Your Global Automation Partner

TURCK

BL20-E-GW-CO
ECO Gateway for CANopen

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 CANopen-Gateway of the product line BL20-ECO (BL20-E-GW-CO).

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

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

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

In addition to that, the mentioned 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-CO.

2.2 Scope of delivery

- BL20-E-GW-CO
- 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

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Witzlebenstraße 7
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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-CO is part of the BL20 system. It forms the interface to a CANopen network and forwards the data collected from the field by the BL20 I/O modules within the BL20 station to the higher-level CANopen 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 Short Description of CANopen

4.1 CANopen

The following description of CANopen is an excerpt from the homepage of CiA (CAN in Automation), the international users' and manufacturers' organization for CAN.

CANopen is an open, non-proprietary network protocol. It consists of a profile family, based on a communication profile and several device profiles.i The CANopen communication profile is standardized as CiA DS-301 (Application Layer and Communication Profile).

The CANopen device profile for I/O-modules has been published as CiA DS-401 (Device Profile for I/O-Modules).

CANopen is based on the following standards:

- ISO 11 898 (Physical and Data Link Layer) Layers 1 and 2 of the ISO/OSI communication model
- CiA DS-301 (Application Layer and Communication Profile) CANopen communication profile
- CiA DS-302 (Framework for Programmable CANopen Devices) CANopen Network Management NMT
- CiA DS-401 (Device Profile for I/O-modules)
- CiA DS-406 (Device Profile for Encoders) CANopen device profile for counter modules
- CiA DS-102 (CAN Physical Layer for Industrial Applications) General application in the field sector (connectors and bit rates) on the basis of ISO 11898

4.2 Communication

The lower layers of CANopen are defined according to the ISO-OSI model in the ISO 11898 standard.

Communication between the individual nodes is made by transmitting "Telegrams".

4 different types of telegram message are defined for CANopen:

- Network management messages
- Service data objects SDO
- Process data objects PDO
- Predefined messages

4.2.1 Network Management Messages

Network management messages are used in the network to control the nodes and their operating states. This type of message makes it possible, for instance, to configure the data transmission mechanism of a node.

The Network Management objects include Boot-up message, Heartbeat protocol and NMT message.

Boot-up message, Heartbeat and Node Guarding are implemented as single CAN frames with 1-byte data field.

The NMT message is mapped to a single CAN frame with a data length of 2 byte. The CAN-Identifier is 0. The first byte contains the command specifier and the second contains the Node-ID of the device that must perform the command (in the case of Node-ID 0 all nodes have to perform the command). The NMT message transmitted by the NMT master forces the nodes to transit to another NMT state. CANopen defines the following status: "Initialization", "Pre-Operational", "Operational"

and "Stopped". After a "power-on", each CANopen devices is in the status "Initialization" and automatically changes to the Pre-Operational status. In this state the transmission of SDOs is allowed. If the NMT master has set one or more nodes into the state Operational, they are allowed to transmit and to receive PDOs. In the state Stopped no communication is allowed except that of NMT objects.

The state Initialization is divided into 3 sub-states. in order to enable a complete or partial reset of a node. In the sub-state Reset Application the parameters of the manufacturer-specific profile area and the standardized device profile area are set to their power-on values. In the sub-state Reset Communication the parameters of the communication profile area are set to their power-on values. The third sub-state is initializing, which a node enters automatically after power-on. Power-on values are the last stored parameters.

The **Heartbeat** protocol and **Node Guarding** are for error control purposes and signals the presence of a node and its state. The Heartbeat message is a periodic message of the node to one or several other nodes. It indicates that the sending node is still working properly.

A device sends the **Boot-up message** to indicate to the NMT master that it has reached the state pre-operational. This occurs whenever the device initially boots-up but also after a power-out during operation. The Boot-up message has the same identifier as the Heartbeat object, however, its data content is zero.

4.2.2 Service Data Objects (SDOs)

A Service Data Object (SDO) reads from entries or writes to entries of the Object Dictionary.

The SDO transport protocol allows transmitting objects of any size. The first byte of the first segment contains the necessary flow control information including a toggle bit to overcome the problem of doubly received CAN frames. The next three bytes of the first segment contain index and sub-index of the Object Dictionary entry to be read or written. The last four bytes of the first segment are available for user data. The second and the following segments (using the very same CAN identifier) contain the control byte and up to seven bytes of user data. The receiver confirms each segment or a block of segments, so that a peer-to-peer communication (client/server) takes place.

4.2.3 Process Data Objects (PDOs)

Process Data Objects (PDOs) are mapped to a single CAN frame using up to 8 bytes of the data field to transmit application objects. Each PDO has a unique identifier and is transmitted by only one node, but it can be received by more than one (producer/consumer communication). PDO transmissions may be driven by an internal event, by an internal timer, by remote requests and by the Sync message received:

PDO transmissions

- „Event-“ or „timer-driven“:
- An event (specified in the device profile) triggers message transmission. An elapsed timer additionally triggers the periodically transmitting of PDO-messages, even if no event has occurred.
- Remotely requested:
- Another device may initiate the transmission of an asynchronous PDO by sending a remote transmission request (remote frame).
- Synchronous transmission:
- In order to initiate simultaneous sampling of input values of all nodes, a periodically transmitted Sync message is required. Synchronous transmission of PDOs takes place in cyclic and acyclic transmission mode. Cyclic transmission means that the node waits for the Sync message, after which it sends its measured values. Acyclically transmitted synchronous PDOs are triggered by a defined application-specific event. The device transmits it's input values. Further transmission is only done if a further Sync messages occurs.

Special Function Objects

CANopen also defines three specific protocols for synchronization, emergency indication, and time-stamp transmission.

