Your Global Automation Partner

TURCK

BL20
I/O Modules

Instructions for Use

1 About These Instructions

These operating instructions describe the structure, functions and the use of the product and will help you to operate the product as intended. Read these instructions carefully before using the product. This is to avoid possible damage to persons, property or the device.

Retain the instructions for future use during the service life of the product. If the product is passed on, pass on these instructions as well.

1.1 Documentation concept

This manual contains all information about the bus-independent I/O-modules for the modular Turck IP20 I/O system BL20.

The following chapters contain a short BL20 system description, exact descriptions of the I/O-modules' functionality and their Technical data as well as all general information concerning the whole system as for example mounting/dismounting, labeling etc. In addition to that, the manual contains a short description of the BL20 DTM in PACTware.

The bus-specific BL20-gateways, the connection to the different automation devices, the maximum system extension as well as all other bus specific information are described in separate manuals (**www.turck.de**).

1.2 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.

ATTENTION
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

1.2.1 Additional documents

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

- Data sheet
- Declaration of Conformity

1.2.2 Prescribed use

The devices described in this manual must be used only in applications prescribed in this manual or in the respective technical descriptions, and only with certified components and devices from third party manufacturers.

Appropriate transport, storage, deployment and mounting as well as careful operating and thorough maintenance guarantee the trouble-free and safe operation of these devices.

2 Notes on the Product

2.1 Product Identification

These instructions apply to the BL20 /IO modules.

2.2 Legal Requirements

The device falls under the following EU directives:

- 2014/30/EU (electromagnetic compatibility)

2.3 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/products**

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 I/O modules are part of the BL20 system. They provide the I/O-functions and can only be used in combination with a BL20 gateway, the interface to the higher level controllers.

The devices may only be used as described in this manual. 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 BL20 I/O System

BL20 is a modular I/O system for use in industrial automation. It connects the sensors and actuators in the field with the higher-level master.

BL20 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (counters, RS232 interface...)

A complete BL20 station counts as **one** station on the bus and therefore occupies **one** fieldbus address in any given fieldbus structure.
A BL20 station consists of a gateway, power distribution modules and I/O modules.

The connection to the relevant fieldbus is made via the bus-specific gateway, which is responsible for the communication between the BL20 station and the other fieldbus stations.

The communication within the BL20 station between the gateway and the individual BL20 modules is regulated via an internal module bus.

NOTE
The gateway is the only fieldbus-dependent module on a BL20 station. All other BL20 modules are not dependent on the fieldbus used.

4.1 BL20 components

4.1.1 Gateways

The gateway connects the fieldbus to the I/O modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the BL20 DTM.

ECO Gateways

The BL20-ECO gateways enlarge the product portfolio of BL20. They offer an excellent cost/ performance ratio.

Further advantages of the gateways in the ECO housing:

- At the moment available for PROFIBUS-DP, DeviceNet, CANopen, Modbus TCP, Modbus RTU/ ASCII, EtherNet/IP, EtherCAT and PROFINET
- Low required space: width 34 mm/ 1.34 inch minimal space requirements
- Can be combined with all existing standard modules (with tension clamp connection technology) and ECO modules
- Simple wiring with ”Push-in” tension clamp terminals, via DeviceNet-Open Style Connector or via Ethernet RJ45-connectors
- Automatic bit rate detection for PROFIBUS-DP and DeviceNet
- Setting of fieldbus address and bus terminating resistor (PROFIBUS-DP, DeviceNet, CANopen) via DIP-switches
- Service interface for commissioning with DTM (without PLC).

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

Gateways with integrated power supply

All standard gateways BL20-GWBR-××× as well as the BL20-gateways for DPV1 and Ethernet (BL20-GW-DPV1, BL20-GW-EN, BL20-GW-EN-IP, BL20-GW-EN-PN, BL20-PG-EN and BL20-PG-EN-IP) offer an integrated power supply unit for feeding the gateway and the connected I/O modules.

It is not necessary to supply each individual module with a separate voltage.

Gateways without integrated power supply

NOTE

The gateways without integrated power supply unit need an additional power supply module (bus refreshing module) which feeds the gateway an the connected I/O modules.

4.1.2 Power distribution modules

The power supply for gateways and I/O modules is fed
to the power distribution modules; therefore, it is not necessary to supply each individual module with a separate voltage.

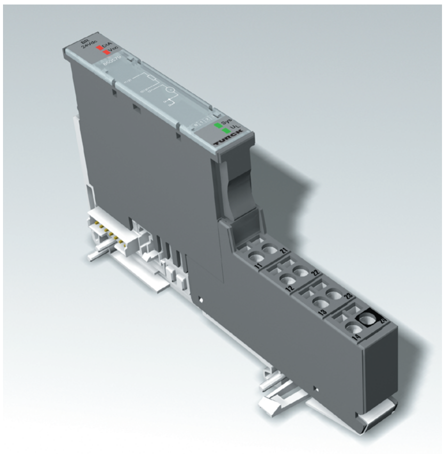

Fig. 2: Power distribution module

4.1.3 Electronics modules (standard product line)

The standard electronics modules contain the I/O-functions of the BL20 modules (power distribution modules, digital and analog input/output modules, and technology modules).

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

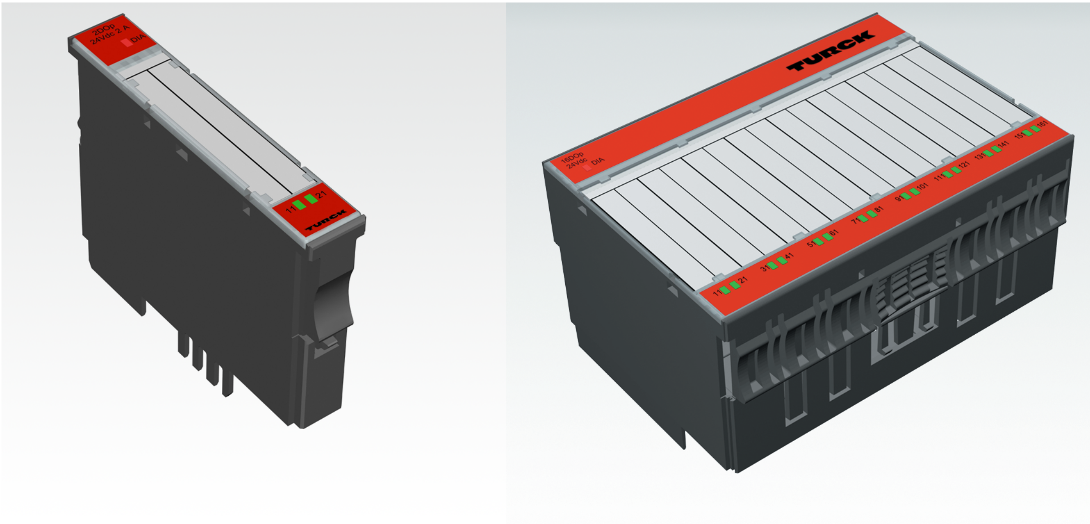

Fig. 3: Electronics module in slice design (left) and in Block design (right)

4.1.4 ECO electronics modules

New ECONOMY modules with a high signal density and exceptionally low channel price expand the BL20 I/O bus terminal system.

Depending on type, up to 16 digital inputs and outputs can be connected on only 13 mm. This high connection density considerably reduces the mounting width required for typical applications.

All advantages at a glance:

- Space saving thanks to 16 channels on 13 mm/ 0.51 inch width
- Cost saving thanks to electronics with integrated connection level
- High signal density
- Tool-less connection via "push-in" spring-type terminal technology for simple and fast mounting
- Flexibility in combining them with standard I/O-modules in tension clamp technology, the standard- and the ECO-gateways.
- Simple assembly reduces error sources

Fig. 4: ECO I/O module

4.1.5 Base modules

The field wiring is connected to the base modules. These are constructed as terminals in block and slice designs and are available in the following variations with either tension clamp or screw connections: 2-/3-wire (2-channel), 4-wire (2-channel) and 4 x 2-/3-wire (4-channel).

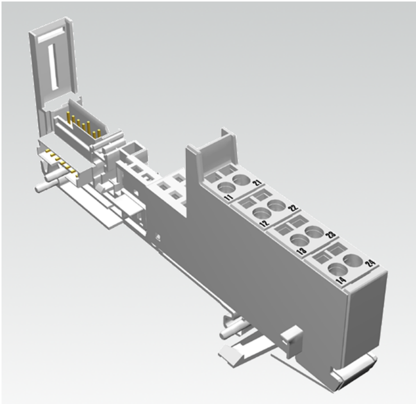

Fig. 5: Base module with tension clamp connection

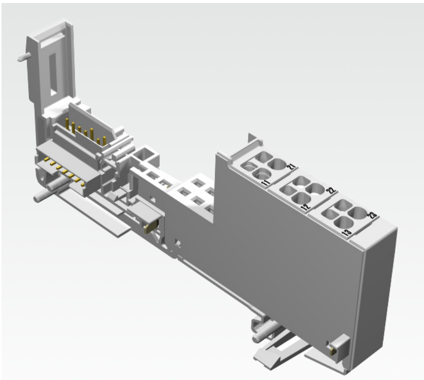

Fig. 6: Base module with screw connection

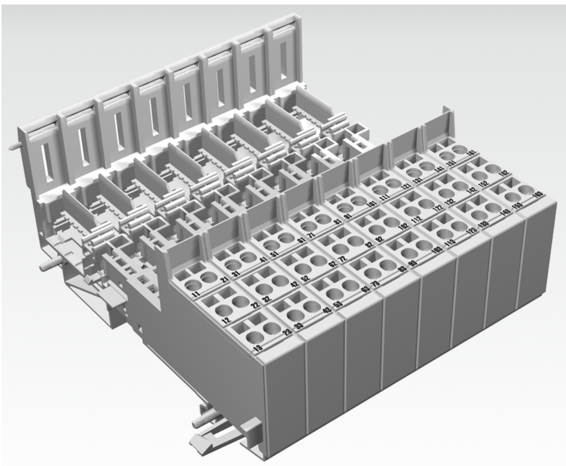

Fig. 7: Base module in block design

4.1.6 End plate

An end plate on the right-hand side physically completes the BL20 station. An end bracket mounted into the end plate ensures that the BL20 station remains secure on the mounting rail even when subjected to vibration.

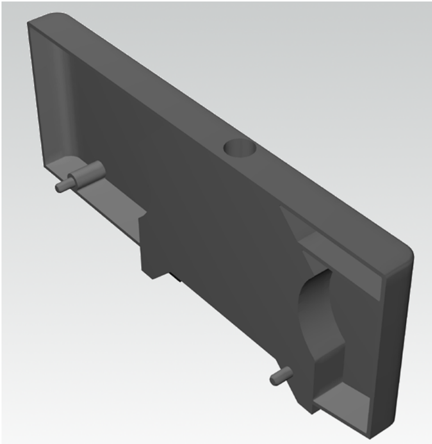

Fig. 8: End plate

4.1.7 End bracket

A second end bracket to the left of the gateway is necessary, as well as the one mounted into the end plate to secure the station.

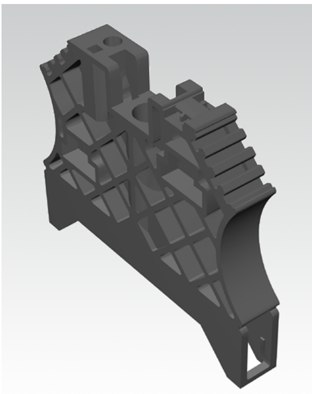

Fig. 9: End bracket

NOTE
The end plate and two end brackets are delivered with the gateway.

4.1.8 Jumpers

Jumpers (QVRs) are used to bridge a connection level of a 4-wire base module. They can be used to connect potentials in relay modules (bridging the relay roots); thus considerably reducing the amount of wiring.

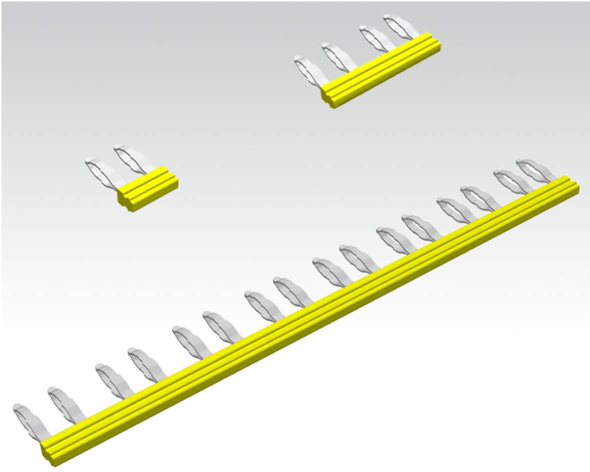

Fig. 10: Jumpers

4.1.9 Marking material

- Labels: for labeling BL20 electronics modules.
- Markers: for colored identification of connection levels of BL20 base modules.
- Dekafix connector markers: for numbering the mounting slots on BL20 base modules.

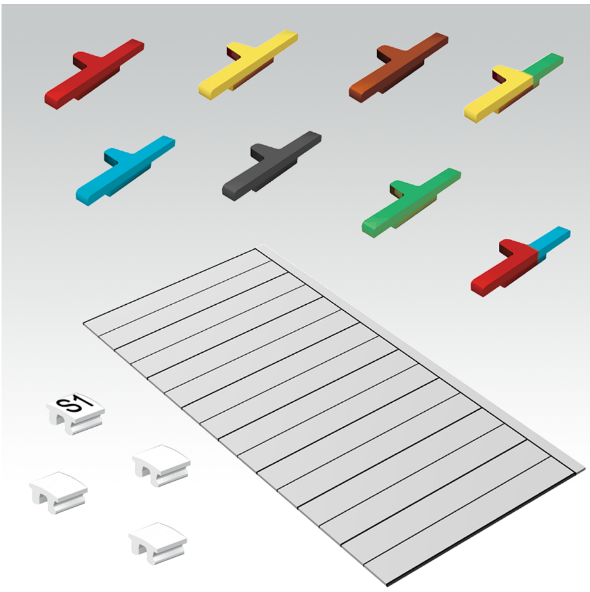

Fig. 11: Marking material

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4.1.10 Shield connection gateway

If the gateway is wired directly to the fieldbus, it is possible to shield the connection using a special gateway-shielding connection attachment (BS3511/KLBUE4-31.5).

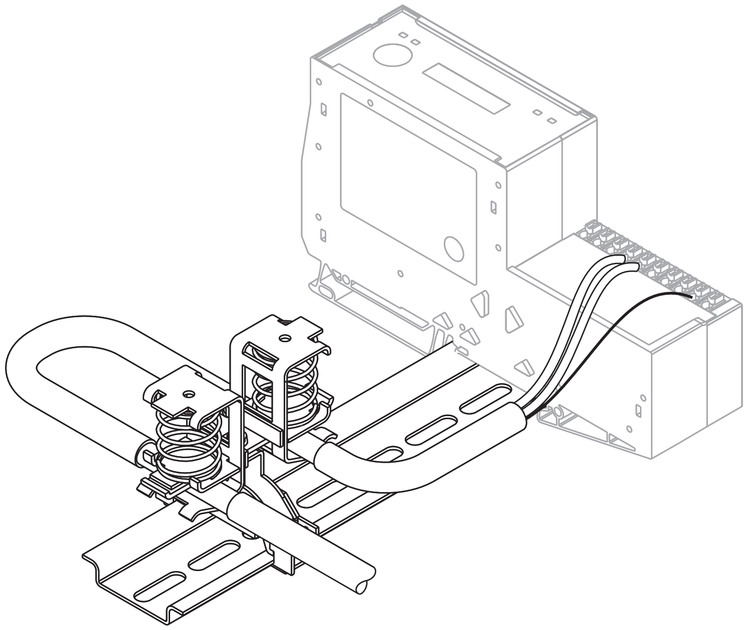

Fig. 12: Shield connection (gateway)

5 General Technical Data of BL20 Modules

This chapter describes the general Technical data valid for all BL20 modules.

The following chapters contain all information about the BL20 I/O, power supply and base modules as well as all module specific Technical data.

NOTE
The Technical data, diagnostic options as well as the parameterizing options for the gateways as well as all other fieldbus specific information are described in the bus-specific manuals for the BL20 gateways.
An overview of all electronic modules and the appropriate base modules can be found in the Appendix.

5.1 Station dimensions

5.1.1 Dimensions for electronics modules

Dimensions in mm / inch (w × l × h)	
Slice design	12.6 × 74.1 × 55.4 / 3.97 × 2.92 × 2.18
Block design	100.8 × 74.1 × 55.4 /3.97 × 5.07 × 1.96

5.1.2 Dimensions for base modules

Dimensions in mm / inch (w × l × h)	
Slice design	
2-/3-wire connection technology	12.6 × 117.6 × 49.9 /3.97 × 5.07 × 1.96
4-wire connection technology	12.6 × 128.9 × 49.9 /3.97 × 5.07 × 1.96
4 × 2-/3-wire connection technology	12.6 × 154.5 × 49.9 /3.97 × 5.07 × 1.96
Block design	
2-/3-wire connection technology	100.8 × 117.6 × 49.9 /3.97 × 5.07 × 1.96
4-wire connection technology	100.8 × 128.9 × 49.9 /3.97 × 5.07 × 1.96
4 × 2-/3-wire connection technology	100.8 × 154.5 × 49.9 /3.97 × 5.07 × 1.96

5.1.3 Dimension drawing

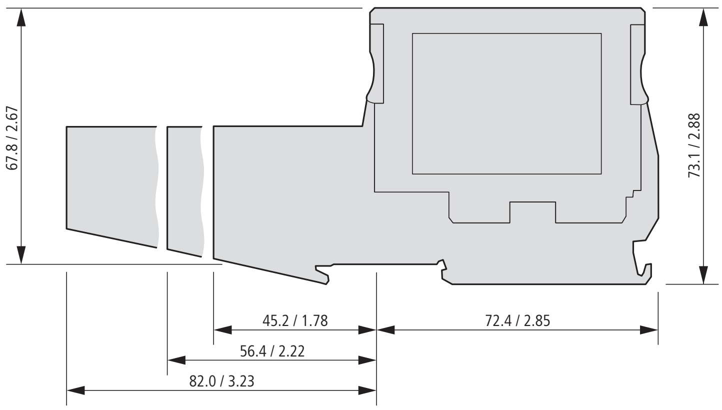

Fig. 13: Side view complete BL20 module (with tension clamp connection)

