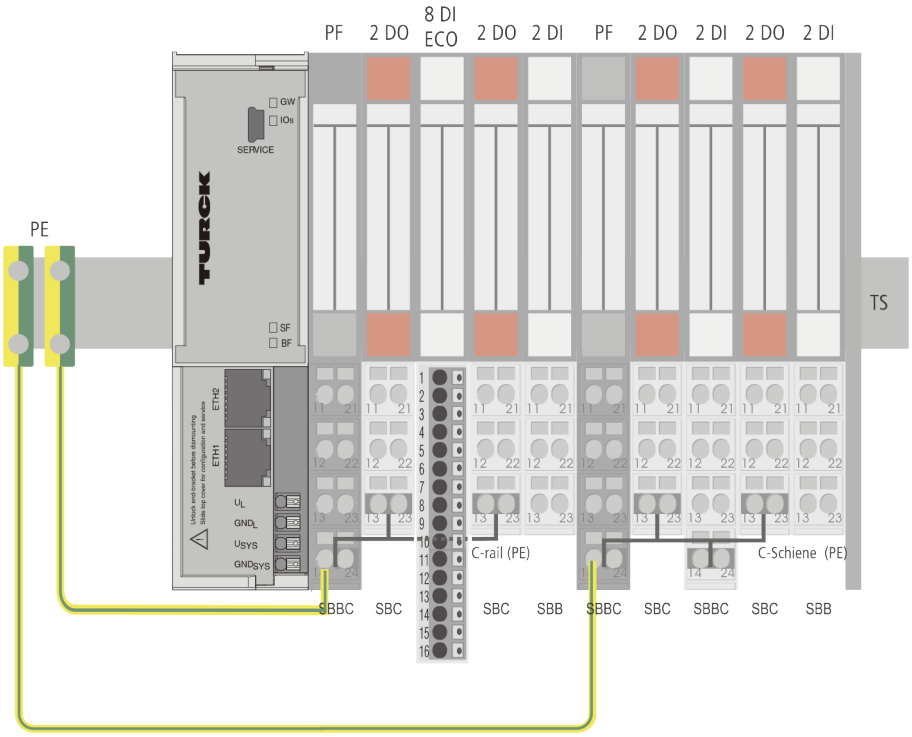

Fig. 38: Using the C-rail as a protective earth

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.

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

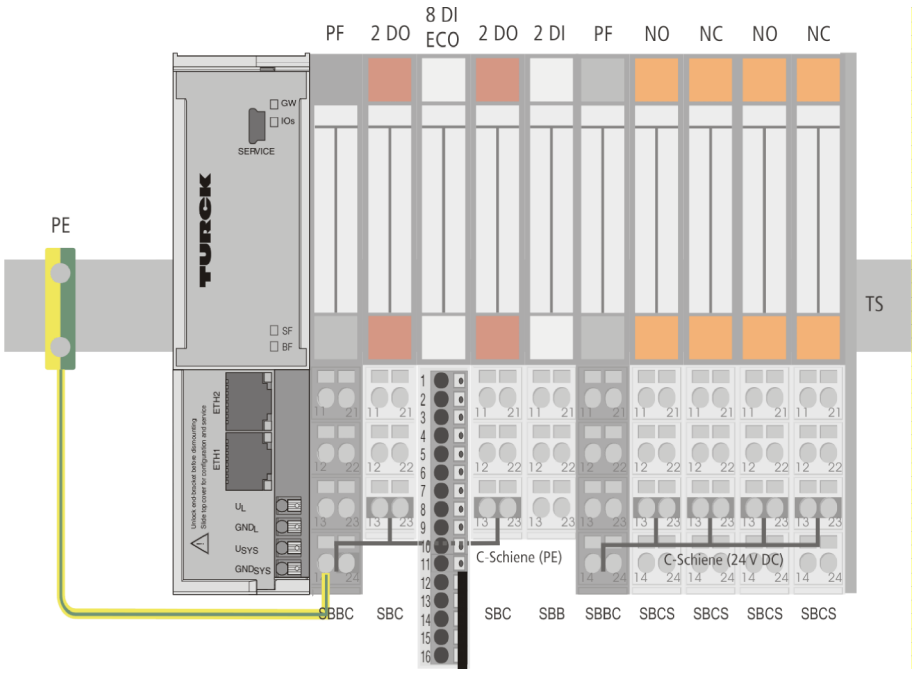

Fig. 39: Using the C-rail as protective earth and for the power supply with relay modules

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).

8.2.5 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.

8.3 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.

8.4 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

8.5 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.

8.6 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.

9 Guidelines for Electrical Installation

9.1 General notes

9.1.1 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.).

9.1.2 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.

9.1.3 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.

9.1.4 Transmission media

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

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

NOTE

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

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

9.2 Potential relationships

9.2.1 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.