- Synchronization object (Sync)
  The Sync Object is broadcast periodically by the Sync Producer. The Sync Object is broadcast periodically by the Sync Producer. The time period between Sync messages is defined by the Communication Cycle Period, which may be reset by a configuration tool to the application devices during the boot-up process. There can be a time jitter in transmission by the Sync Producer due to some other objects with higher prior identifiers or by one frame being transmitted just before the Sync message. The Sync message is mapped to a single CAN frame with the identifier 128 by default. The Sync message is mapped to a single CAN frame with the identifier 128 by default.
- Emergency object (Emcy)
  The Emergency message is triggered by the occurrence of a device internal error situation and are transmitted from an Emergency producer on the concerned application device. This makes them suitable for interrupt type error alerts. An Emergency message is transmitted only once per ‘error event’. As long as no new errors occurs on a device, no further Emergency message can be transmitted. Zero or more Emergency consumers may receive these. The reaction of the Emergency consumer is application-specific. CANopen defines several Emergency Error Codes to be transmitted in the Emergency message, which is a single CAN frame with 8 data byte.
- Time stamp object (Time)
  By means of Time-Stamp, a common time frame reference is provided to application devices. It contains a value of the type Time-of-Day. This object transmission follows the producer/consumer push model.

4.3 BL20 and CANopen

BL20 supports the following CANopen-functions:

- SDO transfer, any length of information
- Emergency object
- Sync frame evaluation
- Event-driven PDOs
- Synchronous PDOs (clock-synchronous)
- Remote-requested PDO/polling

4.3.1 EDS-file – electronic data sheet

CANopen nodes are embedded in the CANopen structure by the help of a standardized EDS file (Electronic Data Sheet).

The EDS file lists all necessary Objects with their corresponding Sub-indices and the matching entries.

The latest version of a particular EDS file can be downloaded directly from the Turck homepage www.turck.com.

5 Eco Gateway for CANopen

5.1 Introduction

This chapter contains a description of BL20-E-CO-gateways for the standardized fieldbus CANopen. The chapter is divided up as follows: a description of functions, general and specific technical data, a description of addressing and status displays.

5.1.1 Function

The BL20 gateways enable BL20 modules to operate on CANopen. The gateway is the connection between the BL20 modules and a CANopen host system. It regulates the process data between the I/O level and the fieldbus and generates diagnostic data for the higher-level host system.

Information is made available to the software tool I/O-ASSISTANT via the service interface.

5.2 Technical data

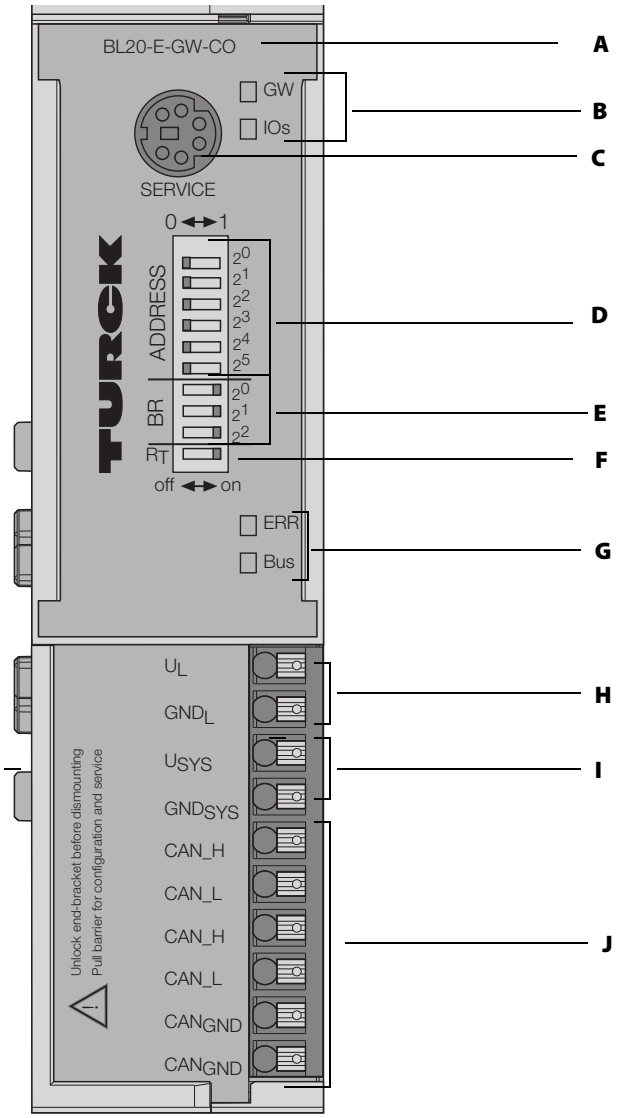


Fig. 1: Gateway BL20-E-GW-CO

A Type designation
B LEDs for BL20 module bus
C Service interface
D DIP switch for the Node-ID
E DIP-switch for the bit rate
F DIP-switch for terminating resistor
G LEDs for CANopen
H Push-In for field supply
I Push-In terminals for system supply
J CANopen, Push-In terminals

Structure of a BL20-ECO gateway

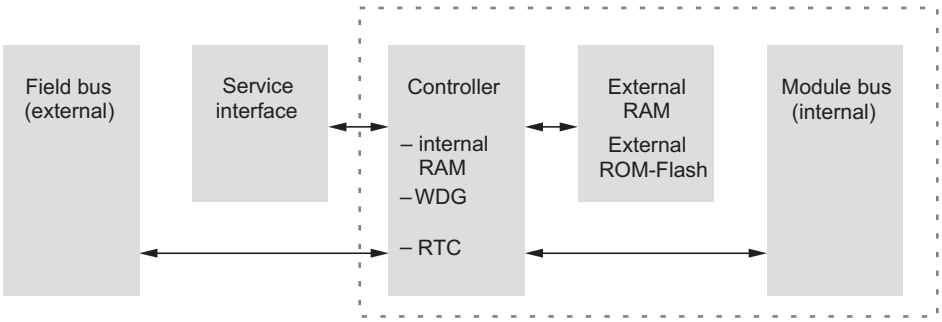


Fig. 2: Structure of a BL20-E-GW-CO

5.2.1 General technical data of a station

WARNING

Defective power supply unit

Danger to life due to dangerous voltages on touchable parts

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

Technical Data	
Supply voltage/auxiliary voltage	
U_{sys} (nominal value) provision for other modules	24 V DC
I_{sys} (at max. system extension)	Approx. 0.5 A
Permissible range	According to EN 61 131-2 (18…30 V DC)
Max. field current I_L	8 A
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 clamps, LSF from Weidmueller
Physical interfaces	
Fieldbus	
Protocol	CANopen
Transmission rate	20 kbps…1 Mbps
Isolation voltage (field bus to U_{sys} and U_L)	500 V_{eff}
Fieldbus connection technology	Push-in tension clamps LSF from Weidmueller