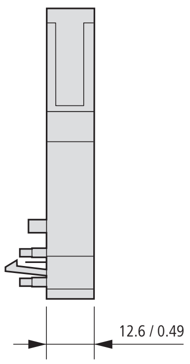

Fig. 14: Rear view of complete BL20 module in slice design

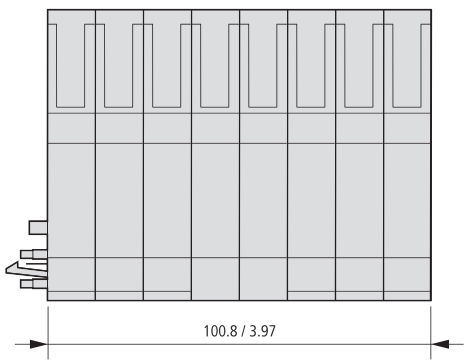

Fig. 15: Rear view of complete BL20 module in block design

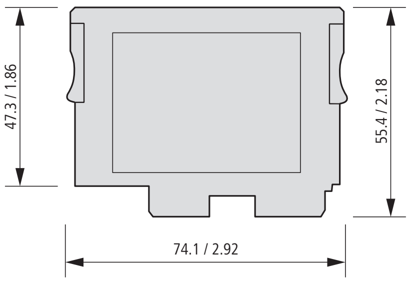

Fig. 16: Side view electronic module

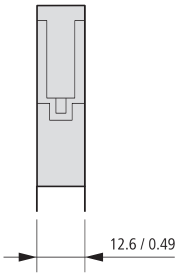

Fig. 17: Rear view of electronic module in slice design

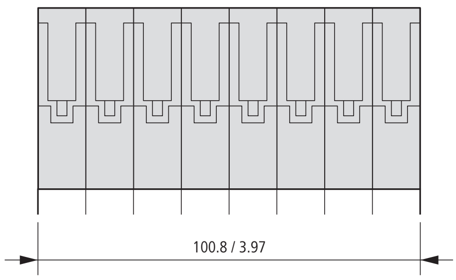

Fig. 18: Rear view of electronic module in block design

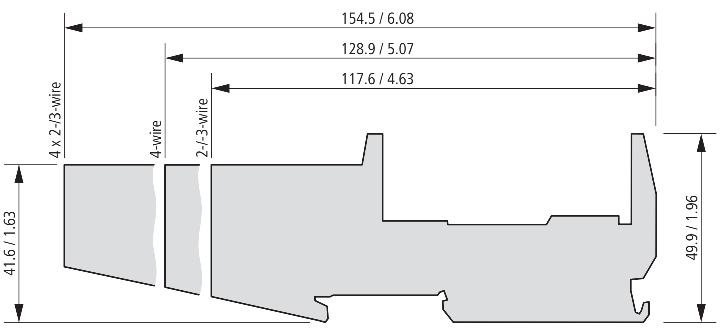

Fig. 19: Base module with tension clamp connection

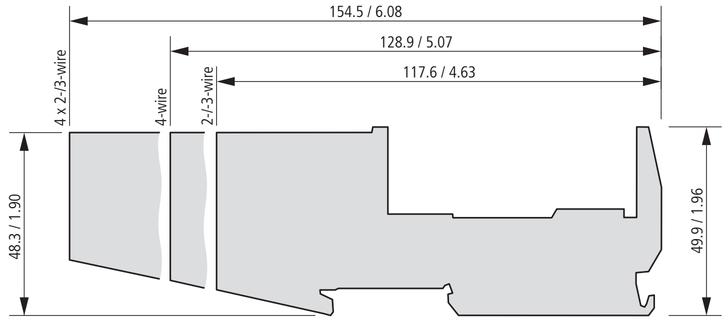

Fig. 20: Base module with screw connection

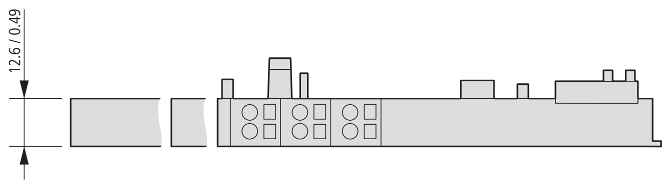

Fig. 21: Base module in slice design (top view)

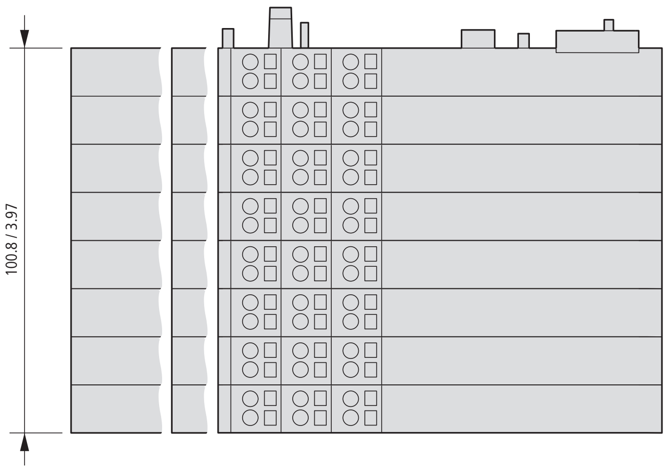

Fig. 22: Base module in block design (top view)

5.1.4 Dimensions of the BL20-ECO modules

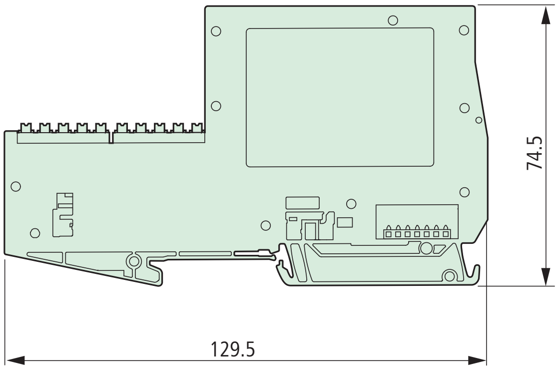

Fig. 23: Side view BL20-E-8D×

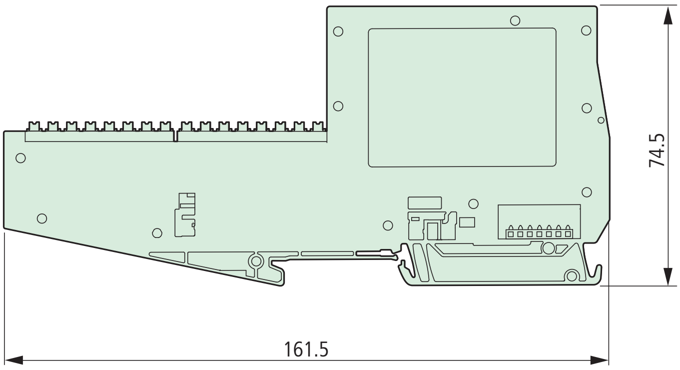

Fig. 24: Side view BL20-E-16D×

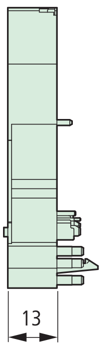

Fig. 25: Rear view BL20-E-… complete module

5.2 General technical data

ATTENTION!
Disregarding the SELV-range
Destruction of components
➤ The auxiliary power supply must comply with the stipulations of SELV (Safety Extra Low Voltage) according to IEC 60364-4-41.

Technical data	
Supply voltage/auxiliary voltage	
Nominal value (provision for other modules)	24 V DC
Permissible range	18…30 VDC According to EN 61131-2
Residual ripple	According to EN 61131-2
Electrical isolation	Yes, via opto-coupler
Ambient conditions	
Operating temperature horizontal/vertical mounting	0 …+55°C For vertical installation, the gateway can be positioned both at the top and bottom. Sufficient ventilation and heat dissipation must be ensured.
Modules with extended temperature range	-25…+60 °C
Storage temperature	- 25…+85 °C
Relative humidity	5…95 %
Climatic tests	According to IEC 61131-2
Corrosive gas	– SO_2 10 ppm (rel. humidity < 75 %, no condensation)
	– H_2S 1.0 ppm (rel. humidity < 75 %, no condensation)
Resistance to vibration according to IEC 61131-2	
10 to 57 Hz, constant amplitude 0.075 mm / 0.003 inch, 1g	Yes
57 to 150 Hz, constant acceleration 1 g	Yes
Mode of vibration	Frequency sweeps with a change in speed of 1 Octave/min
Period of oscillation	20 frequency sweeps per axis of coordinate
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 to 40 kg)	0.5 m

Technical data	
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 61 61000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61000-4-6 I/O-line-length ≤ 30 m	10 V
Static electricity according to EN 61 000-4-4	
Emitted interference according to EN 50 50081-2 (industry)	According to EN 55 55011 Class A, Group 1
Reliability	
Pull/plug cycles of electronic modules	20
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
Temperature change	DIN IEC 68-2-14, temperature 0 to +55 °C / 32 to 131 °F, duration 2 cycles, temperature change per minute; device in use
Pollution severity according to IEC 664 (EN 61 61131-2)	2
Protection class according to IEC 60529	IP20 (not evaluated by UL)

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.

5.2.1 Approvals

Approvals
CE
cULus

5.2.2 Technical data of the base modules

	BL20	BL20 Economy
Protection class	IP 20	IP 20
Insulation stripping length	8 mm	8 mm
Max. wire range	0.5 to 2.5 mm^2/20 to 12 AWG	0.14 to 1.5 mm^2/6 to 16 AWG
Crimpable wire		
"e" solid core H 07V-U	0.5 to 2.5 mm^2/20 to 12 AWG	0.25 to 1.5 mm^2/20 to 12 AWG
"f" flexible core H 07V-K	0.5 to 1.5 mm^2/20 to 12 AWG	0.25 to 1.5 mm^2/20 to 12 AWG
"f" with ferrules according to DIN 46228/1 (ferrules crimped gas-tight)	0.5 to 1.5 mm^2/20 to 12 AWG	0.25 to 1.5 mm^2/20 to 12 AWG
Plug gauge according to IEC 947-1/1988	A1	A1
Max. torque for screw connection technology	0.4 to 0.6 Nm	-
Measurement data according to VDE 0611 Part 1/8.92/ IEC 947-7-1/1989		
Rated voltage	250 V	250 V
Rated current	10 A	10 A
Rated cross section	1.5 mm^2	1.5 mm^2
Rated surge	4 kV	4 kV
Rated temperature	Min. 75 ° C	Min. 75 °C
Pollution severity	2	2
TOP connection technology	Tension clamp or screw connection	Screw connection

6 Power Distribution Modules

6.1 Power distribution (power feeding modules)

Power Feeding modules distribute the required 24 VDC or 120/230 VAC field voltage to the I/O modules. They are necessary when groups of modules with different potentials are planned within a BL20 station, or if the rated supply voltage cannot be guaranteed. The adjoining power supply module and modules to the left are potentially isolated.

NOTE
Power Feeding modules cannot be used to distribute 5 VDC to BL20 gateways.

By using Power Feeding modules, it is not necessary to distribute power separately to each BL20 I/O module.

Power Feeding modules are available in slice design. They are mounted on to base modules with tension clamp or screw connections. The dusty grey color of the base modules for Power Feeding modules clearly distinguishes them from the base modules designed for BL20 I/O modules.

LED displays

Error signals and diagnostic statuses are indicated via LEDs on the module. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

Module overview

- BL20-PF-24VDC-D
- BL20-PF-120/230VAC-D

6.2 Power Feeding module, 24 VDC, with diagnostics

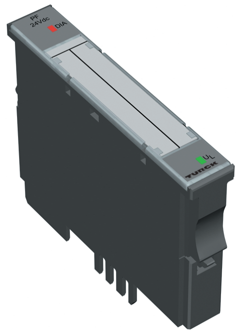

Fig. 26: BL20-PF-24VDC-D

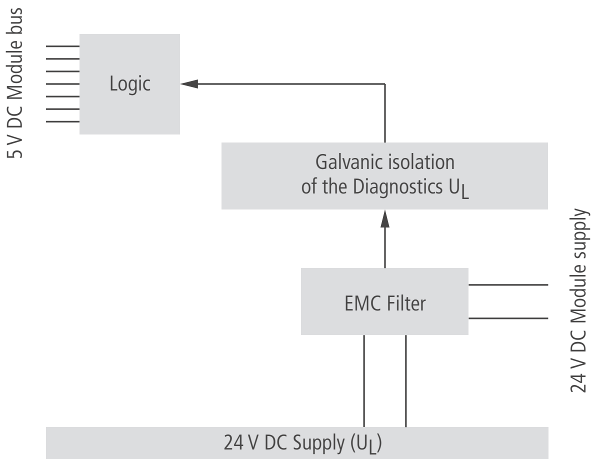

Fig. 27: Block Diagram

6.2.1 Technical data

Technical data	
Designation	BL20-PF-24VDC-D
Nominal voltage	24 VDC
Permissible range	18…30 VDC
Field supply UL	24 VDC
Permissible range	18…30 VDC
Nominal current from module bus I_{MB}	≤ 28 mA
Ripple	< 5 %
Residual ripple	According to EN 61131-2
Maximum operating current I_{EI}	10 A
Voltage anomalies	According to EN 61 000-4-11/ EN 61 131-2

6.2.2 Diagnostic and status messages

The diagnostic functions monitor the supply voltages (system and field supply) supplied by the user for undervoltage. The diagnostic functions indicate errors via the "DIA" LED and transmit the corresponding diagnostic information to the gateway.

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	Check the wiring to the field power supply. Check if the voltage for the field supply is within the permissible range.
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
U_L	Green	Field power supply via external power supply unit OK	–
	Off	Field power supply via external power supply unit faulty	Check the wiring to the field power supply. Check the external power supply unit.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	No field voltage	-	-

- "No field voltage"
  Monitoring of the external power supply to the field

6.2.3 Base modules

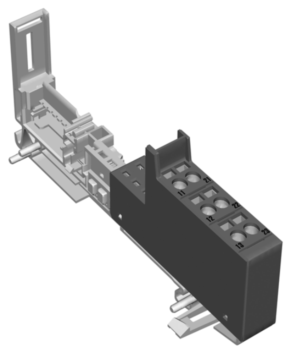

Fig. 28: Base module BL20-P3T-SBB

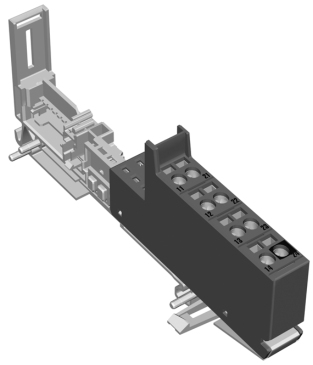

Fig. 29: Base module BL20-P4T-SBBC

- with tension clamp connection
  BL20-P3T-SBB
  BL20-P4T-SBBC
- with screw connection
  BL20-P3S-SBB
  BL20-P4S-SBBC

6.2.4 Wiring diagram

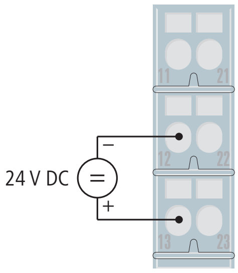

Fig. 30: Wiring diagram BL20-P3T-SBB

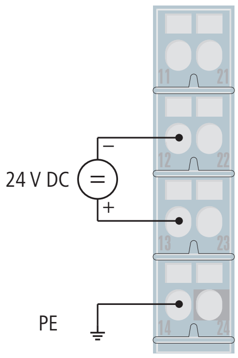

Fig. 31: Wiring diagram BL20-P4x-SBBC

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6.3 Power Feeding module, 120/230 VDC, with diagnostics

DANGER
Dangerous contact voltage at earth faults
Acute danger to life in case of incorrect grounding
➤ Always observe the correct grounding of the system when using 120/230 V modules.

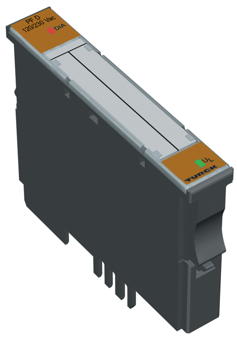


Fig. 32: BL20-PF-120/230VAC-D

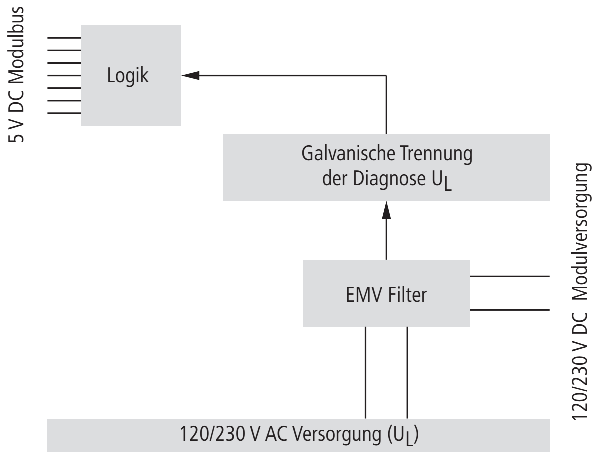


Fig. 33: Block Diagram

6.3.1 Technical data

Technical data	
Designation	BL20-PF-120/230VAC-D
Nominal voltage	120/230 VAC
– Permissible range	According to EN 61131-2
Field supply UL	120/230 VAC
Permissible range of U_L	According to EN 61131-2
Nominal current from module bus I_{MB}	≤ 25 mA
Ripple	< 5 %
Residual ripple	According to EN 61131-2

Technical data	
Maximum operating current I_{EI}	10 A
Voltage anomalies	According to EN 61 000-4-11/ EN 61 131-2

6.3.2 Diagnostic and status messages

The diagnostic functions monitor the supply voltages (system and field supply) supplied by the user for undervoltage. The diagnostic functions indicate errors via the "DIA" LED and transmit the corresponding diagnostic information to the gateway.

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	Check the wiring to the field power supply. Check if the voltage for the field supply is wihtin the permissible range.
	Red, flashing, 0.5 Hz **and** LED U_L "Off"	voltage at the terminal < 84 VAC ± 5 VAC	
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
U_L	Green	Field power supply via external power supply unit OK	–
	Off	Field power supply via external power supply unit faulty	Check the wiring to the field power supply. Check the external power supply unit.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	No field voltage	-	-

- "No field voltage"
  Monitoring of the external power supply to the field

6.3.3 Base modules

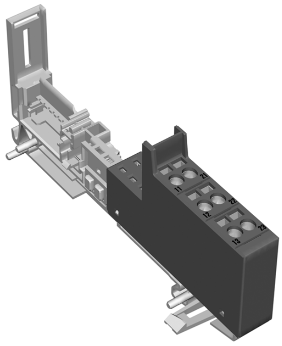


Fig. 34: Base module BL20-P3T-SBB

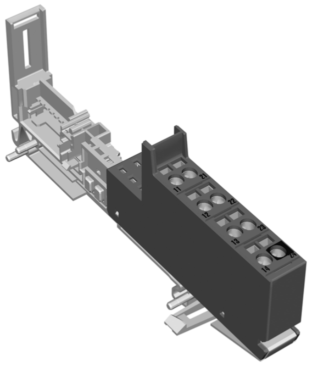


Fig. 35: Base module BL20-P4T-SBBC

- with tension clamp connection
  BL20-P3T-SBB
  BL20-P4T-SBBC
- with screw connection
  BL20-P3S-SBB
  BL20-P4S-SBBC

6.3.4 Wiring diagram

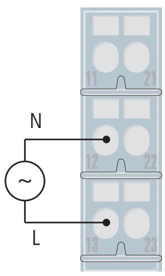


Fig. 36: Wiring diagram BL20-P3T-SBB

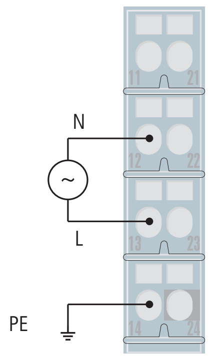


Fig. 37: Wiring diagram BL20-P4x-SBBC

DANGER

Dangerous electrical voltage (120/230 V)

Acute danger to life due to electric shock!

- Turn of the voltage supply
- Secure the voltage supply against restart.

6.4 Bus Refreshing modules

Bus Refreshing modules are used to distribute 5 VDC to the internal BL20 module bus, as well as to distribute a nominal voltage of 24 VDC (permissible range according to EN 61 131-2) to the various BL20 modules, when building up BL20 stations with gateways **without** integrated power supply.

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

When using BL20 gateways with an integrated power supply unit (BL20-GWBR-…), no additional Bus Refreshing module is needed to distribute 5 VDC to the internal BL20 module bus, as well as the nominal voltage of 24 VDC.

NOTE

When using Bus Refreshing modules, this must be mounted immediately to the right of the gateway. This and a special base module guarantee the 5 VDC supply to the gateway.

Bus Refreshing modules eliminate the necessity to separately distribute the system or field voltage to each BL20 I/O module. Depending on the planned application, it is possible to build tailor-made groups of modules with different potentials by selecting appropriate Bus Refreshing modules. Bus Refreshing modules are available in slice design. They are mounted on to base modules with tension clamp or screw connections. The dusty grey color of the base modules for Bus Refreshing modules clearly distinguishes them from the base modules designed for BL20 I/O modules.