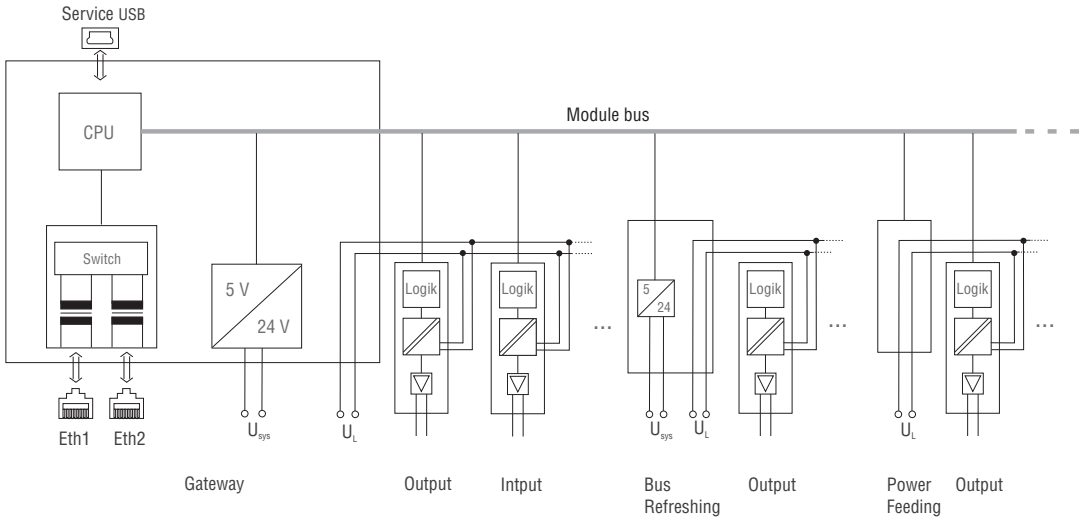

Fig. 40: Block diagram of a BL20 station with EtherCAT- gateway

9.3 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.

9.3.1 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.

9.3.2 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

9.3.3 PE connection

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

9.3.4 Earth-free operation

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

9.3.5 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

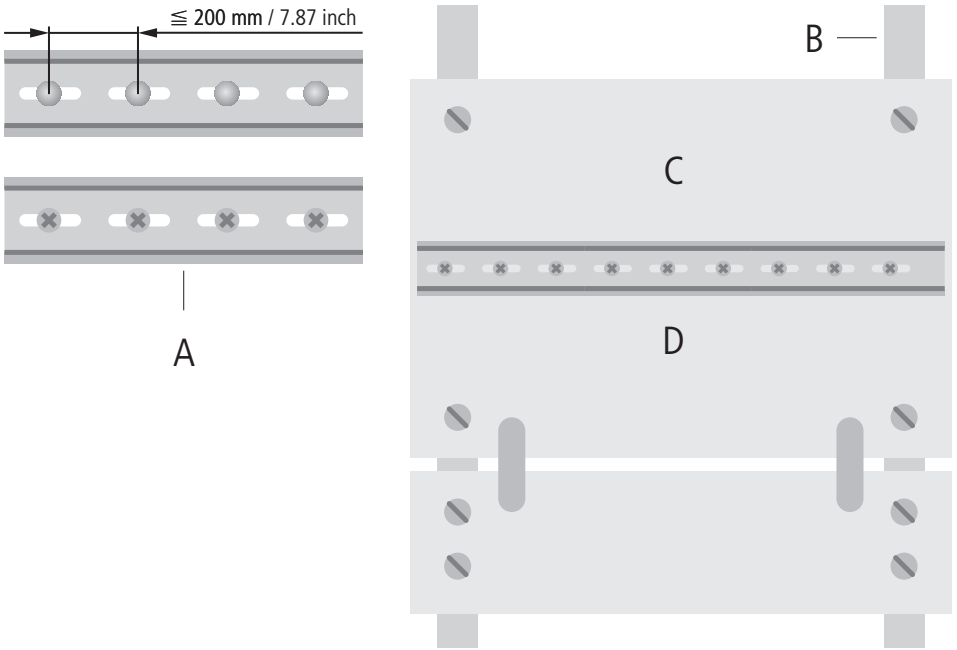

Abb. 41: Mounting options
A *TS 35*
B *mounting rail*
C *mounting plate*
D *TS 35*

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).

9.3.6 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.

9.3.7 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.

9.3.8 Switching inductive loads

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

9.3.9 Protection against Electrostatic Discharge (ESD)

NOTICE

Exposed metal contacts

Material damage due to electrostatic discharge

➤ Avoid to touch the metallic contacts with bare hands

10 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**.

11 Appendix

11.1 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

TURCK

Over 30 subsidiaries and over
60 representations worldwide!

D301260 | 2020/09

www.turck.com