Technical Data	
Address setting	Via DIP-switches (address 1…63)
Service interface	
Connection technology	RS232 via PS2/mini DIN female connector
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/ 0.003 inch, 1g	Yes
57…150 Hz, constant acceleration 1 g	Yes
Mode of vibration	Frequency sweeps with a change in speed of 1 Octave/min
Period of oscillation	20 frequency sweeps per axis of coordinate
Shock resistant according to IEC 68-2-27	18 shocks, sinusoidal half-wave 15 g peak value/11 ms, in each case in ± direction per space coordinate
Resistance to repetitive shock according to IEC 68-2-29	1000 shocks, sinusoidal half-wave 25 g peak value/ 6 ms, in each case in ± direction per space coordinate
Drop and topple	
Height of fall (weight < 10 kg)	1.0 m
Height of fall (weight 10…40 kg)	0.5 m
Test runs	7
Device with packaging, electrically tested printed-circuit board.	
Electromagnetic compatibility (EMC) according to EN 50 50082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61000-4-6	10 V

Technical Data	
Fast transients (Burst) according to EN 61000-4-4	
Emitted interference according to EN 50081-2 (industry)	According to EN 55 55011 Class A, Group 1 Using the device in residential areas can cause disturbances. In this case, additional measures to suppress the disturbance are necessary.

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/-13 °F, duration 96 h; 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 61131-2)	2
Protection class according to IEC 529	IP20 (not evaluated by UL)
MTTF	486 years according toSN 29500 (Ed. 99) 20 °C

5.2.2 Technical data for the push-in tension clamp terminals

Designation	
Protection class	IP20 (not evaluated by UL)
Insulation stripping length	8 mm + 1/0.32 inch + 0,039
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 46228/1 (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 as well as the power supply connection are realized via Push-in tension clamp terminals.

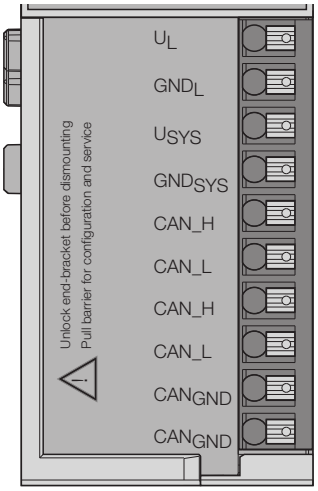


Fig. 3: Push-in tension clamp terminals at the gateway

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-CO has push-in tension clamps for:

- Field supply voltage (U_L, GND_L)

and

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

5.3.2 Fieldbus connection via push-in tension clamp terminals

Push-in tension clamp terminals are also used for the gateway's communication via CANopen.

The pin assignment for the tension clamp terminals is as follows: Connection options service-inter-

Designation	Description	
CAN_H	CAN Bus H	CAN-bus connection with T-function
CAN_L	CAN Bus L	
CAN_H	CAN Bus H	
CAN_L	CAN Bus L	
CAN_{GND}	CAN Bus Ground	
CAN_{GND}	CAN Bus Ground	

NOTE

Equipotential bonding impedance ≤ 1/10 shielding impedance.

face

The shielding of the field bus cable is established directly on the mounting rail using a SHLD terminal. In order to connect the service interface on the gateway with a PC and the I/O-ASSISTANT software (project planning and diagnostics software), a cable with a pin assignment, different from the PS2 standard pin assignment, has to be used: Standard commercial cables will have to be rewired!

- I/O-ASSISTANT-KABEL-BL20/BL67

5.3.3 Connection through an I/O-ASSISTANT cable

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

The service interface can be found under the upper label of the gateway. Pull the label upwards out of the housing in order to reach the service interface.

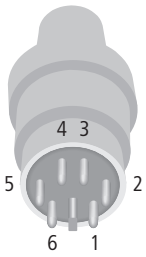


Fig. 4: PS/2 male connector on the connection cable to the gateway (top view)

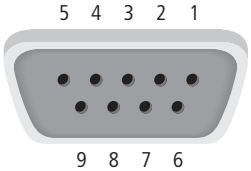


Fig. 5: 9-pole SUB-D female connector on the cable for connecting to PC (top view)

Pin	BL20 gateway PS/2 female connector	SUB-D interface at the PC	Pin
1	CLK	DTR, DSR	4, 6
2	GND	GND	5
3	DATA	–	–
4	n.c. (DATA2)	RxD	2
5	+5 V	RTS	7
6	n.c. (CLK2)	TxD	3

5.4 Setting the node ID

The setting of the Node-ID for the BL20-ECO gateway for CANopen is done via the DIP switches at the gateway.

These DIP switches can be found under the gateway's upper label.

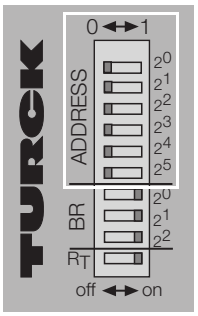


Fig. 6: DIP-switches at the gateway

NOTE

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

The Node-ID of an ECO gateway is limited to values of 1 to 63.
Other nodes at the CANopen bus can use Node-IDs up to 127. Each Node-ID can only be assigned once in the entire CANopen bus structure.

The gateway's field bus address results from the addition of the valences (2^0 to 2^5) of the active DIP-switches (position = 1).

Default setting:

0×3FH = ADR 63

Example:
Bus address 38 = 0×26 = 100110

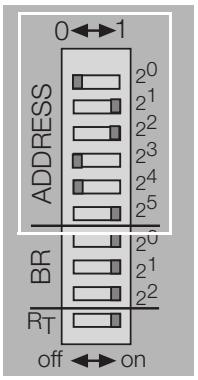


Fig. 7: Bus address 38

The internal module bus does not require any addressing.

5.5 Setting the bit rate

The gateway BL20-E-GW-CO offers 3 DIP switches for setting the bit rate (**BR**).