LED displays

Error signals and diagnostic statuses are indicated via LEDs on the module. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

6.4.1 Module overview

- BL20-BR-24VDC-D

6.5 Bus Refreshing module with diagnostics

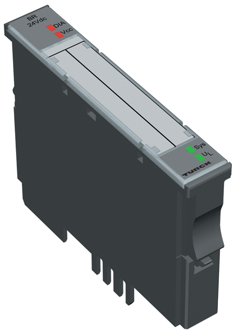


Fig. 38: BL20-BR-24VDC-D

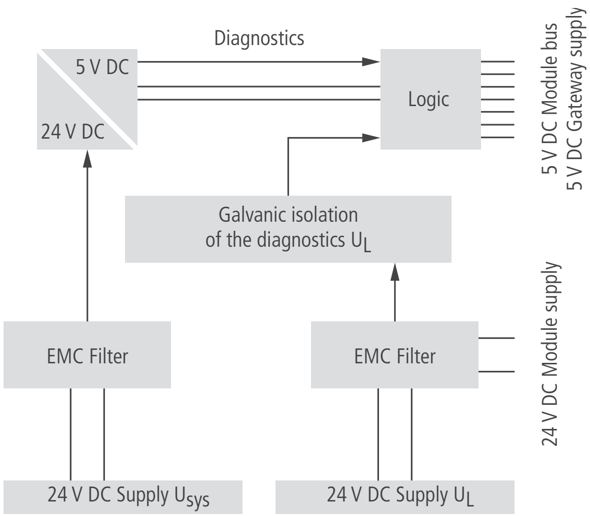


Fig. 39: Block Diagram

6.5.1 Technical data

Technical data	
Designation	BL20-BR-24VDC-D
Nominal voltage	24 VDC
System supply U_{sys}	24 VDC/5 VDC
Permissible range for U_{sys} = 24 VDC	18…30 VDC
Field supply U_L	24 VDC
Permissible range of U_L	18…30 VDC
Ripple	< 5 %
Residual ripple	According to EN 61131-2
Maximum operating current I_{EI}	10 A
Maximum system current supply I_{MB}	1.5 A

6.5.2 Diagnostic and status messages

The diagnostic functions monitor the supply voltages (system and field supply) supplied by the user for undervoltage. They indicate errors via ”DIA” LED and transmit corresponding diagnostic information to the gateway.

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Faulty power supply to the field U_L or system U_{sys} .	Check the wiring to the system supply and to the field supply. Check if the voltages of the system and field supply are in the permissible range..
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the wiring to the system power supply.
	Off	No error messages or diagnostics	–
V_{cc}	Green	5 V_{cc}-power supply for module bus OK	–
	Off	5 V_{cc}-power supply for module bus faulty.	Check the voltage and the wiring for the system supply.
Sys	Green	System supply via external power supply unit OK	–
	Off	System supply via external power supply unit faulty	Check the wiring to the system supply. Check the external power supply unit.
U_L	Green	Field supply via external power supply unit OK	–
	Off	Field power supply via external power supply unit faulty	Check the wiring to the field power supply. Check the external power supply unit.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	No field voltage	-	Module bus voltage warning

- "Module bus voltage warning"
  Monitoring of the external power supply to the system U_{sys} = 24 VDC. The system supply is transformed (24 VDC => 5 V).
- "No field voltage"
  Monitoring of the external power supply to the field

6.5.3 Base modules

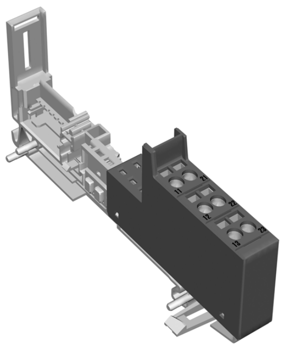


Fig. 40: BL20-P3T-SBB with gateway power supply

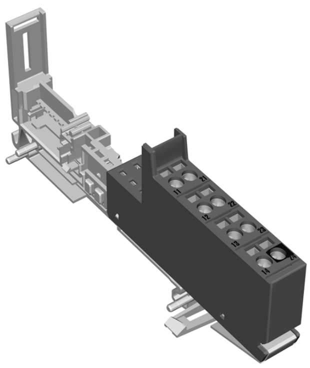


Fig. 41: BL20-P4T-SBBC-B without gateway power supply

Base modules **with** power supply to the gateway:

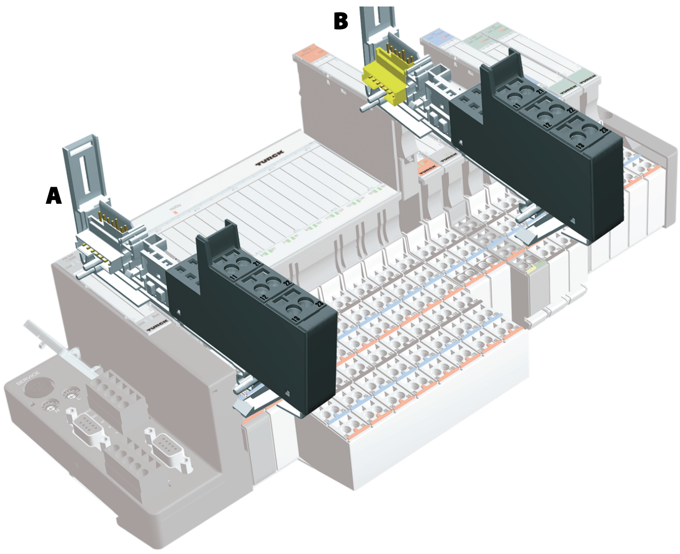
- with tension clamp connection
  BL20-P3T-SBB
  BL20-P4T-SBBC
- with screw connection
  BL20-P3S-SBB
  BL20-P4S-SBBC

Base modules without power supply to the gateway:

- with tension clamp connection
  BL20-P3T-SBB-B
  BL20-P4T-SBBC-B
- with screw connection
  BL20-P3S-SBB-B
  BL20-P4S-SBBC-B

NOTE
Only the modules BL20-P3x-SBB or BL20-P4x-SBBC (= first module to the right of the gateway) can be used to distribute power to the gateways. The Bus refreshing module is placed directly right to the gateway.

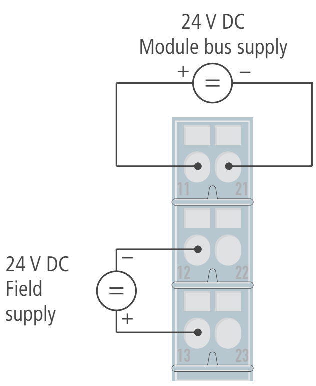
The base modules with or without power distribution to the gateways can be differentiated as follows:



A *with power distribution to the gateway: light grey connection*
B *without power distribution to the gateway: yellow connection*

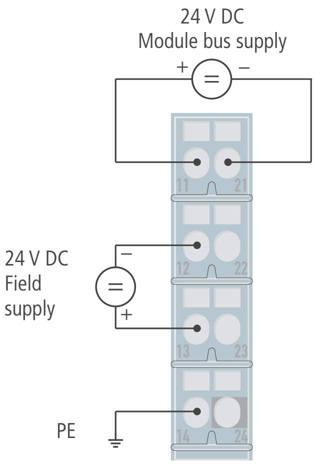
Fig. 42: Assigning base modules

Wiring diagram



BL20-P3×-SBB with gateway power supply
BL20-P3×-SBB-B without gateway power supply

Fig. 43: Wiring diagram



BL20-P4x-SBBC with gateway power supply
BL20-P4x-SBBC-B without gateway power supply

Fig. 44: Wiring diagram

7 Digital Input Modules

Digital input modules (DI) detect electrical high- and low-level values through the base module connections and transmit the corresponding digital value to the gateway via the module bus.

The module bus electronics of the digital input modules are galvanically isolated from the field level via an optocoupler. The module provides reverse polarity protection.

7.1 LED status indicators

Channel statuses are indicated by LEDs. Error signals from the I/O level are indicated by each module via the "DIA" LED.

A continuously lit up red "DIA" LED indicates the failure of the module bus communication at the digital input module.

7.2 Module overview

	Number of channels	positive switching	negative switching
BL20-2DI-24VDC-P	2	✓	
BL20-2DI-24VDC-N	2		✓
BL20-2DI-120/230VAC	2		
BL20-4DI-24VDC-P	4	✓	
BL20-4DI-24VDC-N	4		✓
BL20-4DI-24VDC-P	8	✓	
BL20-16DI-24VDC-P	16	✓	
BL20-E-16DI-24VDC-P	16	✓	
BL20-E-16DI-24VDC-N	16		✓
BL20-32DI-24VDC-P	32	✓	

7.3 Digital input module, 2DI, 24 V DC, positive switching (sinking)

Fig. 45: BL20-2DI-24VDC-P

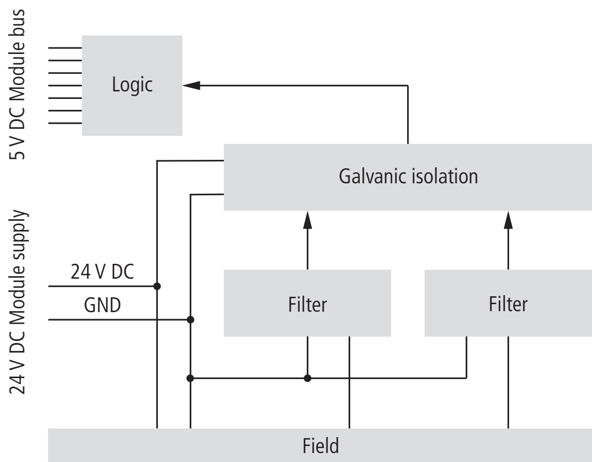


Fig. 46: Block Diagram

7.3.1 Technical data

Technical data	
Designation	BL20-2DI-24VDC-P
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 20 mA
Nominal current from module bus I_{MB}	≤ 28 mA
Power loss of the module, typical	ca. 0.7W
Input voltage, nominal value at 24 VDC	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	11 V…30 V
Input current	

Technical data	
Low level I_{LOW}	0…1.5 mA
High level I_{HIGH}	2…10 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs
2-wire initiators (Bero) can be connected with a permissible closed-circuit current of 1.5 mA	

7.3.2 Base modules

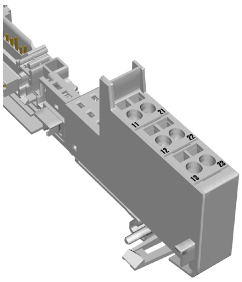


Fig. 47: Base module BL20-S3T-SBB

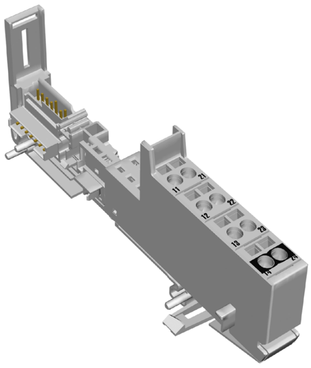


Fig. 48: Base module BL20-S4T-SBBC

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBC

- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBC

7.3.3 Wiring diagram

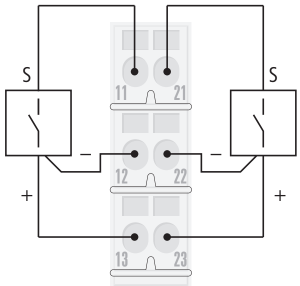


Fig. 49: Wiring diagram BL20-S3x-SBB

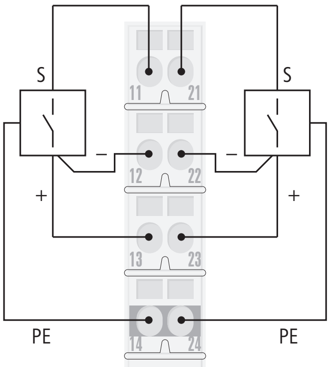


Fig. 50: Wiring diagram BL20-S3x-SBB

7.3.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	-	-	-	-	-	-	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.3.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	-
	Off	Status channel 1 = 0	-
21	Green	Status channel 2 = 1	-
	Off	Status channel 2 = 0	-

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

7.4 Digital input module, 2DI, 24 V DC, negative switching (sourcing)

Fig. 51: BL20-2DI-24VDC-N

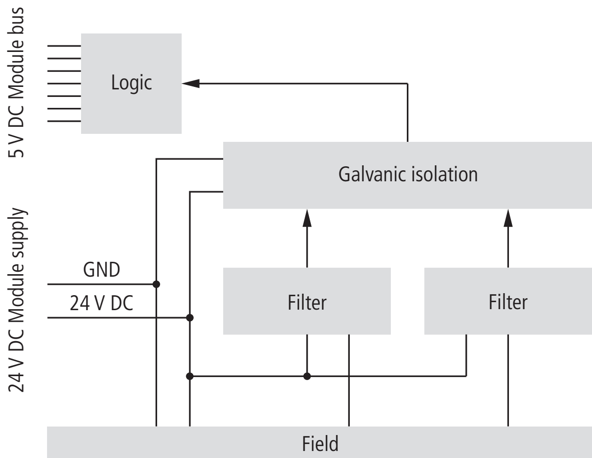


Fig. 52: Block Diagram

7.4.1 Technical data

Technical data	
Designation	BL20-2DI-24VDC-P
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 20 mA
Nominal current from module bus I_{MB}	≤ 28 mA
Power loss of the module, typical	ca. 0.7W
Input voltage, nominal value at 24 VDC	
High level U_A	0 V…+5 V
Low level U_I	> (U_{PF} - 11 V)
Input current	

Technical data	
High level U_{HIGH}	1.3…6 mA
Low level	0…1.2 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs
2-wire initiators (Bero) can be connected with a permissible closed-circuit current of 1.5 mA	

7.4.2 Base modules

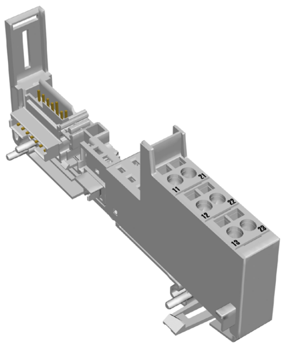


Fig. 53: Base module BL20-S3T-SBB

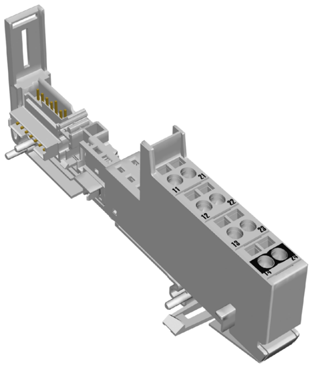


Fig. 54: Base module BL20-S4T-SBBC

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBC
- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBC

7.4.3 Wiring diagram

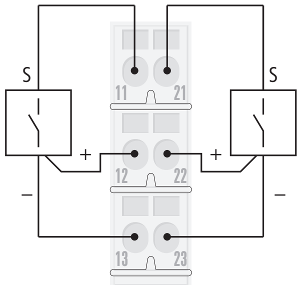


Fig. 55: Wiring diagram BL20-S3x-SBB

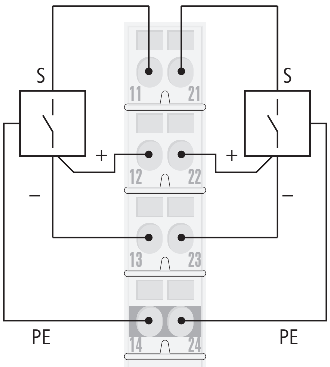


Fig. 56: Wiring diagram BL20-S3x-SBB

7.4.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	-	-	-	-	-	-	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.4.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	-
	Off	Status channel 1 = 0	-
21	Green	Status channel 2 = 1	-
	Off	Status channel 2 = 0	-

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

7.5 Digital input module, 2DI, 120/230 VAC

Fig. 57: BL20-2DI-120/230VAC

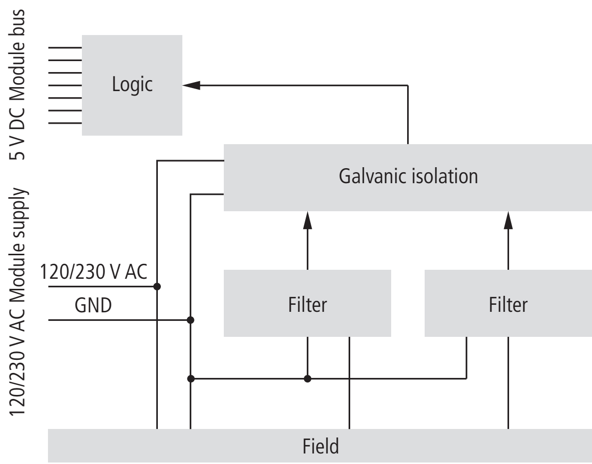


Fig. 58: Block Diagram

7.5.1 Technical data

Technical data	
Designation	BL20-2DI-120/230VAC
Number of channels	2
Nominal voltage from supply terminal U_L	120/230 VAC
Nominal current from supply terminal I_L	≤ 20 mA
Nominal current from module bus I_{MB}	≤ 28 mA
Power loss of the module, typical	< 1 W
Input voltage, nominal value at 120/230 VAC	
Low level U_{LOW}	0…20 VAC
High level U_{HIGH}	79…265 VAC
Frequency range	47.5 Hz…63 Hz

Technical data	
Input current	
Low level I_{LOW}	0…1 mA
High level I_{HIGH}	3…10 mA
Input delay	
t_{ON}	< 20 ms
t_{OFF}	< 20 ms

7.5.2 Base modules

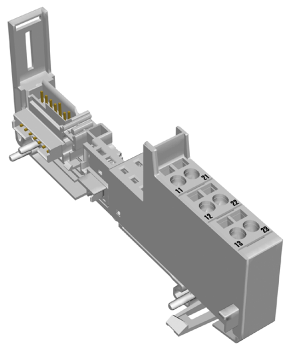


Fig. 59: Base module BL20-S3T-SBB

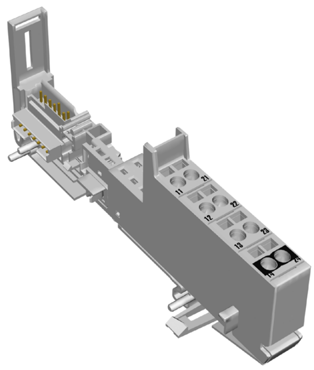


Fig. 60: Base module BL20-S4T-SBBC

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBC
- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBC

7.5.3 Wiring diagram

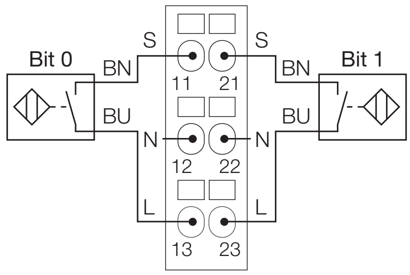


Fig. 61: Wiring diagram BL20-S3x-SBB

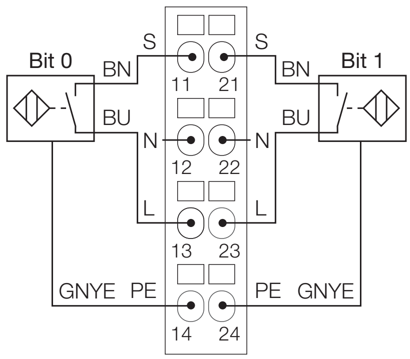


Fig. 62: Wiring diagram BL20-S3x-SBB

7.5.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	-	-	-	-	-	-	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.5.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	-
	Off	Status channel 1 = 0	-
21	Green	Status channel 2 = 1	-
	Off	Status channel 2 = 0	-

NOTE

The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

7.6 Digital input module, 4DI, 24 VDC, positive switching (sinking)

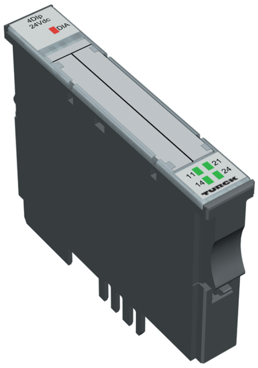


Fig. 63: BL20-4DI-24VDC-P

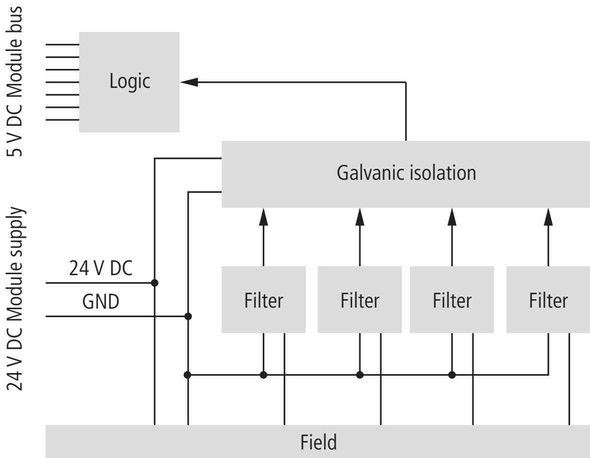


Fig. 64: Block Diagram

7.6.1 Technical data

Technical data	
Designation	BL20-4DI-24VDC-P
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 40 mA
Nominal current from module bus I_{MB}	≤ 29 mA
Power loss of the module, typical	ca. 1 W
Input voltage, nominal value at 24 VDC	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	15 V…30 V
Input current	

Technical data	
Low level I_{LOW}	0…1.5 mA
High level I_{HIGH}	2…10 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs