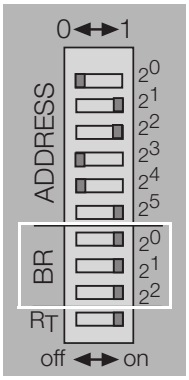


Fig. 8: DIP switches for setting the bit rate

DIP-switch no.	Bit rate autobaud	20 kbps	50 kbps	125 kbps	250 kbps	500 kbps	800 kbps	1 Mbps
2^0	1	0	1	0	1	0	1	0
2^1	1	1	0	0	1	1	0	0
2^2	1	1	1	1	0	0	0	0

5.5.1 Autobaud function

Autobaud is activated once after switching on the device. As soon as a valid bitrate has been detected, it will not be changed. The autobaud phase is signaled by alternating fast flashing (10 Hz) of the ERR LED (red) of the BUS LED (green).

5.6 Activation of the terminating resistor

If the gateway is used as the first or the last station in the bus communication, the fieldbus line has to be terminated using a terminating resistor.

The BL20-E-GW-CO allows the activation of the resistors $\mathbf{R_T}$ using the last DIP-switch.

Fig. 9: Bus terminating resistor switched off

Fig. 10: Bus terminating resistor switched on

5.7 Storing of the BL20 station configuration

When configuring the BL20 station for the first time or changing the existing station structure (module list), the current configuration must be transferred to the CANopen image of the BL20 gateway.

The configuration acceptance at this device is done via the DIP switches set to address 0.

Please proceed as follows:

1. Set the DIP switches at the gateway to a Node-ID ≠ "0".
2. Switch on the system supply U_{sys} and the field supply U_L.
3. Set the Node-ID to "0".
   → The device stores the station's configuration. This is indicated by the flashing of the "IOs" LED.
   → After the storage procedure, the "IOs" LED shortly flashes orange and than stops flashing. →The LEDs "Err" and "Bus" flash alternately red with 4 Hz due to the invalid Node-ID "0" which is still set at the gateway.
4. De-energize the gateway and set a Node-ID ≠ "0" at the gateway.
   → After power-on, the "IOs" LED changes to green after approximately 2 seconds.

NOTE

The green "IOs" LED indicates that the current BL20 configuration matches the stored reference module list.

If the new configuration stored to the gateway does not match the old configuration, all CANopen-parameters are set to their default values. Therefore it is necessary, to reload the whole station parameterization.

5.8 Status indicators/diagnostic messages

The gateway transmits the following diagnostics: the status of the BL20 station, the communication via the internal module bus, the communication to CANopen and the status of the gateway.

Diagnostics messages are indicated in two different ways:

- via the LEDs
- via the software of the respective higher (for example PLC)

5.8.1 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 CANopen communication (field bus LEDs): ERR and Bus

LED	Status	Meaning	Remedy
GW	Off	CPU not supplied.	Check the wiring at the gateway or at the Bus refreshing module.
	Green	5 V DC operating voltage is present; firmware is active; gateway is ready for operation and transfer	-
	Green flashing, 1 Hz	Undervoltage at U_{sys} or U_L	Check if the Power supply is within the permissible range.
	Green flashing, 1 Hz IOs: red	Firmware not active	Reload the firmware
	Green flashing, 4 Hz	Firmware active, gateway hardware error.	Replace the gateway.
IOs	Off	CPU not supplied.	Check the wiring Power supply output.
	Green	The modules configured correspond to the modules in the station, communication running.	-
	Green flashing, 1 Hz	Station is in the Force Mode of the I/O-ASSISTANT	Deactivate the Force Mode of the I/O-ASSISTANT
	Red and **GW** off	Controller is not ready, U_{sys} level is not within the required range.	Check the voltage supply Usys at the gateway.

LED	Status	Meaning	Remedy
IOs	Red	Module bus not ready-to operate	Check the correct mounting of the single BL20-modules
	Red flashing, 1 Hz	Non adaptable changes in the configuration of the module bus nodes	Compare the configured list of modules in your BL20-station to the current configuration. Check the physical station for defective or incorrectly plugged electronic modules.
	Red flashing, 4 Hz	No module bus communication	Check the station configuration and the voltage supply at the gateway and at the supply modules.
	Red/green flashing, 1 Hz	Adaptable changes in the configuration of the module bus nodes	Check the physical station for pulled or new but not planned modules.
ERR	Off	No errors in communication between the BL20-CANopen gateway and other CANopen nodes	–
	Red	Faulty or interrupted communication between BL20-CANopen gateway and other CANopen nodes. – CAN BusOff – Heartbeat error – Guarding error – Transmit timeout	– Check that the fieldbus ends with a termination resistor, if the BL20-CANopen gateway is the last node in the bus topology. – Check the CANopen cable for possible damage, and for correct connections – Check that the correct bit rate has been set. – Check that the NMT-master is still functioning properly.
BUS	Green	The modules configured correspond to the modules in the station, communication running.	-
	Red	NMT-slave state of the BL20-CANopen gateway is "Stopped"	– „Reset-Node“-command from NMTmaster for the respective node necessary. – If this command is not successful, execute a voltage reset.
	Orange	NMT-slave state of the BL20-CANopen gateway is "Preoperational"	„Start-Node“-command from NMT-master necessary.
ERR + BUS	Red flashing, alternately, 4 Hz	Invalid Node-ID set	Set the correct Node-ID with the DIP switches (1 to 63)
	Red flickering, alternately, 10 Hz	Autobaud function active	

6 BL20 - Communication in CANopen

NOTE

The CANopen-description for BL20 can be found in a separate manual "BL×× CANopen-object register" **D301230** under **www.turck.de**.

7 Guidelines for Station Planning

7.1 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.

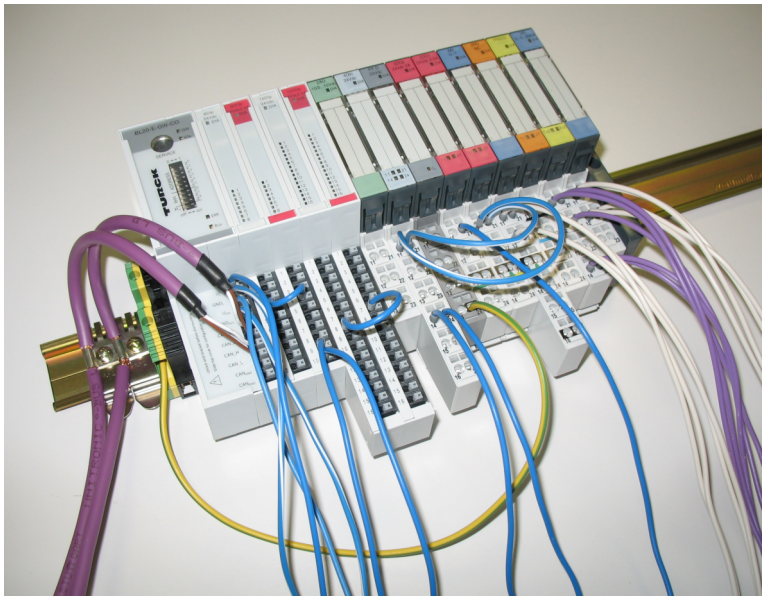


Abb. 1: Example of a station structure with ECO gateway (here for CANopen), Eco and standard I/O modules

NOTE

Only base modules with tension clamp connection and ECO modules can be used next tot the gateway.

To be able to use base modules with screw connection, a supply module (BR or PF) with screw connection must first be configured.

7.1.1 Complete planning

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

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

7.1.2 Maximum system extension

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

- Die maximum number of 252 communications bytes, which are transferred via the module bus from the gateway to the modules may not be exceeded (see below Communication bytes and nominal current consumptions of the BL20 modules).
- If the maximum sum of the modules' nominal current consumptions right to the gateway (max. sum 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**.
- The station extension may not exceed the maximum number of 62 modules.

Further limitations can occur using Power Feeding modules BL20-PF-24VDC-D/BL20-PF-120/230VACD. They are used to build up potential groups or in case of insufficient power supply. 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 "Station Verify station".

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

Module	No. of communication bytes	Nominal current consumption at the module bus
BL20-BR-24VDC-D	2	-
BL20-PF-24VDC-D	2	28 mA
BL20-PF-120/230VAC-D	2	25 mA
BL20-2DI-24VDC-P	1	28 mA
BL20-2DI-24VDC-N	1	28 mA
BL20-2DI-120/230VAC	1	28 mA
BL20-4DI-24VDC-P	1	29 mA
BL20-4DI-24VDC-N	1	28 mA
BL20-4DI-NAMUR	5	40 mA
BL20-E-8DI-24VDC-P	1	15 mA
BL20-E-16DI-24VDC-P	2	15 mA
BL20-16DI-24VDC-P	2	45 mA
BL20-32DI-24VDC-P	4	30 mA
BL20-1AI-I(0/4...20MA)	3	41 mA
BL20-2AI-I(0/4...20MA)	5	35 mA
BL20-1AI-U(-10/0...+10VDC)	3	41 mA

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

7.2 Power supply

7.2.1 Power supply to the gateway

The gateway is supplied via the push-in cage clamp terminals on the gateway (**chapter 5 Spannungsversorgung**, s. **S. 21**).

7.2.2 Module bus refreshing

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

NOTE

The sum of the nominal current consumptions of the modules following directly the gateway BL20-E-GW-CO must 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-CO have to be combined with the base modules BL20-P3T-SBB-B or BL20-P4T-SBBC-B (tension clamp) or with the base modules BL20-P3S-SBB-B or BL20-P4S-SBBC-B (screw terminals).

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

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

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

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

7.2.3 Creating potential groups

Bus Refreshing and Power Feeding modules can be used to create potential groups. The potential isolation of potential groups to the left of the respective power distribution modules is provided by the base modules. Ensure that the correct base modules are planned for when using Bus Refreshing modules.

NOTE

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

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

NOTICE

Common potential of 24 VDC and 230 VAC field supply

Destruction of electronic

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

7.2.4 C-rail (cross connection)

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

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

Abb. 2: C-rail (front view)

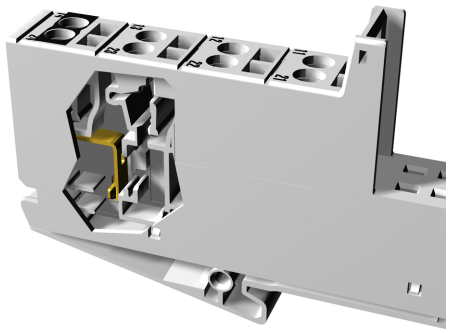


Abb. 3: C-rail front (side view)

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.

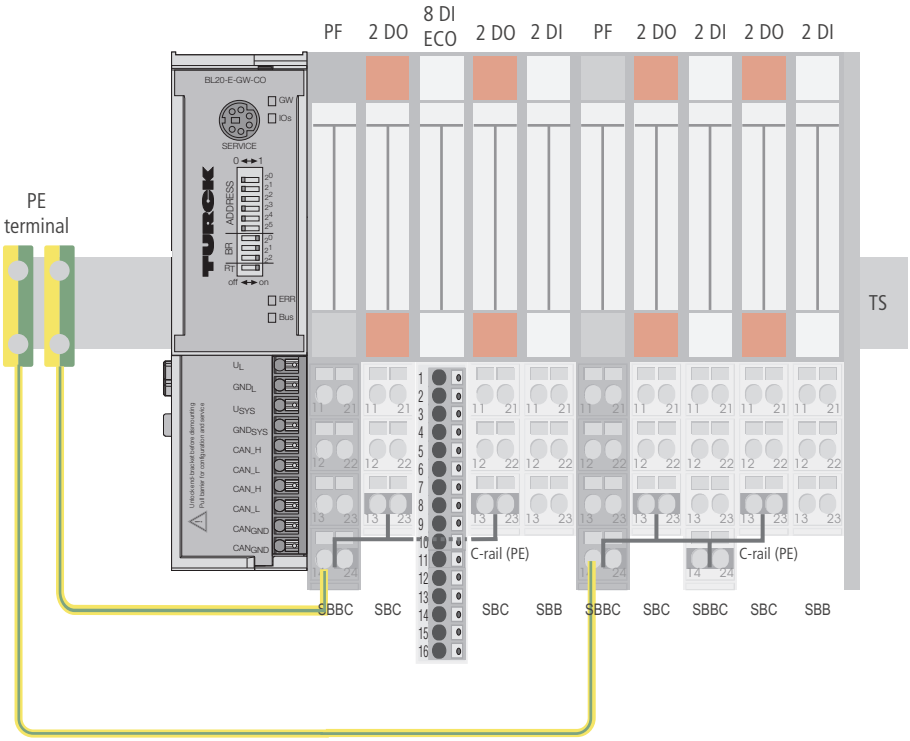


Abb. 4: Using the C-rail as a protective earth

NOTE

For information about introducing a BL20 station into a ground reference system, please read **chapter 8, Guidelines for Electrical Installation**.