7.6.2 Base modules

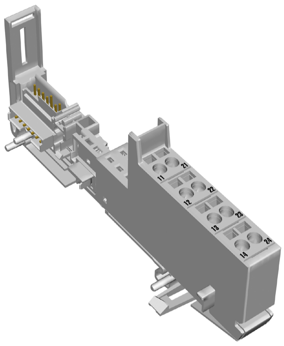


Fig. 65: Base module BL20-S4T-SBBS

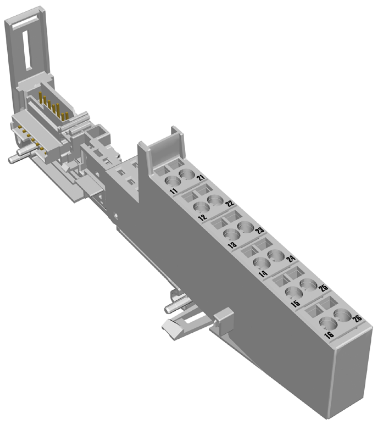


Fig. 66: Base module BL20-S6T-SBBSBB

- with tension clamp connection
  BL20-S4T-SBBS
  BL20-S6T-SBBSBB
- with screw connection
  BL20-S4S-SBBS
  BL20-S6S-SBBSBB

7.6.3 Wiring diagram

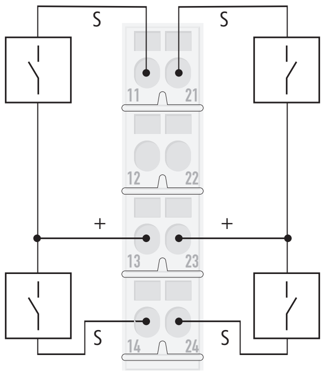


Fig. 67: Wiring diagram BL20-S4x-SBBS

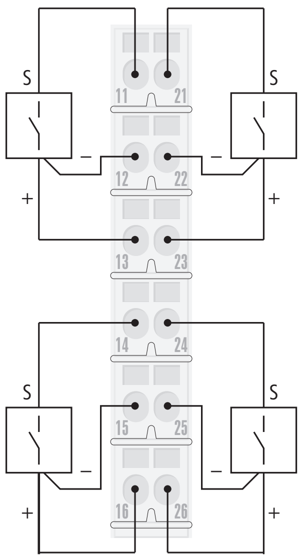


Fig. 68: Wiring diagram BL20-S6x-SBBSBB

7.6.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	-	-	-	-	DI4	DI3	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.6.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
14	Green	Status channel 3 = 1	
	Off	Status channel 3 = 0	
24	Green	Status channel 4 = 1	
	Off	Status channel 4 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

7.7 Digital input module, 4DI, 24 V DC, negative switching (sourcing)

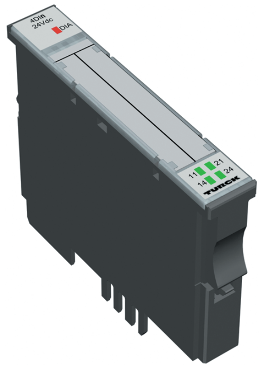


Fig. 69: BL20-4DI-24VDC-N

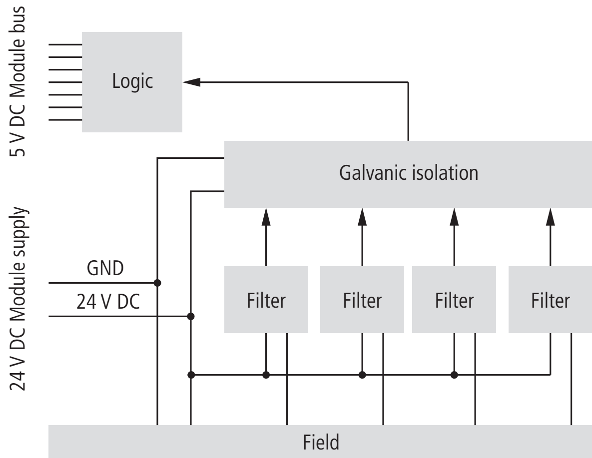


Fig. 70: Block Diagram

7.7.1 Technical data

Technical data	
Designation	BL20-4DI-24VDC-N
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 40 mA
Nominal current from module bus I_{MB}	≤ 28 mA
Power loss of the module, typical	< 1 W
Input voltage, nominal value at 24 VDC	
High level U_A	0 V…+5 V
Low level U_I	> (U_{PF} - 11 V)
Input current	

Technical data	
High level U_{HIGH}	1.3…6 mA
Low level	0…1.2 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs

7.7.2 Base modules

s

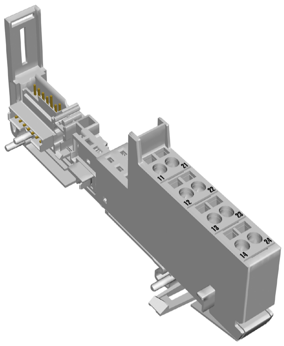


Fig. 71: Base module BL20-S4T-SBBS

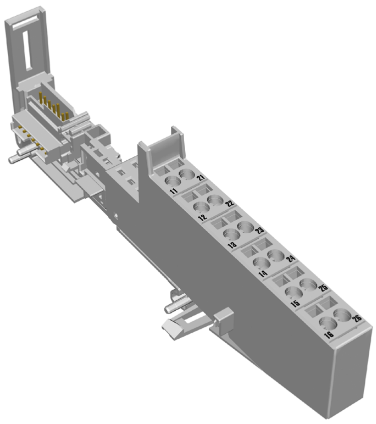


Fig. 72: Base module BL20-S6T-SBBSBB

- with tension clamp connection
  BL20-S4T-SBBS
  BL20-S6T-SBBSBB
- with screw connection
  BL20-S4S-SBBS
  BL20-S6S-SBBSBB

7.7.3 Wiring diagram

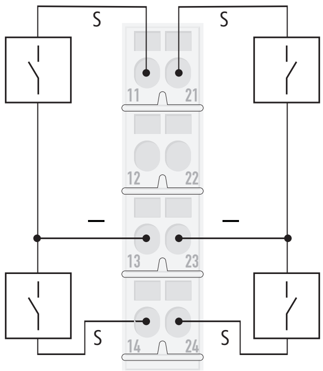


Fig. 73: Wiring diagram BL20-S4x-SBBS

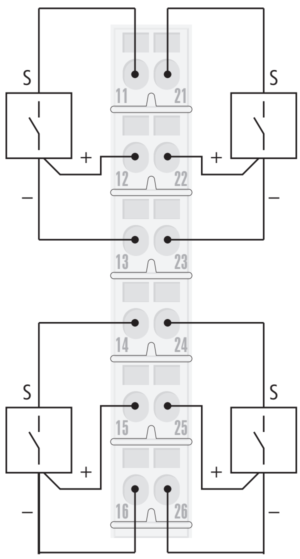


Fig. 74: Wiring diagram BL20-S6x-SBBSBB

7.7.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	-	-	-	-	DI4	DI3	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.7.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
14	Green	Status channel 3 = 1	
	Off	Status channel 3 = 0	
24	Green	Status channel 4 = 1	
	Off	Status channel 4 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

7.8 Digital input module, 4DI, NAMUR

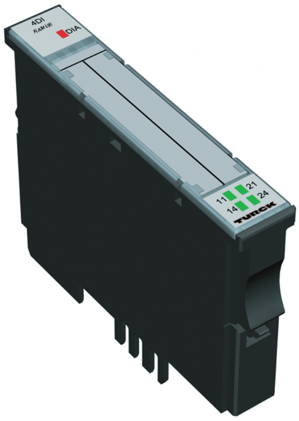


Fig. 75: BL20-4DI-NAMUR

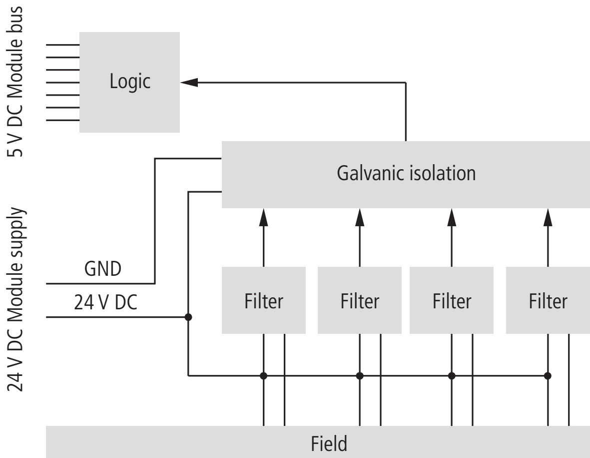


Fig. 76: Block Diagram

7.8.1 Technical data

Technical data	
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 30 mA
Nominal current from module bus I_{MB}	≤ 40 mA
IN_{NAMUR} (input)	
switch-on threshold	≥ 1.74 mA
switch-off threshold	≤ 1.45 mA
IN_{WB}	
switch-on threshold	≤ 0.08 mA
switch-off threshold	≥ 0.12 mA

Technical data	
IN_{SC}	
switch-on threshold	≥ 6.2 mA
switch-off threshold	≤ 5.9 mA
Isolation voltage	
U_{TMB} (module bus/ field)	2500 VDC
U_{FE} (field supply/ FE)	1000 VDC

7.8.2 Base modules

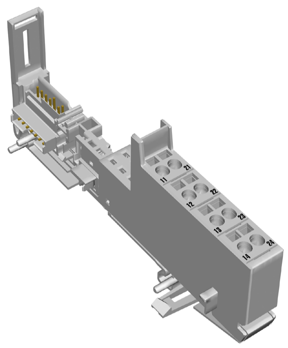


Fig. 77: Base module BL20-S4T-SBBS

- with tension clamp connection BL20-S4T-SBBS
- with screw connection BL20-S4S-SBBS

7.8.3 Wiring diagram

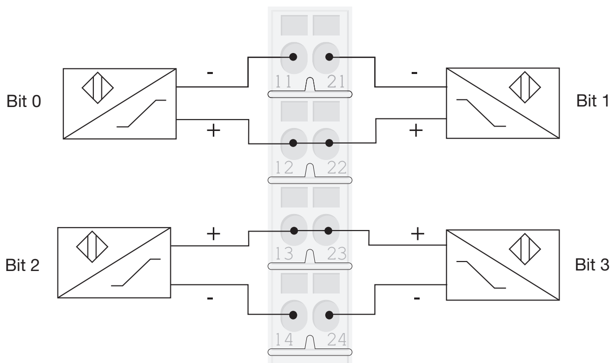


Fig. 78: Wiring diagram BL20-S4x-SBBS

7.8.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	SCWB4	SCWB3	SCWB2	SCWB1	DI4	DI3	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active
SCWBx	0	Overcurrent (short circuit) or wire break at the channel
	1	Data valid, no diagnostics

7.8.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Red	Short circuit or wire break	
	Off	Status channel 1 = 0	
14	Green	Status channel 2 = 1	
	Red	Short circuit or wire break	
	Off	Status channel 2 = 0	
21	Green	Status channel 3 = 1	
	Red	Short circuit or wire break	
	Off	Status channel 3 = 0	

LED	Display	Meaning	Remedy
24	Green	Status channel 4 = 1	
	Red	Short circuit or wire break	
	Off	Status channel 4 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Wire break 4	Overcur-rent 4	Wire break 3	Overcur-rent 3	Wire break 2	Overcur-rent 2	Wire break 1	Overcur-rent 1

7.8.6 Module parameters

NOTE
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1		Bit 0		Bit 0		Bit 0	Activate input filter
		Bit 1		Bit 1		Bit 1	Invert digital input
		Bit 2		Bit 2		Bit 2	Activate overcurrent monitoring
		Bit 3		Bit 3		Bit 3	Activate overcurrent diagnostics
		Bit 4		Bit 4		Bit 4	Activate wire break monitoring
		Bit 5		Bit 5		Bit 5	Activate wire break diagnostics
		Bit 6		Bit 6		Bit 6	Input on diagnostic
	Byte 0	Bit 7		Bit 7	Byte 0	Bit 7	Substitute value
Channel 2		Bit 0		Bit 0		Bit 0	Activate input filter
		Bit 1		Bit 1		Bit 1	Invert digital input
		Bit 2		Bit 2		Bit 2	Activate overcurrent monitoring
		Bit 3		Bit 3		Bit 3	Activate overcurrent diagnostics
		Bit 4		Bit 4		Bit 4	Activate wire break monitoring
		Bit 5		Bit 5		Bit 5	Activate wire break diagnostics
		Bit 6		Bit 6		Bit 6	Input on diagnostic
	Byte 1	Bit 7	Word 0	Bit 7	Byte1	Bit 7	Substitute value
Channel 3		Bit 0		Bit 0		Bit 0	Activate input filter
		Bit 1		Bit 1		Bit 1	Invert digital input
		Bit 2		Bit 2		Bit 2	Activate overcurrent monitoring
		Bit 3		Bit 3		Bit 3	Activate overcurrent diagnostics
		Bit 4		Bit 4		Bit 4	Activate wire break monitoring
		Bit 5		Bit 5		Bit 5	Activate wire break diagnostics
		Bit 6		Bit 6		Bit 6	Input on diagnostic
	Byte 2	Bit 7		Bit 7	Byte 2	Bit 7	Substitute value
Channel 4		Bit 0		Bit 0		Bit 0	Activate input filter
		Bit 1		Bit 1		Bit 1	Invert digital input
		Bit 2		Bit 2		Bit 2	Activate overcurrent monitoring
		Bit 3		Bit 3		Bit 3	Activate overcurrent diagnostics
		Bit 4		Bit 4		Bit 4	Activate wire break monitoring
		Bit 5		Bit 5		Bit 5	Activate wire break diagnostics
		Bit 6		Bit 6		Bit 6	Input on diagnostic
	Byte 3	Bit 7	Word 1	Bit 7	Byte 3	Bit 7	Substitute value

Parameters	Value
Invert digital input	0 = no
	1 = yes
Activate input filter	0 = no, filter time = 0.25 ms
	1 = yes, filter time = 2.5 ms
Activate overcurrent monitoring	0 = no
	1 = yes
Activate overcurrent diagnostics	0 = no
	1 = yes
Activate wire break monitoring	0 = no
	1 = yes
Activate wire break diagnostics	0 = no
	1 = yes
Input on diagnostic	0 = substitute value
	1 = current value
Substitute value	0 = 0
	1 = 1

7.9 Digital input module, BL20 Economy, 8 DI, 24 VDC, positive switching (sinking)

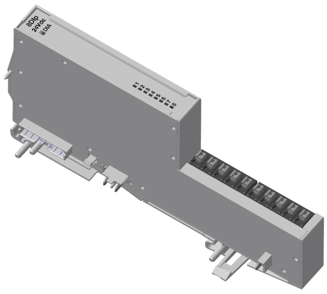


Fig. 79: BL20-E-8DI-24VDC-P

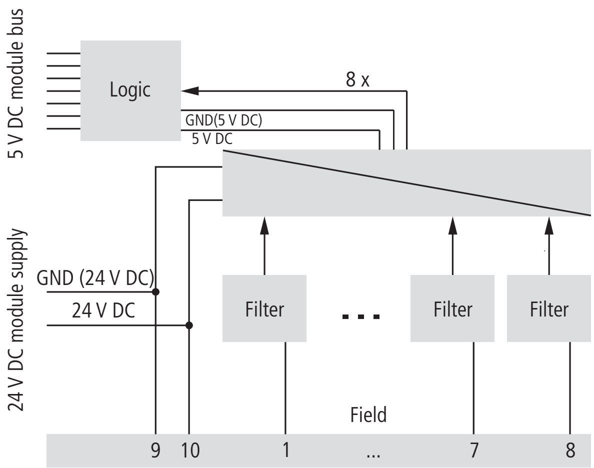


Fig. 80: Block Diagram

7.9.1 Technical data

Technical data	
Designation	BL20-E-8DI-24VDC-P
Number of channels	8
Nominal voltage from supply terminal U_L	24 VDC
Current from supply terminal (for supply of module electronic - the inputs are switches off - maximum)	1.5 mA The total current needed for every module is the sum of all partial currents.
Nominal current from module bus I_{MB}	< 15 mA
Input voltage, nominal value at 24 VDC	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	11 V…30 V
Input current	
Low level I_{LOW}	-1…1.5 mA
High level I_{HIGH}	2…5 mA

Technical data	
Input delay	
t_{ON}	< 100 µs
t_{OFF}	< 200 µs
Isolation voltage	
Module bus/ channels	500 V_{eff}

7.9.2 Wiring diagram

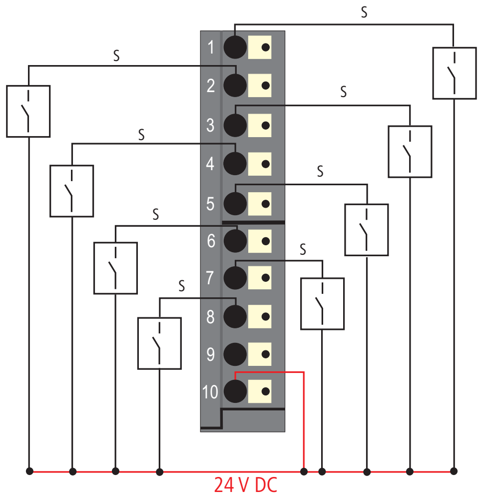


Fig. 81: Wiring diagram

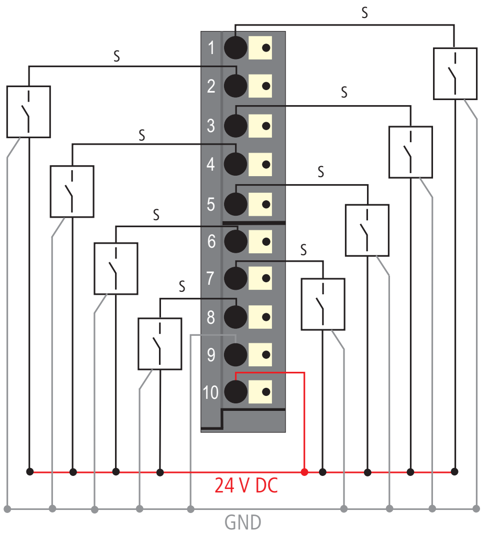


Fig. 82: Wiring diagram with sensor supply

7.9.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.9.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
8	Green	Status channel 8 = 1	
	Off	Status channel 8 = 0	

7.10 Digital input module, 16DI, 24 VDC, positive switching (sinking)

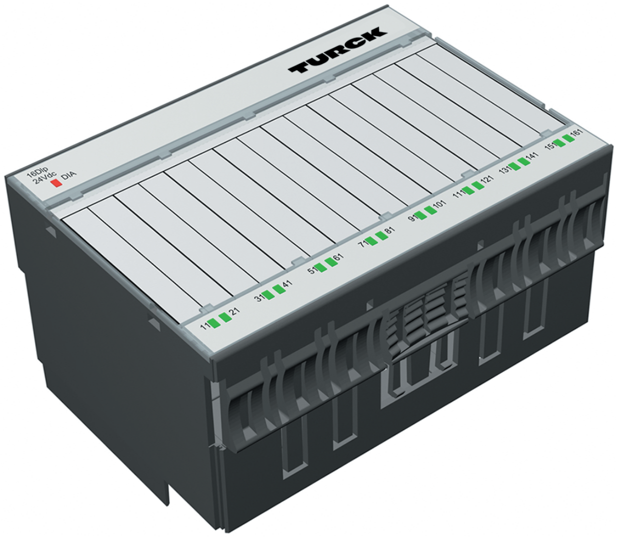


Fig. 83: BL20-16DI-24VDC-P

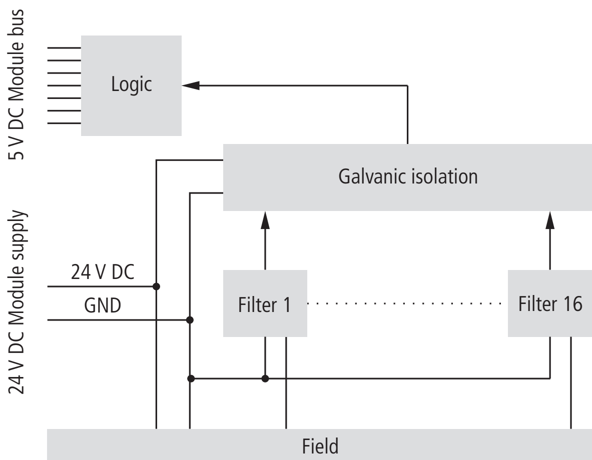


Fig. 84: Block Diagram

7.10.1 Technical data

Technical data	
Designation	BL20-16DI-24VDC-P
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 40 mA
Nominal current from module bus I_{MB}	< 45 mA
Power loss of the module, typical	< 2,5 W
Input voltage, nominal value at 24 VDC	