C-rails can be used for a common voltage supply 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.

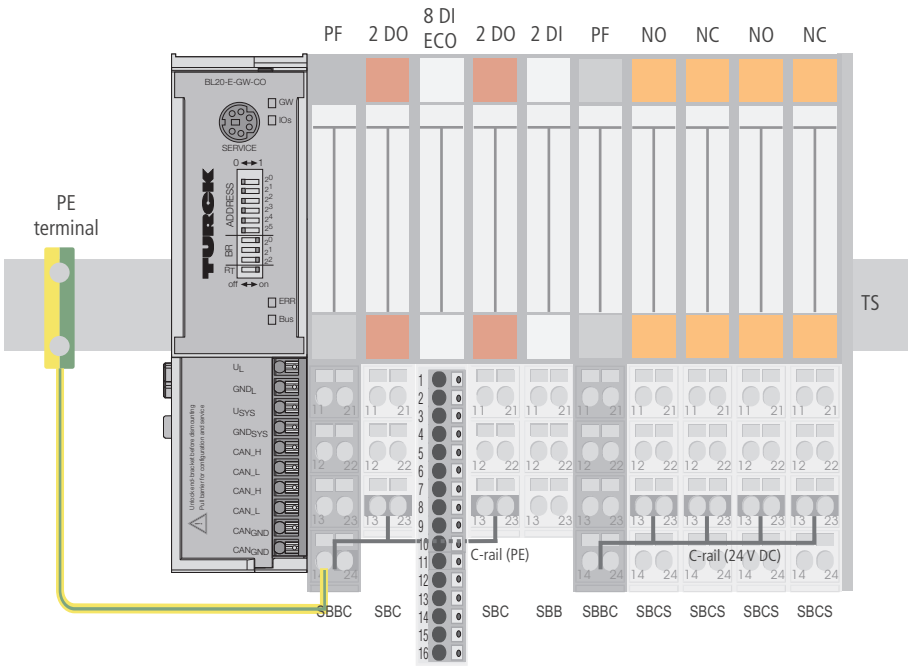


Abb. 5: Using the C-rail as protective earth and for the power supply with relay modules

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

7.2.5 Direct wiring of relay modules

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

7.3 Protecting the service interface on the gateway

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

7.4 Plugging and pulling electronics modules

BL20 enables the pulling and plugging of electronics modules without having to disconnect the field wiring. The BL20 station remains in operation if an electronics module is pulled. The voltage and current supplies as well as the protective earth connections are not interrupted

NOTICE

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

7.5 Extending an existing station

NOTICE

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

7.6 Firmware download

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

NOTICE

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

8 Guidelines for Electrical Installation

8.1 General notes

8.1.1 General

Cables should be grouped together, for example: signal cables, data cables, heavy current cables, power supply cables.

Heavy current cables and signal or data cables should always be routed in separate cable ducts or bundles. Signal and data cables must always be routed as close as possible to ground potential surfaces (for example support bars, cabinet sides etc.).

8.1.2 Cable routing

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

Cable routing inside and outside of cabinets

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

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

Group 1:

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

Group 2:

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

Group 3:

- unshielded cables for DC and AC voltages > 400 V

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

- Group 1/Group 2

The group combinations:

Group 1/Group 3 and Group 2/Group 3

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

Cable routing outside buildings

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

WARNING

Insufficient lightning protection measures

Risk of death due to lightning strike

➤ When installing cables outside buildings, observe all applicable guidelines for internal and external lightning protection and all earthing regulations.

8.1.3 Lightning protection

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

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

8.1.4 Transmission cable

The slaves on the bus are connected to one another with fieldbus lines that correspond to the DeviceNet specification (ODVA Spec. Rel. V2.0).

The bus cables must be terminated at the beginning and end with a bus terminating resistor. This can be connected via the number DIP switch RT on the gateway.

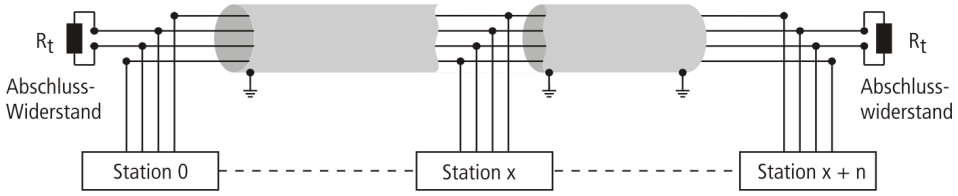


Abb. 1: Representation of a bus cable

Cable types

Turck offers a variety of cable types for field bus lines as pre-molded or bulk cables with different connectors.

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

8.2 Potential relationships

8.2.1 General

The potential relationship of a CANopen 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.
- Separate power supplies for the system and the field level allow a potential-free installation.

The block diagram shows the arrangement of a typical BL20 with the ECO gateway BL20-E-GW-CO.