Technical data	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	15 V…30 V
Input current	
Low level I_{LOW}	0…1.5 mA
High level I_{HIGH}	2…10 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs

7.1.1 Base modules

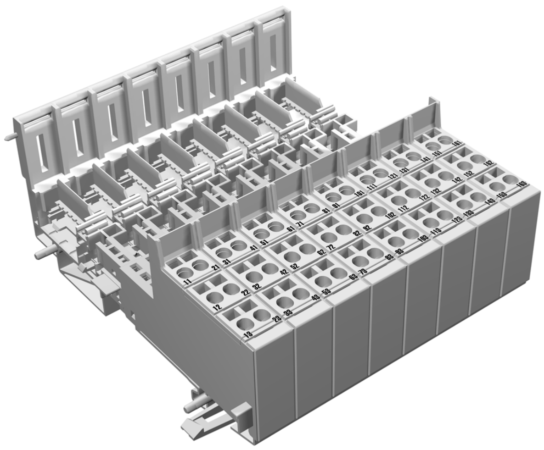


Fig. 85: Base module BL20-B3T-SBB

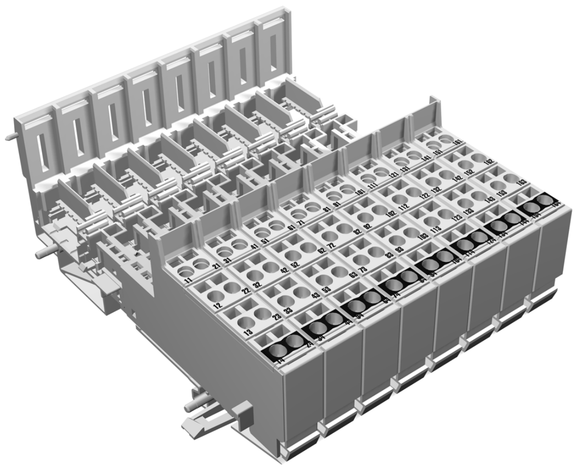


Fig. 86: Base module BL20-B4T-SBBC

- with tension clamp connection
  BL20-B3T-SBB
  BL20-B4T-SBBC

- with screw connection
  BL20-B3S-SBB
  BL20-B4S-SBBC

7.10.2 Wiring diagram

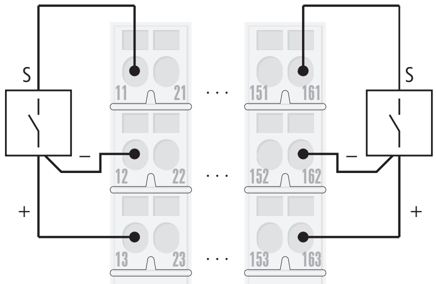


Fig. 87: Wiring diagram BL20-B3x-SBB

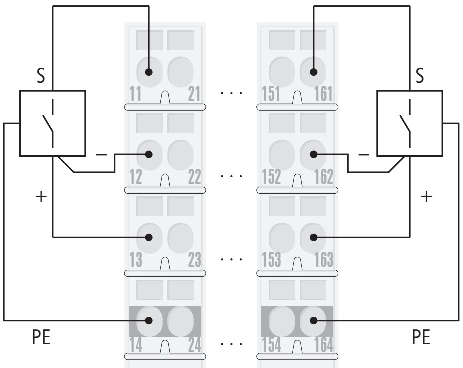


Fig. 88: Wiring diagram BL20-B4x-SBBC

7.10.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1
	n + 1	DI16	DI15	DI14	DI13	DI12	DI11	DI10	DI9

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.10.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
31	Green	Status channel 3 = 1	
	Off	Status channel 3 = 0	
…			
161	Green	Status channel 16 = 1	
	Off	Status channel 16 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

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7.11 Digital input module, BL20 Economy, 16 DI, 24 VDC, positive switching (sinking)

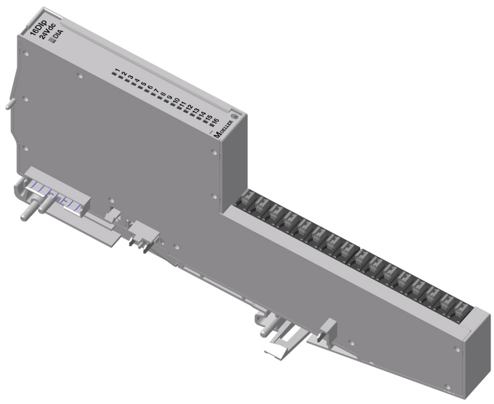


Fig. 89: BL20-E-16DI-24VDC-P

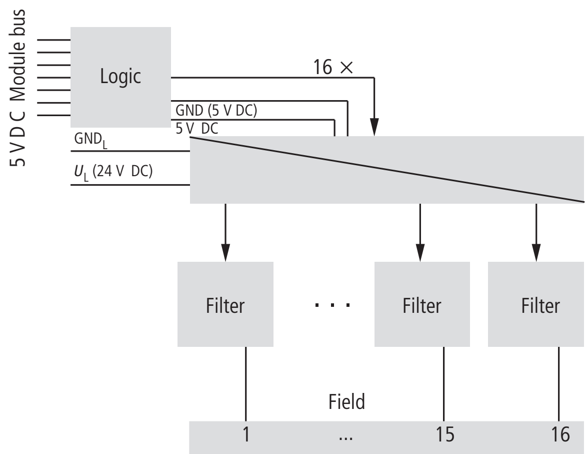


Fig. 90: Block Diagram

7.11.1 Technical data

Technical data	
Designation	BL20-E-16DI-24VDC-P
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Current from supply terminal	The total current needed for every module is the sum of all partial currents.
≤ VN 01-02	3 mA for supply of module electronics, inputs inactive, maximum
≥ VN 02-00	< 3 µA

Technical data	
Nominal current from module bus I_{MB}	
≤ VN 01-02	< 15 mA
≥ VN 02-00	< 22 mA (inputs inactive) < 35 mA (inputs active)
Input voltage, nominal value at 24 VDC	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	11 V…30 V
Input current	
Low level I_{LOWo}	-1…1.5 mA
High level I_{HIGH}	2…5 mA
Input delay	
t_{ON}	
≤ VN 01-02	< 150 µs
≥ VN 02-00	< 40 µs
t_{OFF}	
≤ VN 01-02	< 300 µs
≥ VN 02-00	< 60 µs
Isolation voltage	
Module bus/ channels	500 V_{eff}
Weight	65 g

7.11.2 Wiring diagram

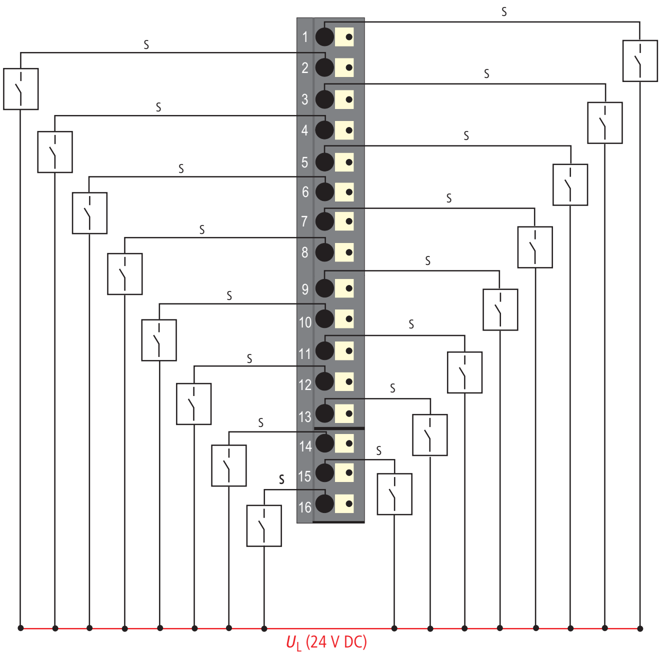


Fig. 91: Wiring diagram

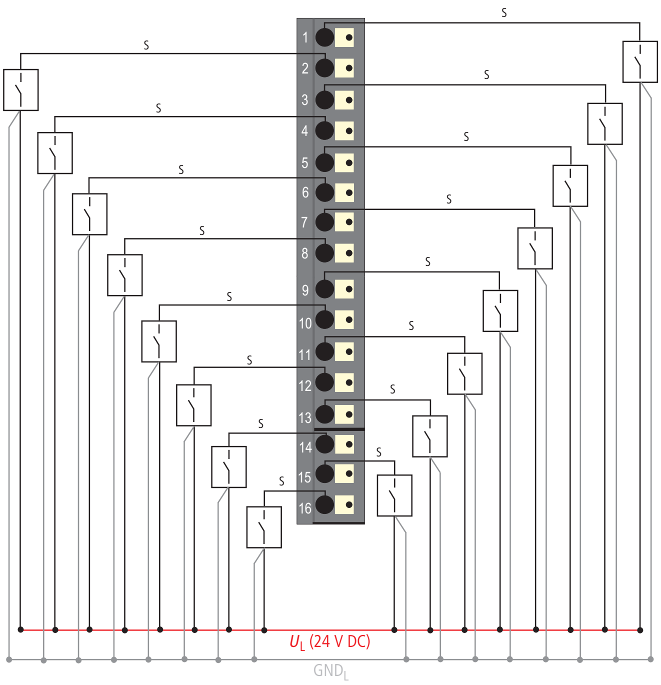


Fig. 92: Wiring diagram with sensor supply

7.11.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1
	n + 1	DI16	DI15	DI14	DI13	DI12	DI11	DI10	DI9

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.11.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
16	Green	Status channel 16 = 1	
	Off	Status channel 16 = 0	

7.12 Digital input module, BL20 Economy, 16 DI, 24 VDC, negative switching (sourcing)

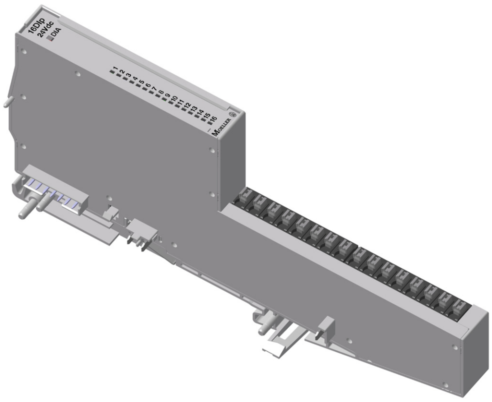


Fig. 93: BL20-E-16DI-24VDC-N

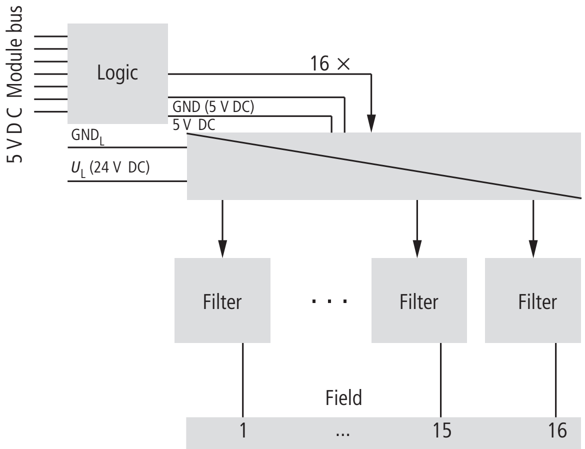


Fig. 94: Block Diagram

7.12.1 Technical data

Technical data	
Designation	BL20-E-16DI-24VDC-N
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Current from supply terminal	< 3 µA (inputs inactive) < 40 mA (inputs active)
Nominal current from module bus I_{MB}	< 22 mA (inputs inactive) < 35 mA (inputs active)
Input voltage, nominal value at 24 VDC	
Low level U_{LOW}	> (U_L - 5 V)
High level U_{HIGH}	< (U_L - 11 V)
Input current	

Technical data	
Low level I_{LOWo}	-1…1.5 mA
High level I_{HIGH}	2…5 mA
Input delay	
t_{ON}	< 20 µs
t_{OFF}	< 125 µs
Isolation voltage	
Module bus/ channels	500 V_{eff}
Weight	65 g

7.12.2 Wiring diagram

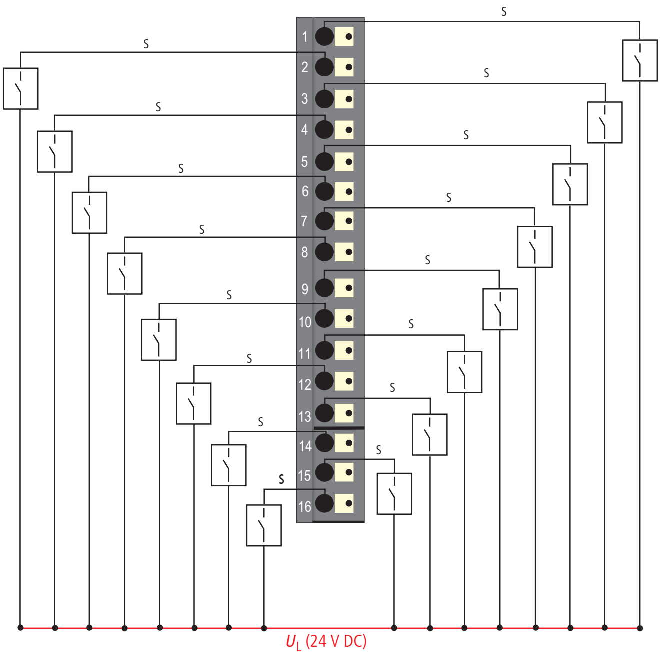


Fig. 95: Wiring diagram

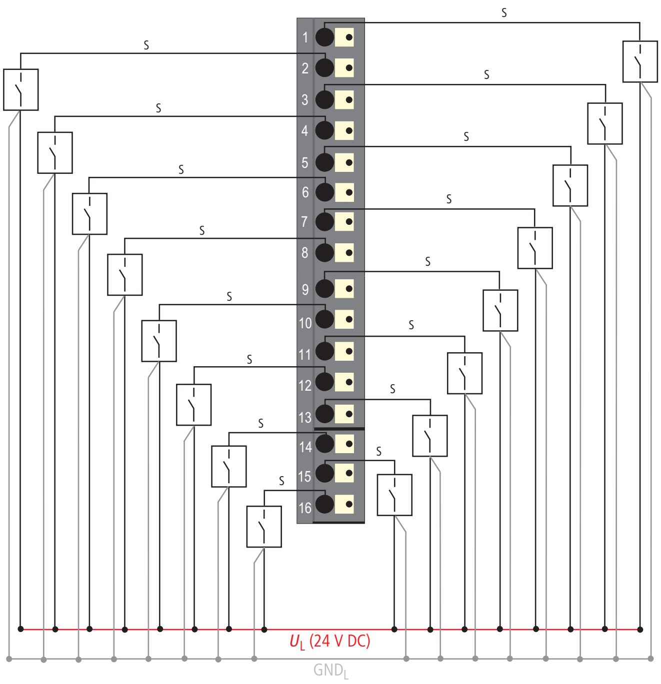


Fig. 96: Wiring diagram with sensor supply

7.12.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1
	n + 1	DI16	DI15	DI14	DI13	DI12	DI11	DI10	DI9

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.12.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
16	Green	Status channel 16 = 1	
	Off	Status channel 16 = 0	

7.13 Digital input module, 32DI, 24 VDC, positive switching (sinking)

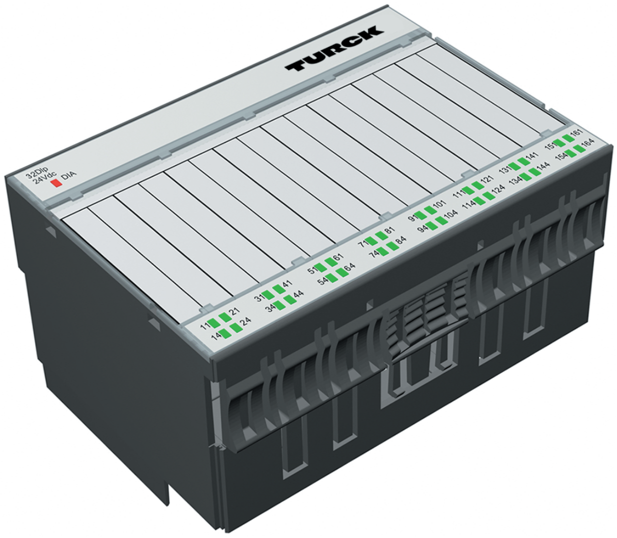
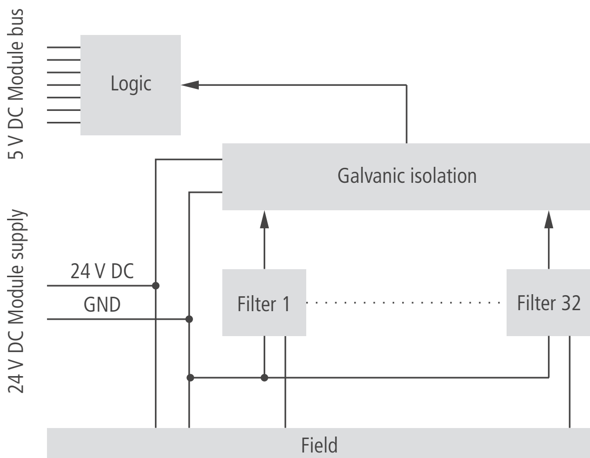


Fig. 97: BL20-32DI-24VDC-P



Block Diagram

7.13.1 Technical data

Technical data	
Designation	BL20-32DI-24VDC-P
Number of channels	32
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	< 45 mA
Power loss of the module, typical	< 4,2 W
Input voltage, nominal value at 24 VDC	

Technical data	
Low level U_{LOW}	- 30 V…+5 V
High level U_{HIGH}	15 V…30 V
Input current	
Low level I_{LOW}	< 1.5 mA
High level I_{HIGH}	2…10 mA
Input delay	
t_{ON}	< 200 µs
t_{OFF}	< 200 µs

7.13.2 Base modules

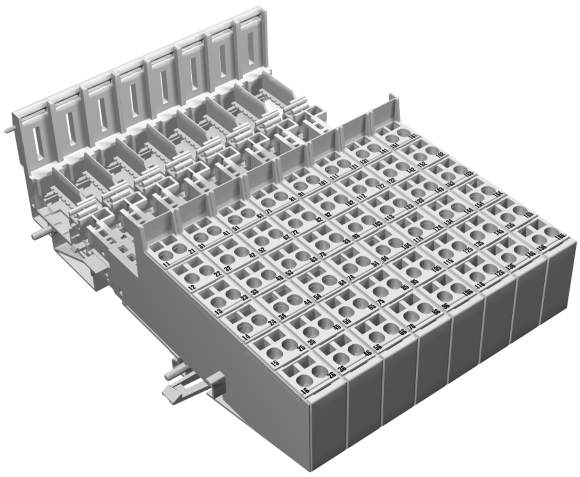


Fig. 98: Base module BL20-B6T-SBBSBB

- with tension clamp connection
  BL20-B6T-SBBSBB
- with screw connection
  BL20-B6S-SBBSBB

7.13.3 Wiring diagram

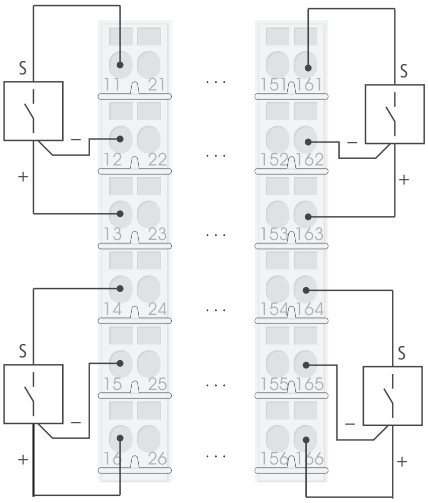


Fig. 99: Wiring diagram BL20-B6x-SBBSBB

7.13.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1
	n + 1	DI16	DI15	DI14	DI13	DI12	DI11	DI10	DI9
	n + 2	DI24	DI23	DI11	DI21	DI20	DI19	DI18	DI17
	n + 3	DI32	DI31	DI30	DI29	DI28	DI27	DI26	DI25

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the Turck BL20 DTM in PACTware.

Process data	Value	Meaning
DIx	0	Digital input inactive
	1	Digital input active

7.13.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus commu-nication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
	…		
161	Green	Status channel 16 = 1	
	Off	Status channel 16 = 0	
…			
14	Green	Status channel 17 = 1	
	Off	channel 17 = 0	
164	Green	Status channel 32 = 1	
	Off	channel 32 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

8 Analog Input Modules

Analog input modules (AI) detect standard electrical signals at the connections of the base modules, digitalize them and transmit the corresponding measurement values to the gateway via the internal module bus.

The module bus electronics of the analog input modules are galvanically isolated from the field level via an optocoupler. The module provides reverse polarity protection.

Supported signal ranges

- 0…20 mA
- 4…20 mA
- 0…10 VDC
- -10…+10 VDC
- HART

Connectable sensors

- Platinum sensors (Pt100, Pt200, Pt500, Pt1000)
- Nickel sensors (Ni100, Ni1000 (DIN 43 760), Ni1000TK5000)
- Thermo elements (types: B, E, J, K, N, R, S, T)
- Resistances (0…250 Ω, 0…400 Ω, 0…800 Ω, 0…2000 Ω, 0…4000 Ω)

LED status indicators

Error signals from the I/O level are indicated by each module via the "DIA" LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

A continuously lit up red "DIA" LED indicates the failure of the module bus communication at the analog input module.

8.0.1 Shield

When using shielded signal cables, the connection between the shield and the base module is made via a two-pole shield connection, which is available as an accessory.

8.0.2 Analog data representation

The analog values can either be represented with16 bit or 12 bit. The two's-complement representation allow the representation of positive as well as negative values.

NOTE

For some analog modules (e.g. BL20-E-8AI-U/I-4PT/NI or BL20-2AIH-I) with extended value representation functions, the tables for the measurement values can be found within the respective module descriptions.

NOTE

A detailed description of the 16 bit/12-bit-representation for the analog values can be found in the Appendix of this manual.

8.0.3 Module overview

Module	Number of channels
BL20-1AI-I(0/4…20MA)	1
BL20-2AI-I(0/4…20MA)	2
BL20-1AI-U(-10/0...+10VDC)	1
BL20-2AI-U(-10/0...+10VDC)	2
BL20-2AI-PT/NI-2/3	2
BL20-2AI-THERMO-PI	2
BL20-4AI-U/I	4
BL20-E-8AI-U/I-4PT/NI	8/4
BL20-2AIH-I	2
BL20-E-4AI-TC	4

8.1 Analog input module, 1AI, 0/4...20 mA

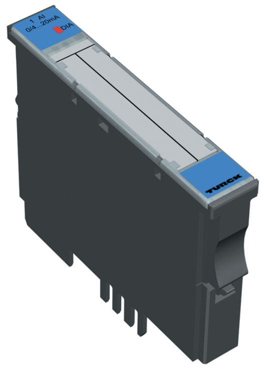


Fig. 100: BL20-1AI-I(0/4…20MA)

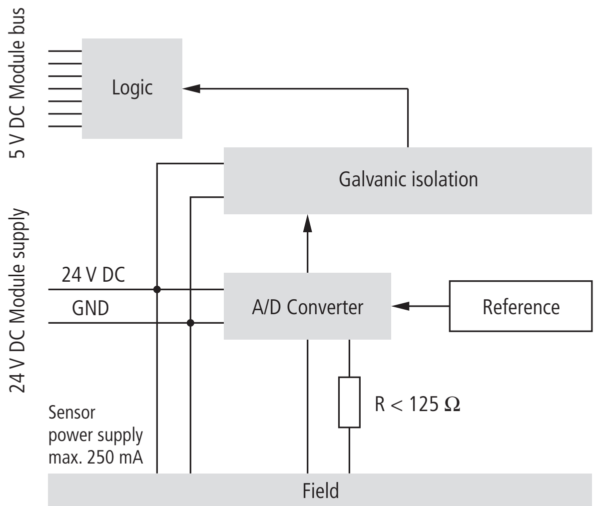


Fig. 101: Block Diagram

8.1.1 Technical data

Technical data	
Designation	BL20-1AI-I(0/4…20MA)
Number of channels	1
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	≤ 50 mA
Nominal current from module bus I_{MB}	≤ 41 mA
Power loss of the module, typical	< 1 W
Input current	0/4...20 mA
Max. input current	50 mA
Input resistance (burden)	< 125 Ω
Cutoff frequency (-3 dB)	200 Hz

Technical data	
Basic error at 23 °C / 73.4 °F	< 0,2 %
Repeatability	0,09 %
Temperature coefficient	≤ 300 ppm/°C from end value
Resolution of the A/D converter	14 bit signed integer
Measuring principle	gradual approximation
Measurement value representation	16 bit signed integer/ 12 bit full range, left-justified
Sensor supply	bridged with L+ and L- from the power supply; not short-circuit proof

8.1.2 Base modules

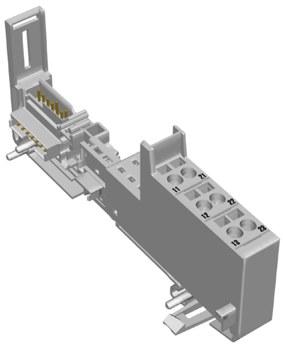


Fig. 102: Base module BL20-S3T-SBB

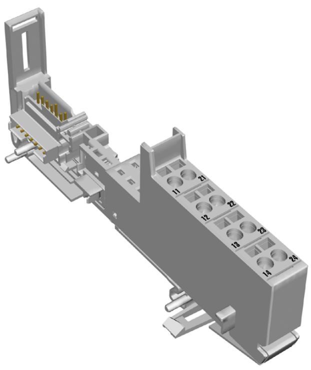


Fig. 103: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBS
- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBS

8.1.3 Wiring diagram

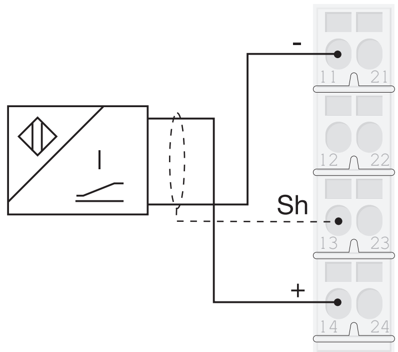


Fig. 104: 2-wire sensor with sensor supply via base module BL20-S4×-SBBS

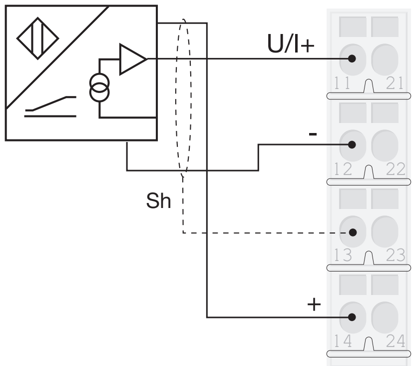


Fig. 105: 3-wire sensor with sensor supply via base module BL20-S4×-SBBS

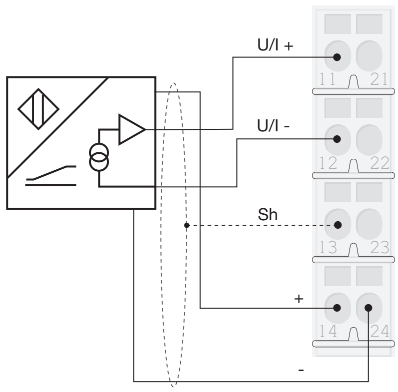


Fig. 106: 4-wire sensor with sensor supply via base module BL20-S4×-SBBS

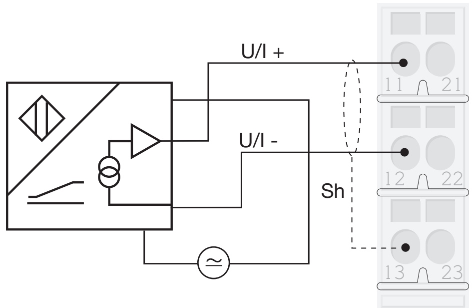


Fig. 107: 4-wire sensor with external sensor supply BL20-S3x-SBB

8.1.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.1.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an over- or undercurrent of 1 % of the set current range; whereby, undercurrents can only be recognized with those modules that have a set current range of 4…20 mA. Overcurrent Imax (I > 20,2 mA); Undercurrent: Imin (I < 3,8 mA)
Wire break	Displays a wire break in the signal line for the operating mode: 4…20 mA (I < 3 mA)

8.1.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard					PROFIBUS PROFINET		Parameters
	Byte oriented		Word oriented					
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0		Measurement range
		Bit 1		Bit 1		Bit 1		Data format
		Bit 2		Bit 2		Bit 2		Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3		reserved
		Bit 4		Bit 4		Bit 4		
		Bit 5		Bit 5		Bit 5		
		Bit 6		Bit 6		Bit 6		
		Bit 7		Bit 7		Bit 7		
	-			Bit 8	-			
				Bit 9				
				Bit 10				
				Bit 11				
				Bit 12				
				Bit 13				
				Bit 14				
				Bit 15				

The default values are written in **bold**.

Parameters	Value
Measurement range	**0 = 0…20 mA**
	1 = 4…20 mA
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes

8.1.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.2 Analog input module, 2AI, 0/4...20mA

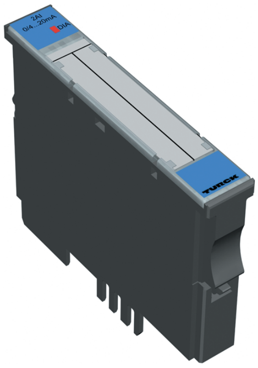


Fig. 108: BL20-2AI-I(0/4…20MA)

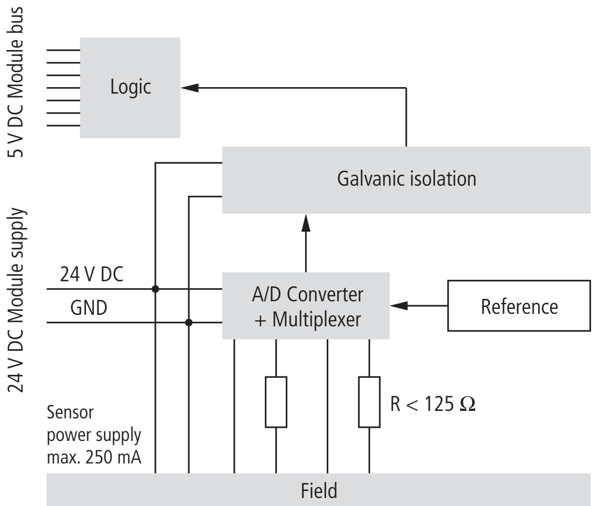


Fig. 109: Block Diagram

8.2.1 Technical data

Technical data	
Designation	BL20-2AI-I(0/4…20MA)
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 12 mA
Nominal current from module bus I_{MB}	≤ 35 mA
Power loss of the module, typical	< 1 W
Input current	0/4...20 mA
Max. input current	50 mA
Input resistance (burden)	< 125 Ω

Technical data	
Cutoff frequency (-3 dB)	50 Hz
Basic error at 23 °C / 73.4 °F	< 0,2 %
Repeatability	0,05 %
Temperature coefficient	≤ 300 ppm/°C from end value
Resolution of the A/D converter	16 bit
Measuring principle	Delta Sigma
Measurement value representation	16 bit signed integer/12 bit full range, left justified
Sensor supply	≤ 250 mA; bridged with L+ and L- from the power supply; not short-circuit proof

8.2.2 Base modules

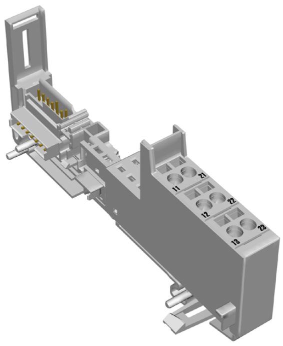


Fig. 110: Base module BL20-S3T-SBB

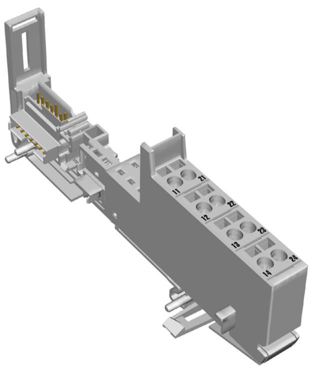


Fig. 111: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBS
- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBS

8.2.3 Wiring diagram

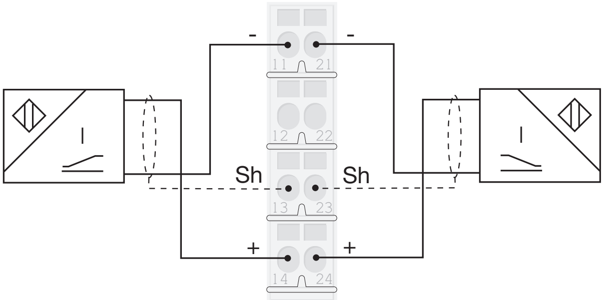


Fig. 112: 2-wire sensor with sensor supply via base module BL20-S4x-SBBS

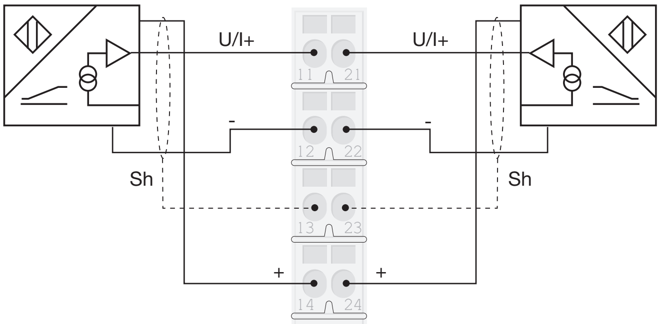


Fig. 113: 3-wire sensor with sensor supply via base module BL20-S4x-SBBS

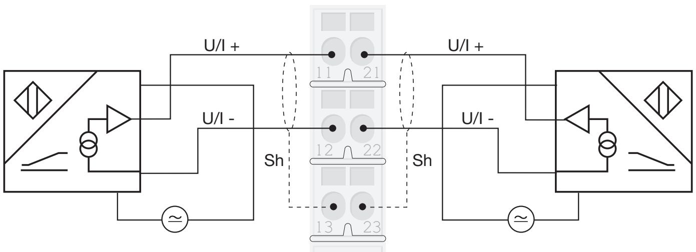


Fig. 114: 4-wire sensor with external sensor supply BL20-S3x-SBB

8.2.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.2.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an over- or undercurrent of 1 % of the set current range; whereby, undercurrents can only be recognized with those modules that have a set current range of 4…20 mA. Overcurrent I_{max} (I > 20,2 mA); Undercurrent:$_{Imin}$ (I < 3,8 mA)
Wire break	Displays a wire break in the signal line for the operating mode: 4…20 mA (I < 3 mA)

NOTE

If the measurement value representation is parameterized as "12bit (left-justified)" the diagnostic data will be transferred with the process data bits 0…3 of the respective channel.

8.2.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see Cross reference list parameters (page 523)).

	Standard				PROFIBUS PROFINET		Parameters
	Byte oriented		Word oriented				
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	reserved
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
Channel 2	Byte 1	Bit 0		Bit 8	Byte 1	Bit 0	Measurement range
		Bit 1		Bit 9		Bit 1	Data format
		Bit 2		Bit 10		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 11		Bit 3	Deactivate channel
		Bit 4		Bit 12		Bit 4	reserved
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

The default values are written in **bold**.

Parameters	Value
Measurement range	**0 = 0…20 mA**
	1 = 4…20 mA
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes
Deactivate channel	**0 = no**
	1 = yes

8.2.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.3 Analog input module, 1AI, -10/0…+10 VDC

Fig. 115: BL20-1AI-U(-10/0...+10VDC)

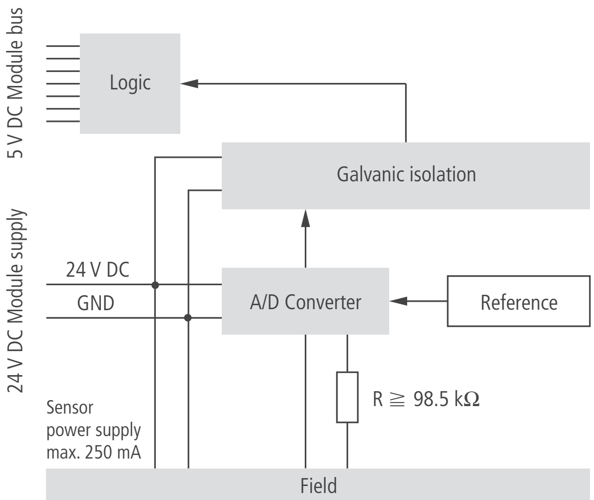


Fig. 116: Block Diagram

8.3.1 Technical data

Technical data	
Designation	BL20-1AI-U(-10/0...+10VDC)
Number of channels	1
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 50 mA
Nominal current from module bus I_{MB}	≤ 41 mA
Power loss of module, typical	< 1 W
Input voltage	-10/0…+10 V
Maximum input voltage	35 V continuous
Input resistance (burden)	≥ 98,5 kΩ

Technical data	
Cutoff frequency (-3 dB)	200 Hz
Basic error at 23 °C / 73.4 °F	< 0,2 %
Repeatability	0,05 %
Temperature coefficient	≤ 300 ppm/°C from end value
Resolution of the A/D converter	gradual approximation
Measuring principle	Delta Sigma
Measured value representation	16 bit signed integer /12 bit signed integer left-justified/ 12 bit full range, left-justified/
Sensor supply	bridged with L+ and L- from the power supply; not short-circuit proof

8.3.2 Base modules

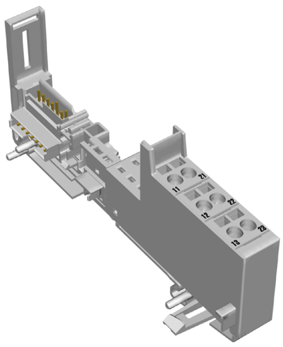


Fig. 117: Base module BL20-S3T-SBB

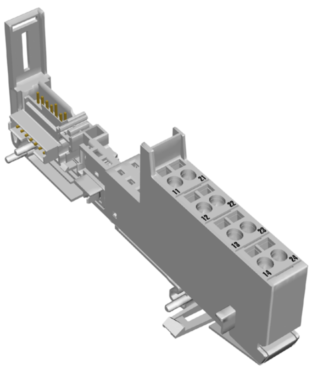


Fig. 118: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBS

- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBS

8.3.3 Wiring diagram

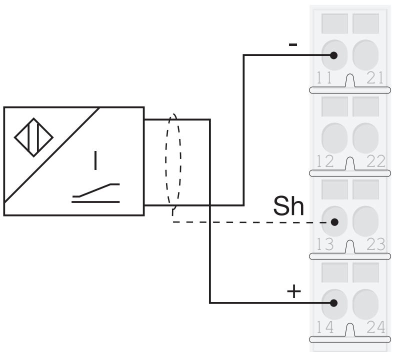


Fig. 119: 2-wire sensor with sensor supply via base module BL20-S4×-SBBS

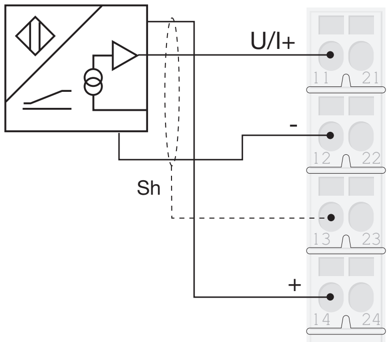


Fig. 120: 3-wire sensor with sensor supply via base module BL20-S4×-SBBS

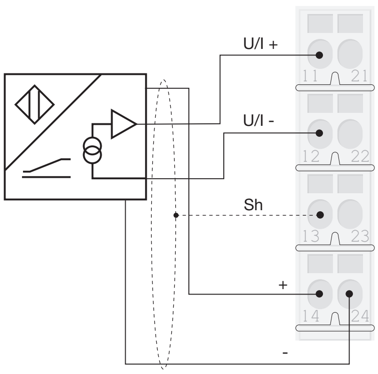


Fig. 121: 4-wire sensor with sensor supply via base module BL20-S4×-SBBS

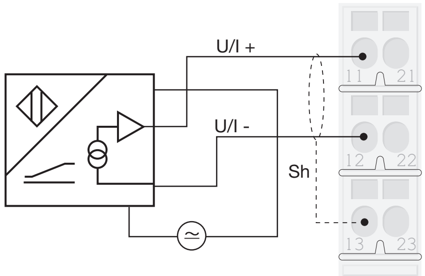


Fig. 122: 4-wire sensor with external sensor supply BL20-S3x-SBB

8.3.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.3.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	Measured value out of range

Diagnostics		Meaning
Measured value out of range	Out of Range	Indicates an over- or undervoltage of 1% of the set voltage range. Overvoltage: U_{max} ($U > 10{,}1$ V); Undervoltage: U_{min} ($U < -10{,}1$ V) at-10…+10 V U_{min} ($U < -0{,}1$ V) at 0…10 V

8.3.6 Module parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard				**PROFIBUS PROFINET**		**Parameters**
	Byte oriented		**Word oriented**				
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	reserved
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
Channel 2	-			Bit 8	-		
				Bit 9			
				Bit 10			
				Bit 11			
				Bit 12			
				Bit 13			
				Bit 14			
				Bit 15			

The default values are written in **bold**.