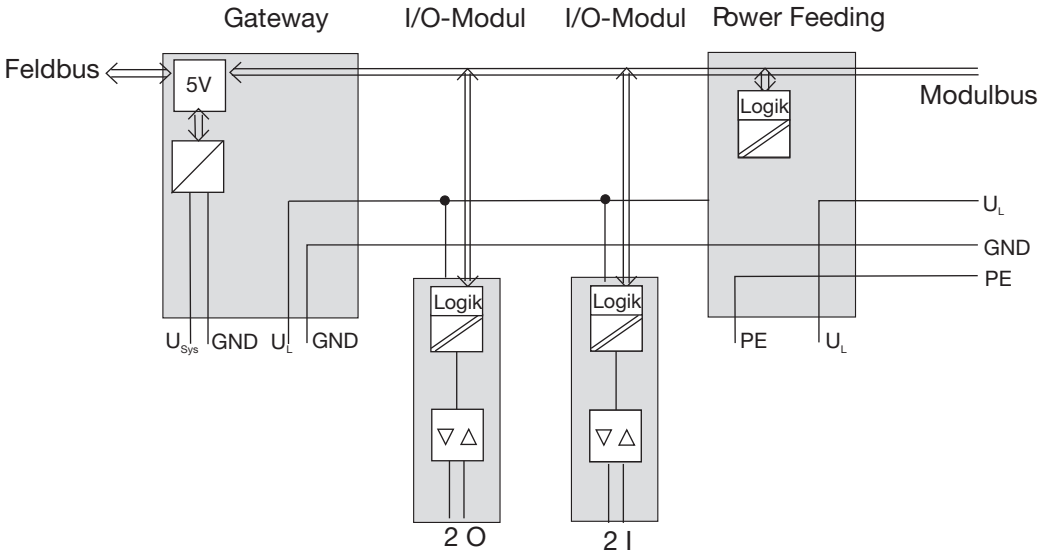


Abb. 2: Block diagram BL20-station with ECO-CANopen-gateway

8.2.2 Potential-free installation

In a potential-free installation, the reference potentials of control and load circuitry are galvanically isolated from each other.

A potential-free installation is necessary with

- All AC load circuits (for example, when using the Power Feeding module BL20-PF-120/230VAC-D)
- Floating DC load circuits

The potential-free installation does not depend on the method of grounding.

8.3 Electromagnetic compatibility (EMC)

BL20 products comply in full with the requirements pertaining to EMC regulations. Nevertheless, an EMC plan should be made before installation. Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

8.3.1 Ensuring electromagnetic compatibility

The EMC of BL20 modules is guaranteed when the following basic rules are adhered to:

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

8.3.2 Grounding of inactive metal components

All inactive metal components (for example: switchgear cabinets, switchgear cabinet doors, supporting bars, mounting plates, top-hat rails, etc.) must be connected to one another over a large surface area and with a low impedance (grounding). This guarantees a standardized reference potential area for all control elements and reduces the influence of coupled disturbances.

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.
- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

WARNING

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

8.3.3 PE connection

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

8.3.4 Earth-free operation

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

8.3.5 Protection against high frequency interference signals

In order to comply with radiation limit values in accordance with EN 55 011/2 000, the supply lines for supplying the gateway with power are to be fed through a ferrite ring (PS416-ZBX-405). This is to be placed immediately next to the connection terminals. devices. From there on, it is not permitted to make connections to further

8.3.6 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

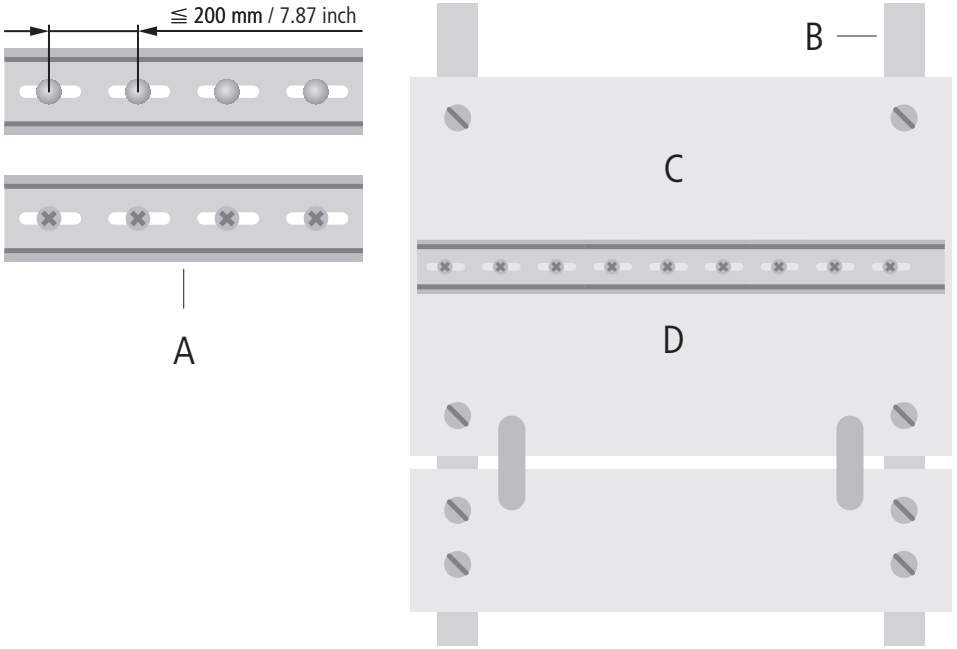
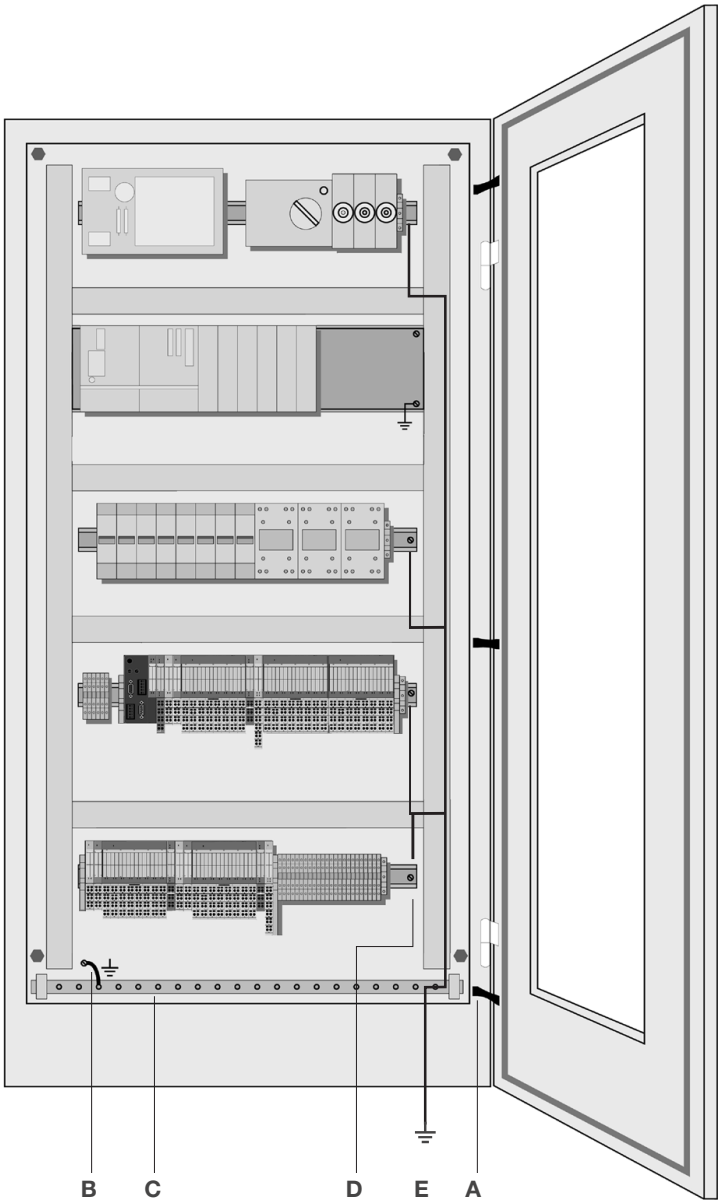