Parameters	Value
Measurement range	0 = -10…+10V
	1 = 0…10V
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes

8.3.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.4 Analog input module, 2AI, -10/0…+10 VDC

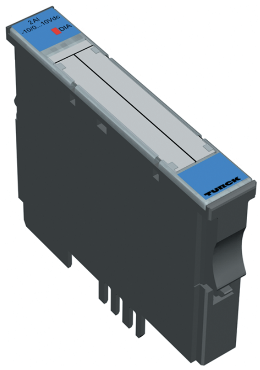


Fig. 123: BL20-2AI-U(-10/0...+10VDC)

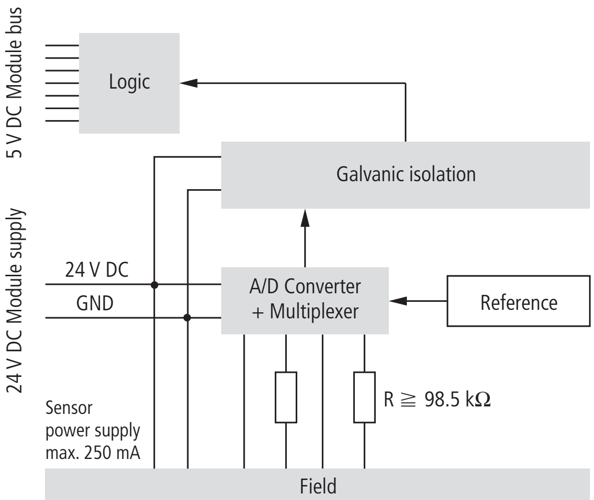


Fig. 124: Block Diagram

8.4.1 Technical data

Technical data	
Designation	BL20-2AI-U(-10/0...+10VDC)
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	≤ 12 mA

Technical data	
Nominal current from module bus I_{MB}	≤ 35 mA
Power loss of the module, typical	< 1 W
Input voltage	-10/0…+10 V
Maximum input voltage	35 V continuous
Input resistance (burden)	≥ 98,5 kΩ
Cutoff frequency (-3 dB)	≥ 50 Hz
Basic error at 23 °C / 73.4 °F	< 0,2 %
Repeatability	0,05 %
Temperature coefficient	≤ 150 ppm/°C from end value
Resolution of the A/D converter	16 bit
Measuring principle	Delta Sigma
Measurement value representation	16 bit signed integer/12 bit full range, left justified
Sensor supply	≤ 250 mA; bridged with L+ and L- from the power supply; not short-circuit proof

8.4.2 Base modules

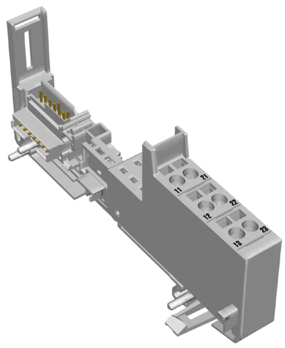


Fig. 125: Base module BL20-S3T-SBB

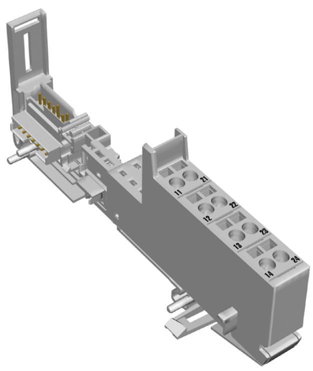


Fig. 126: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBS
- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBS

8.4.3 Wiring diagram

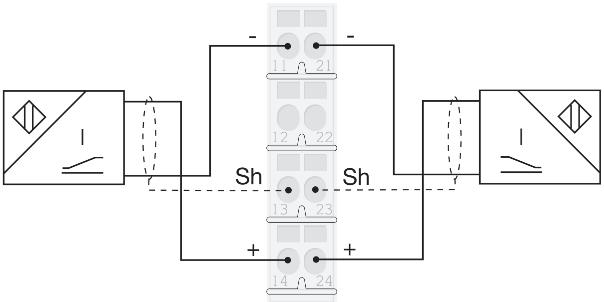


Fig. 127: 2-wire sensor with sensor supply via base module BL20-S4×-SBBS

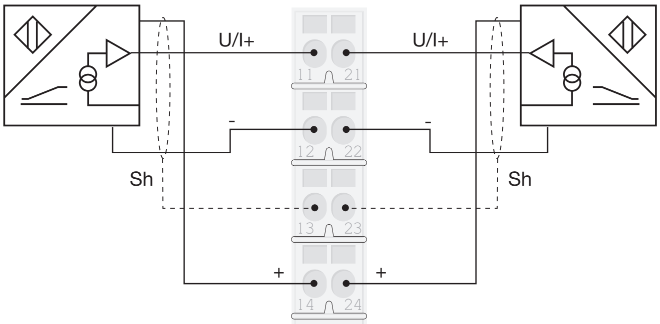


Fig. 128: 3-wire sensor with sensor supply via base module BL20-S4×-SBBS

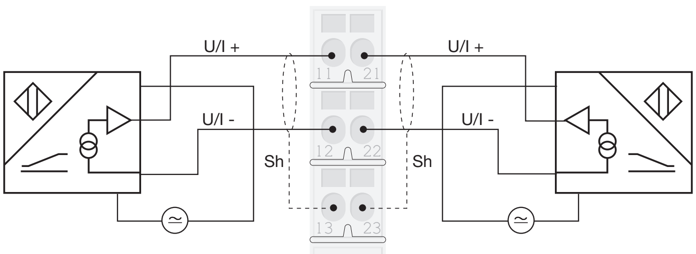


Fig. 129: 4-wire sensor with external sensor supply BL20-S3×-SBB

8.4.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.4.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an over- or undervoltage of 1% of the set voltage range. Overvoltage: U_{max} (U > 10,1 V); Undervoltage: U_{min} (U < -10,1 V) at -10…+10 V U_{min} (U < -0,1 V) at 0…10 V

NOTE
If the measurement value representation is parameterized as "12bit (left-justified)" the diagnostic data will be transferred with the process data bits 0…3 of the respective channel.

8.4.6 Module parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard						
	Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 1		Bit 0		Bit 0		Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	reserved
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 0	Bit 7		Bit 7	Byte 0	Bit 7	
Channel 2		Bit 0		Bit 8		Bit 0	Measurement range
		Bit 1		Bit 9		Bit 1	Data format
		Bit 2		Bit 10		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 11		Bit 3	Deactivate channel
		Bit 4		Bit 12		Bit 4	reserved
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 1	Bit 7	Word 0	Bit 15	Byte 1	Bit 7	

The default values are written in **bold**.

Parameters	Value
Measurement range	0 = -10…+10V
	1 = 0…10V
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes
Deactivate channel	**0 = no**
	1 = yes

8.4.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.5 Analog input module, 2 AI, Pt-/Ni sensors

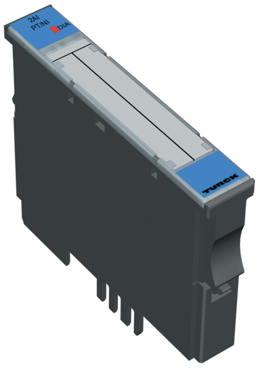


Fig. 130: BL20-2AI-PT/NI-2/3

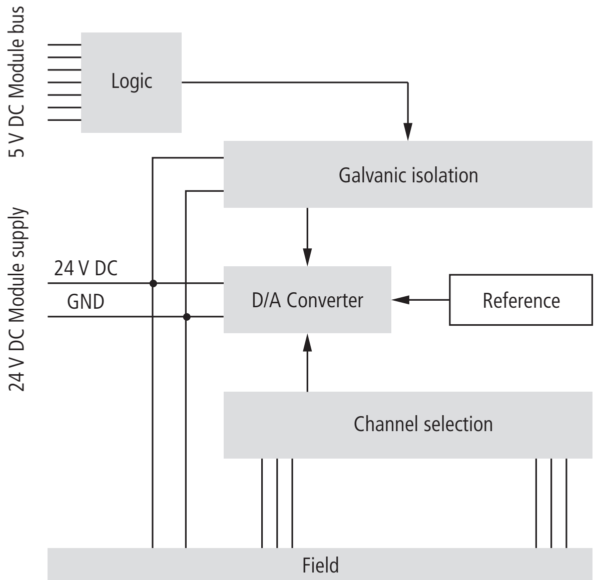


Fig. 131: Block Diagram

8.5.1 Technical data

Technical data	
Designation	BL20-2AI-PT/NI-2/3
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	≤ 45 mA
Power loss of the module, typical	< 1 W
Measurement current	< 1 mA
Destruction limit	> 30 VDC

Technical data	
Platinum sensors	According to DIN IEC 751
Nickel sensors	According to EN 43 760
Offset error	≤ 0,1%
Linearity	< 0,1 %
Basic error at 23 °C / 73.4 °F	< 0,2 % from end value
Repeatability	0,05 %
Temperature coefficient	≤ 300 ppm/°C from end value
Cycle time	≤ 130 ms per channel
Measuring principle	Delta Sigma
Connectable sensors	
Platinum sensors	Pt100, Pt200, Pt500, Pt1000
Nickel sensors	Ni100, Ni1000

8.5.2 Base modules

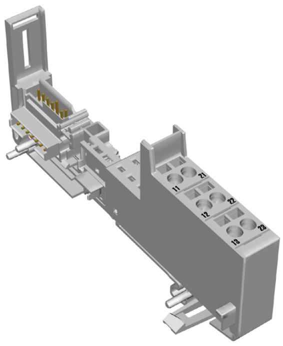


Fig. 132: Base module BL20-S3T-SBB (only 2-wire measurement possible)

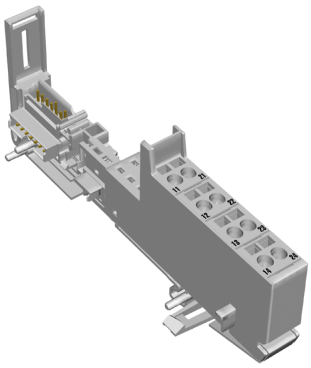


Fig. 133: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S3T-SBB
  BL20-S4T-SBBS

- with screw connection
  BL20-S3S-SBB
  BL20-S4S-SBBS

8.5.3 Wiring diagram

2-wire measurement:

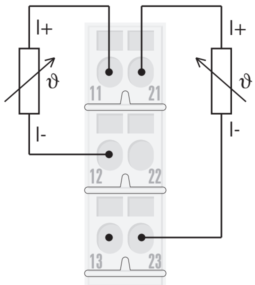


Fig. 134: Wiring diagram BL20-S3x-SBB

3-wire measurement:

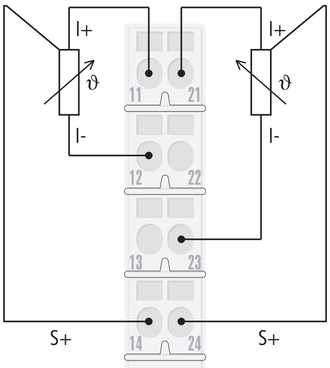


Fig. 135: Wiring diagram BL20-S4x-SBBS

8.5.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.5.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	overcurrent	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Underflow diagnostics in temperature measurement ranges only → threshold: 1 % of the positive measurement range end value
Wire break	
overcurrent	in temperature measurement ranges only → threshold: 5 Ω (loop resistance)

NOTE

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.

8.5.6 Module parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard						
	Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 1	Bit 0	Mains suppression
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	RTD type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 1	Bit 0		Bit 8	Byte 0	Bit 0	wiring type
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

	Standard Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 2	Byte 2	Bit 0		Bit 0	Byte 3	Bit 0	Mains suppression
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	RTD type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 3	Bit 0	Word 1	Bit 8	Byte 2	Bit 0	wiring type
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

The default values are written in **bold**.

Parameters	Value
Mains suppression	**0 = 50Hz**
	1 = 60 Hz
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes
Deactivate channel	**0 = no**
	1 = yes

Parameters	Value
RTD type	**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…1000Ω
wiring type	**0 = 2-wire**
	1 = 3 wire

8.5.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.6 Analog input module, 2 AI, thermocouples

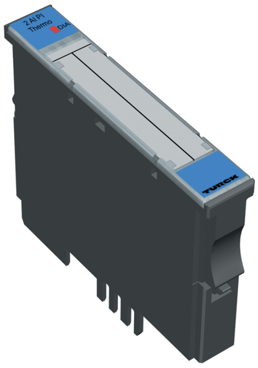


Fig. 136: BL20-2AI-THERMO-PI

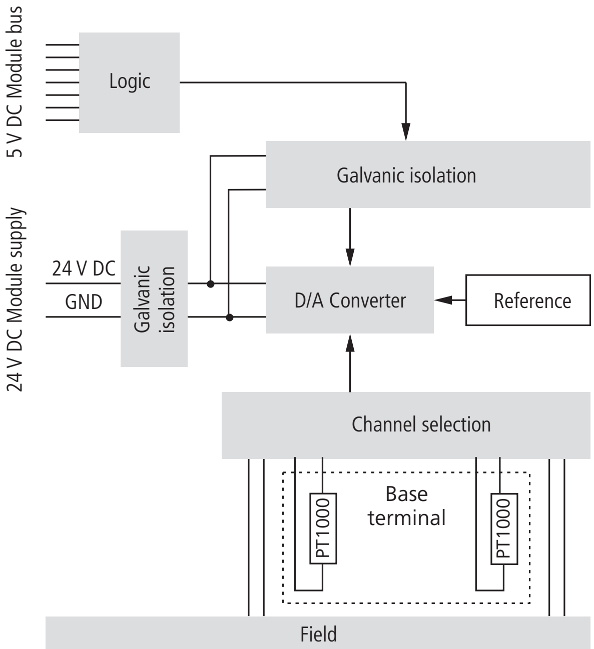


Fig. 137: Block Diagram

8.6.1 Technical data

Technical data	
Designation	BL20-2AI-THERMO-PI
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	≤ 45 mA
Power loss of the module, typical	< 1 W
Destruction limit	10 VDC (permanent)
Sensors	According to IEC 584, class 1, 2, 3
Temperature ranges	
Type B	100…1820.0 °C
Type E	-270…1000.0 °C
Type J	-210…1200.0 °C
type K	-270…1370.0 °C
type N	-270…1300.0 °C
Type R	-50…1760.0 °C
Type S	-50…1540.0 °C
Type T	-270…400.0 °C
Voltage measurement (resolution)	
± 50 mV	< 2 µV
± 100 mV	< 4 µV
± 500 mV	< 20 µV
± 1 V	< 50 µV
Measurement value representation	16 bit signed integer/12 bit full range, left justified
Basic error at 23 °C / 73.4 °F	see table s. p. 137
Crosstalk suppression	≥ 80 dB
Repeatability	see table s. p. 137
Temperature coefficient	≤ 300 ppm/°C from end value
Cycle time	– Voltage measurement: 70 ms/channel – Temperature measurement: 130 ms/channel

8.6.2 Base modules

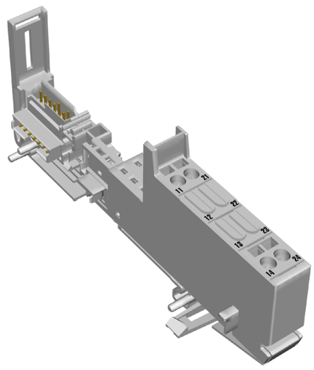
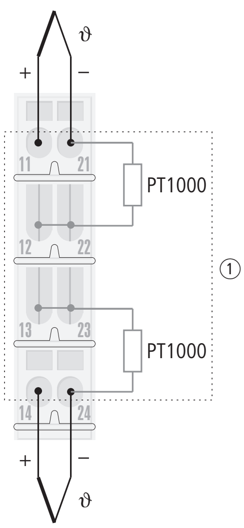


Fig. 138: Base module BL20-S4T-SBBS-CJ

- with tension clamp connection
  BL20-S4T-SBBS-CJ
- with screw connection
  BL20-S4S-SBBS-CJ

8.6.3 Wiring diagram



① Cold junction compensation in base module

Fig. 139: Wiring diagram BL20-S4×-SBBS-CJ

Basic errors and repeat accuracies

Thermocouple	Temperature range/ °C	Basic error at 23°C / % of positive end value
type K	-200…1370	± 0,2
Type J	-210…1200	± 0,2
Type B	500…1820	± 0,2
type N	-150…1300	± 0,2
Type E	-180…1000	± 0,2
Type R	0…1760	± 0,2
Type S	0…1540	± 0,2
Type T	-200…0 0…400	± 0,6 ± 0,2
Voltage measurement	all measurement ranges	± 0,2

Wider deviations of the cold junction compensation are to be expected for lower temperatures.

Thermocouple	Repeat accuracy/% of positive end value	Error due to cold junction compensation/ % of positive end value
Type K	0.05	± 0,15
Type J	0.05	± 0,17
Type B	0.05	± 0,11
Type N	0.05	± 0,16
Type E	0.05	± 0,20
Type R	0.05	± 0.12
Type S	0.05	± 0,13
Type T	0.1 0.075	– 0
Voltage measurement	0.05	–

8.6.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.6.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	Cold junction error Wire break	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	threshold: 1 % of the positive measurement range end value

Diagnostics	Meaning
Wire break	in temperature measurement ranges only
Cold junction compensation Wire break	the Pt1000-sensor for the respective channel in the base module is defective → the Pt1000-sensor of the other channel is taken as cold junction. The diagnostic message "No Pt1000-sensor found" at both module channels indicates the usage of a wrong base module. → A cold junction temperature of 23°C is presumed. The diagnostic "Underflow" is generated by the sensor types K, N and T when the temperature falls below -271.6 °C.

8.6.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 1		Bit 0		Bit 0		Bit 0	Mains suppression
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Thermocouple type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 0	Bit 7		Bit 7	Byte 1	Bit 7	
		Bit 0		Bit 8		Bit 0	reserved
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 1	Bit 7	Word 0	Bit 15	Byte 0	Bit 7	

	Standard				PROFIBUS PROFINET		Parameters
	Byte oriented		Word oriented				
Channel 2		Bit 0		Bit 0		Bit 0	Mains suppression
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Thermocouple type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 2	Bit 7		Bit 7	Byte 3	Bit 7	
		Bit 0		Bit 8		Bit 0	reserved
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 3	Bit 7	Word 1	Bit 15	Byte 2	Bit 7	

The default values are written in **bold**.

Parameters	Value
Mains suppression	**0 = 50Hz**
	1 = 60 Hz
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes
Deactivate channel	**0 = no**
	1 = yes

Thermocouple type	**0000 = Typ 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

8.6.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the **Appendix**, s. **p. 493**.