Abb. 3: Mounting options
A *TS 35*
B *Mounting rail*
C *Mounting plate*
A *TS 35*

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

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

8.3.7 EMC compliant cabinet installation



EMC compliant cabinet installation

A *Bonding straps*
Bonding straps connect inactive metal components, if it is not possible to create a large surface area contact. Use short bonding straps with large surface areas.

B *Mounting plates*
Mounting plates used to hold control components must have a large surface area contact with the cabinet housing.

C *Protective conductor rail*
The protective conductor rail must also be connected over a large surface area to the mounting plates and additionally with an external cable (cross-section at least 10 mm2/0,015 inch2) to the protective conductor system to avoid interference currents.

D *Protective conductor terminal block*
The protective conductor terminal block must be connected to the protective conductor rail.

E *Protective conductor system cable (grounding point)*
The cable must be connected over a large surface area with the protective conductor system.

8.4 Shielding of cables

Shielding is used to prevent interference from voltages and the radiation of interference fields by cables. Therefore, use only shielded cables with shielding braids made from good conducting materials (copper or aluminum) with a minimum degree of coverage of 80%.

The cable shield should always be connected to both sides of the respective reference potential (if no exception is made, for example, such as high-resistant, symmetrical, analog signal cables). Only then can the cable shield attain the best results possible against electrical and magnetic fields.

A one-sided shield connection merely achieves an isolation against electrical fields.

NOTE

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

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

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is used in stationary operation The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

The cable shield should not be severed, but routed further within the system (for example, to the switchgear cabinet), right up to the interface connection.

NOTE

Should it not be possible to ground the shield on both sides due to switching arrangements or device specific reasons, then it is possible to route the second cable shield side to the local reference potential via a capacitor (short connection distances). If necessary, a varistor or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.

A further possibility is a double-shielded cable (galvanically separated), whereby the innermost shield is connected on one side and the outermost shield is connected on both sides.

8.4.1 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.

Connection 1				**Connection 2**
CAN_H	0	---------	0	CAN_H
CAN_L	0	---------	0	CAN_L
GND	0	---------	0	GND

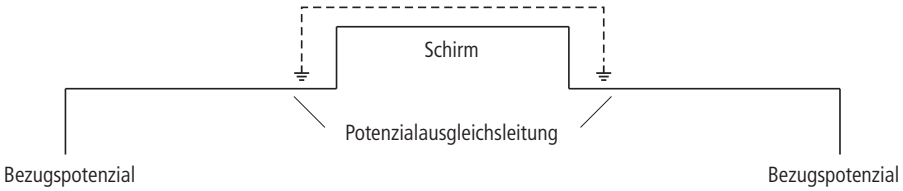


Abb. 4: Potential compensation

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.

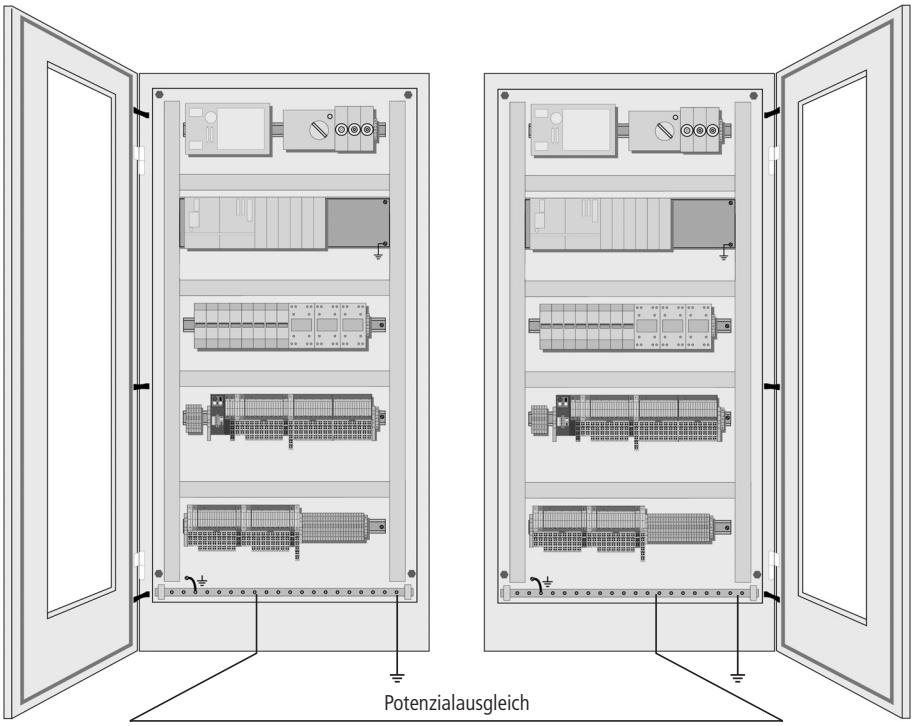


Abb. 5: Potential compensation Between switch cabinets

8.4.2 Switching inductive loads

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

8.4.3 Protection against Electrostatic Discharge (ESD)

NOTICE

Exposed metal contacts

Material damage due to electrostatic discharge

➤ Avoid to touch the metallic contacts with bare hands

9 BL20-Approvals for Zone 2/Division 2

NOTE

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

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