8.7 Analog input module, 4AI, voltage/current

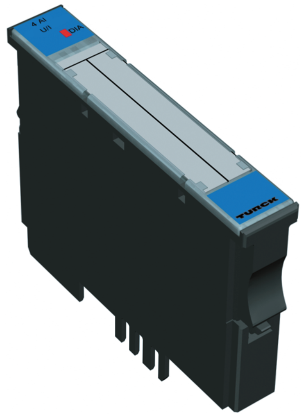
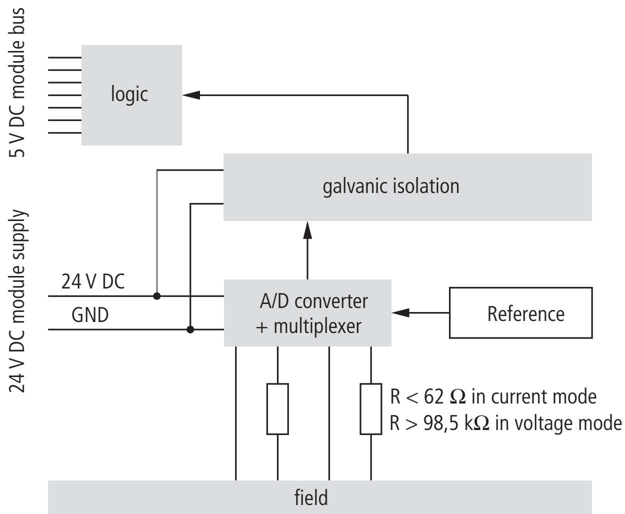


Fig. 140: BL20-4AI-U/I

Fig. 141:
Block Diagram



8.7.1 Technical data

Technical data	
Designation	BL20-4AI-U/I
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	20 mA
Nominal current from module bus I_{MB}	≤ 50 mA
Power loss of the module, typical	< 1 W
Input signal (current mode)	
Input resistance (burden)	< 62 Ω
Input current (range which can be evaluated by the A/D converter)	0…20 mA 4…20 mA
Input current (maximum - from 20.2 mA an Measured value out of range" message is generated).	50 mA
Cutoff frequency (-3 dB)	20 Hz
Input signal (voltage mode)	
Input resistance (burden)	> 98.5 kΩ
Input viltage (range which can be evaluated by the A/D converter)	-10…10 VDC 0…10 VDC
Input voltage (maximum - a deviation of 1% already generates a "Measured value out of range" message)	35 VDC
Cutoff frequency (-3 dB)	20 Hz
accuracy fo the input signal	
Basic error at 23 °C / 73.4 °F	< 0,3 %
Temperature coefficient	≤300 ppm/°C from end value
Measurement value representation	
Resolution of the A/D converter	16 bit
Measuring principle	Delta Sigm, NE43, Extended range
Measured value representation	16 bit: two's complement coded or 12 bit left-justified – two's complement coded (even negative values possible) – binary number without coding (only positive values possible)

8.7.2 Base modules

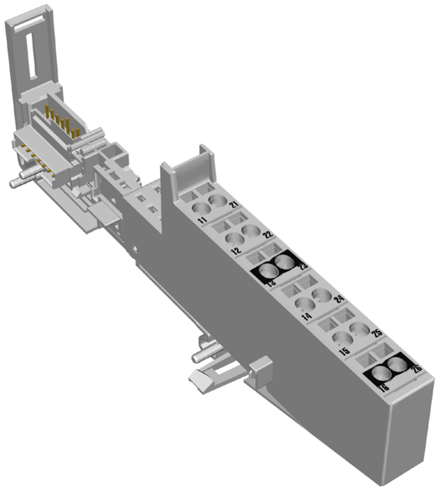


Fig. 142: Base module BL20-S6T-SBCSBC

- with tension clamp connection
  BL20-S6T-SBCSBC
- with screw connection
  BL20-S6S-SBCSBC

8.7.3 Wiring diagram

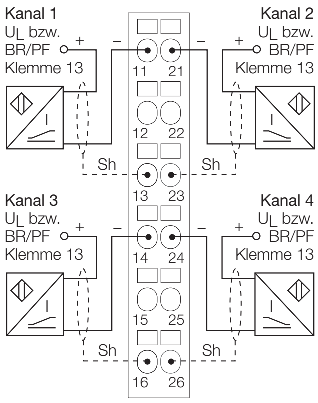


Fig. 143: 2-wire sensors with sensor supply via UL or BR/PF-module, base module BL20-S6×-SBCSBC

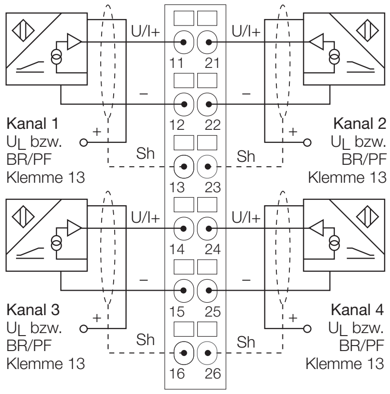


Fig. 144: 3-wire sensors with sensor supply via UL or BR/PF-module, base module BL20-S6×-SBCSBC

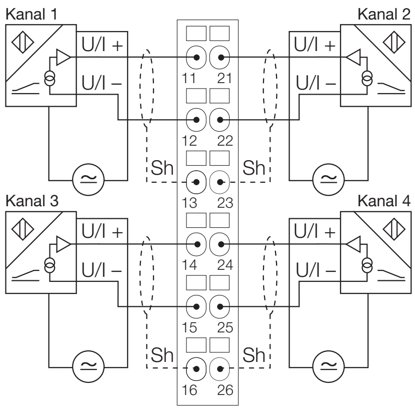


Fig. 145: 4-wire sensor with external sensor supply BL20-S6×-SBCSBC

8.7.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							
	n + 4	AI3 LSB							
	n + 5	AI3 MSB							
	n + 6	AI4 LSB							
	n + 7	AI4 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.7.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an over- or undercurrent of 1 % of the set current range; whereby, undercurrents can only be recognized with those modules that have a set current range of 4…20 mA. Overcurrent: Imax (I > 20,2 mA); Undercurrent: Imin (I < 3,8 mA) Indicates an over- or undervoltage of 1% of the set voltage range. Overvoltage: U_{max} (U > 10,1 V); Undervoltage: U_{min} (U < -10,1 V) at -10…+10 V U_{min} (U < -0,1 V) at 0…10 V
Wire break	Displays a wire break in the signal line for the operating mode: 4…20 mA (I < 3 mA)

NOTE

If the measurement value representation is parameterized as "12bit left-justified" the diagnostic data will be transferred with the process data bits 0…3 of the respective channel.

8.7.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see Cross reference list parameters (page 523)).

	Standard Byte oriented		Word oriented		PROFIBUS PROFINET		Parameter
Channel 1		Bit 0		Bit 0		Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Mode
		Bit 5		Bit 5		Bit 5	Data representation
		Bit 6		Bit 6		Bit 6	
	Byte 0	Bit 7		Bit 7	Byte 0	Bit 7	
Channel 2		Bit 0		Bit 8		Bit 0	Measurement range
		Bit 1		Bit 9		Bit 1	Data format
		Bit 2		Bit 10		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 11		Bit 3	Deactivate channel
		Bit 4		Bit 12		Bit 4	Mode
		Bit 5		Bit 13		Bit 5	Data representation
		Bit 6		Bit 14		Bit 6	
	Byte 1	Bit 7	Word 0	Bit 15	Byte 1	Bit 7	
Channel 3		Bit 0		Bit 0		Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Mode
		Bit 5		Bit 5		Bit 5	Data representation
		Bit 6		Bit 6		Bit 6	
	Byte 2	Bit 7		Bit 7	Byte 2	Bit 7	
Channel 4		Bit 0		Bit 0		Bit 0	Measurement range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Mode
		Bit 5		Bit 5		Bit 5	Data representation
		Bit 6		Bit 6		Bit 6	
	Byte 0	Bit 7	Word 1	Bit 7	Byte 0	Bit 7	

The default values are written in **bold**.

Parameters	Value
Measurement range	**0 = 0…10 V/ 0…20 mA**
	1 = -10…+10 V/ 4…20 mA
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no**
	1 = yes
Deactivate channel	**0 = no**
	1 = yes
Mode	**0 = voltage**
	1 = current
Data representation	**0 = 15 bit + sign** 1 = NE 43 2 = Extended Range This parameter is only valid for modules with a version

8.7.7 Measurement value representation

NOTE
A detailed description of the measurement value representation for the analog input modules in 16 or 12 bit can be found in the Appendix, s. p. 493.

8.8 Analog input module, 8AI voltage/current and 4 Pt/Ni, Economy

The analog input module is used to connect 8 analog signals. Each channel can be parameterized in different current or respectively voltage ranges. Additionally, 2 analog channels at a time can be combined to a Pt-/Ni- or R-input with 2- or 3-wire technology (see Connection options, s. p. 153).

The module thus provides a maximum number of 8 measurement inputs for voltage or current or 4 channels for 2- or 3-wire Pt-/Ni- or resistance-measurement. The function setting is done via channel-oriented parameters.

The module provides galvanic isolation between the field and the module bus connection.

The supply for the signals has to be connected externally. A shield connection to the base module is not possible.

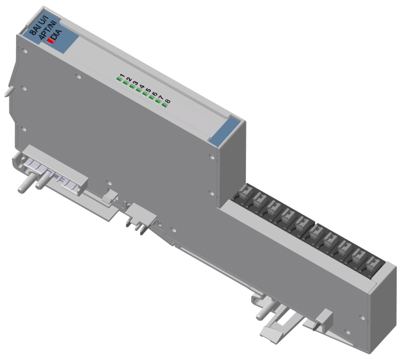


Fig. 146: BL20-E-8AI-U/I-4PT/NI

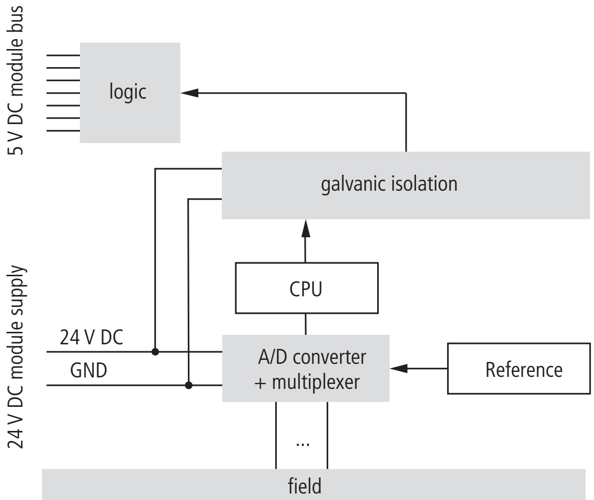


Fig. 147: Block Diagram

8.8.1 Technical data

Technical data	
Designation	BL20-E-8AI-U/I-4PT/NI
Number of channels	8 (U/I) /4 (Pt/Ni/R)
Nominal voltage from supply terminal U_L	24 VDC (18 VDC…30 VDC)
Nominal current from supply terminal I_L	typ. 35 mA (without measurement signal)
Nominal current from module bus I_{MB}	< 30 mA
Power loss of module, typical	< 1,5 W
Special Technical data	
Parameterizable measured variables	voltage, current, Pt, Ni, R
– Voltage measurement	-10…10 VDC/0…10 VDC
Max. input voltage U_{max}	± 20 VDC
Input resistance (burden) R_L	> 200 kΩ
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0.2 %
Temperature coefficient	200 ppm/ °C
– Current measurement	0…20 mA/ 4…20 mA
Max. input current I_{max}	40 mA
Max. input voltage U_{max}	< 17 VDC
Input resistance (burden) R_L	< 52 Ω
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0.2 %
Temperature coefficient	200 ppm/ °C
– Pt sensor (EN 60 751)	Pt 100, Pt 200, Pt 500, Pt 1000
Measurement current I_{meas}	0…400 Ω: < 2 mA 400…4000 Ω: < 0,5 mA (integral)
Destruction limit U_{max}	> 30 VDC
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0,2 % (Pt200, Pt500, Pt1000) 0,35 % (Pt100)
Temperature coefficient	200 ppm/ °C

Technical data	
– Ni sensor	Ni100, Ni1000 (DIN 43 760) Ni1000TK5000
Measurement current I_{meas}	0…400 Ω: < 2 mA 400…4000 Ω: < 0,5 mA (integral)
Destruction limit U_{max}	> 30 VDC
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0,2 % (Ni1000, Ni1000TK5000) 0,35% (Ni100)
Temperature coefficient	200 ppm/ °C
– R (resistance measurement)	0…250 Ω, 0…400 Ω, 0…800 Ω, 0…2000 Ω, 0…4000 Ω
Measurement current I_{meas}	0…400 Ω: < 2 mA 400…4000 Ω: < 0,5 mA (integral)
Destruction limit U_{max}	> 30 VDC
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0.2 %
Temperature coefficient	200 ppm/ °C

8.8.2 Wiring diagram

The terminal assignment depends on the sensor type.

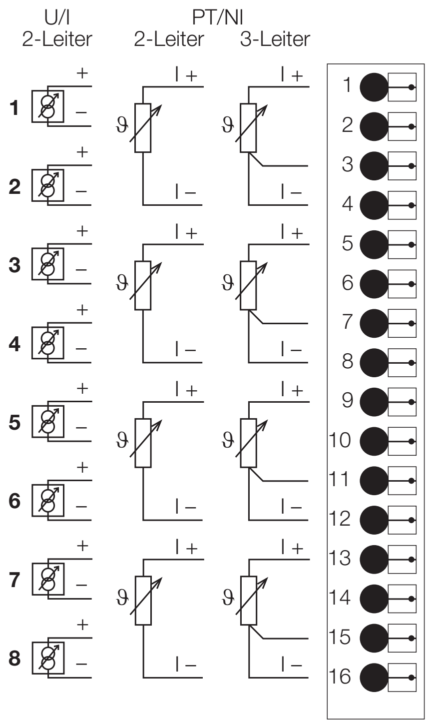


Fig. 148: Connection options

> **NOTE**
> Open inputs or unused channels should not be parameterized in the operation mode PT/NI or R because this parameterization can cause marginal measurement errors in adjacent channels.
> Should this though be is necessary due to the application, the respective channels have to be terminated with a resistor. theresistor value has to lie within the parameterized range.

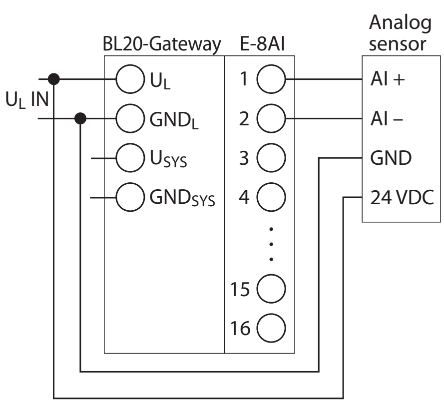
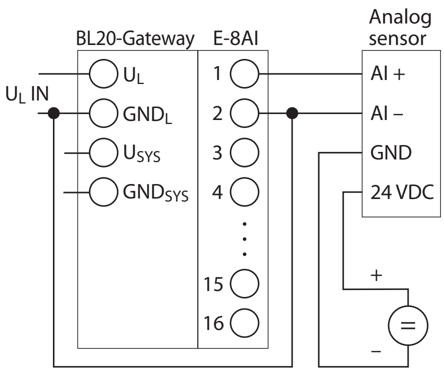


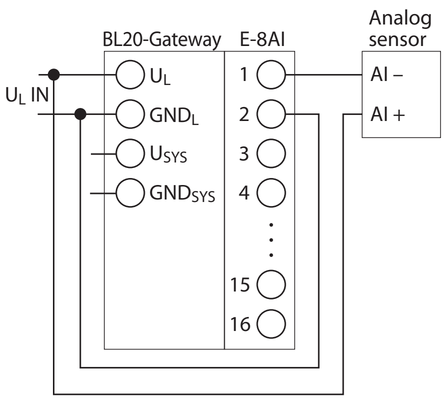
Fig. 149: 4-wire-sensor (U/I)

The sensor is fed from the same source as U_L of the BL20 system. The sensor and U_L of the BL20 system are automatically on the same GND potential.



The sensor and UL of the BL20 system are fed from different sources. U_L of the BL20 system and AI of the sensor must be on the same GND-potential. For this, U_L and AI must be bridged.

Fig. 150: 4-wire-sensor (U/I)



The sensor is fed from the same source as U_L of the BL20 system. The sensor and U_L of the BL20 system are automatically on the same GND potential.

Fig. 151: 2-wire-sensor (U/I)

8.8.3 Process data mapping

For input-parameterization as Pt-/Ni-or R, the measurement value can be found in the channel with the lower number of the used channels (K1, K3, K5, K7).

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							
	n + 4	AI3 LSB							
	n + 5	AI3 MSB							
	n + 6	AI4 LSB							
	n + 7	AI4 MSB							
	n + 8	AI5 LSB							
	n + 9	AI5 MSB							
	n + 10	AI6 LSB							
	n + 11	AI6 MSB							
	n + 12	AI7 LSB							
	n + 13	AI7 MSB							
	n + 14	AI8 LSB							
	n + 15	AI8 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.8.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure or field voltage U_L not con-nected.	Check if more than two ad-joining electronics modules have been pulled. Check the field voltage U_L.
	Off	No error messages or diagnostics	–
1 -8	Green	channel input active	
	Green flashing 4 Hz	channel is in overrange	
	Green flashing 0.5 Hz	channel is in under-range	
	Off	channel inactive	

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Hardware error	-	-	-	Overflow/ under- flow, OUFL	overcur- rent	Wire break	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an exceeding or undercut of the value ranges. → Limit values according to parameterization, page 161 ff. The permissible measurement value limits are exceeded, it is thus possible that no valid measurement value can be detected.
Wire break	Indicates an open circuit in the signal line for the operating mode: in temperature measurement in resistance measurement in current measurement 4…20 mA → limits see page 161 ff.
overcurrent	in temperature measurement: threshold: 5 Ω (loop resistance)
Overflow/underflow, OUFL	The measurement value is below the value ranges and the device is not able to capture these values. → limits see page 161 ff.
Hardware error	Shows common errors of the module hardware. The return analog value in case of an error is ”0”.

NOTE

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.

NOTE

In the current measurement ranges , the module switches automatically to the voltage measurement after 300 ms if I > 40.0 mA. For the 300 ms, a current of max. 500 mA is accepted. After this, a periodical switching to current measurement is done. If the current falls again to the permissible range, the module switches permanently back to current measurement. During this procedure, the transmitted value is always the measurement range end value. Please observe the module’s maximum input voltage!

8.8.5 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

The module provides 8 byte parameter data. One byte is assigned to each analog input channel.

NOTE
Please read s. p. 161 ff. for detailed information about the parameter settings (Standard, Extended Range, PA (NE 43)).

	Standard				**PROFIBUS PROFINET**		**Parameters**
	Byte oriented		**Word oriented**				
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Data format
		Bit 7		Bit 7		Bit 7	Deactivate all diagnostics
Channel 2	Byte 1	Bit 0		Bit 8	Byte 1	Bit 0	Mode
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Data format
		Bit 7		Bit 15		Bit 7	Deactivate all diagnostics
…							

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	Standard						
	Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 7		Bit 0		Bit 0		Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Data format
	Byte 6	Bit 7		Bit 7	Byte 6	Bit 7	Deactivate all diagnostics
Channel 8		Bit 0		Bit 0		Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Data format
	Byte 7	Bit 7	Word 4	Bit 7	Byte 7	Bit 7	Deactivate all diagnostics

The default values are written in **bold**.

Parameters	Settings
Mode	In Pt-, Ni and resistance measurement, only the first of the used channel has to be parameterized (channel 1, 3, 5. 7). The parameterization of the second channel is ignored.
	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 V DC extended range 000101 = voltage 0…10 V DC extended range 001000 = current 0…20 mA DC standard 001001 = current 4…20 mA DC standard 001010 = current 0…20 mA DC PA (NE 43) 001011 = current 4…20 mA DC PA (NE 43) 001100 = current 0…20 mA DC extended range 001101 = current 4…20 mA DC extended range 010000 = Pt200, -200 °C…850 °C, 2 wire 010001 = Pt100 -200 °C…150 °C, 2 wire 010010 = Pt200, -200 °C…850 °C, 2 wire 010011 = Pt200 -200 °C…150 °C, 2 wire 010100 = Pt500 -200 °C…850 °C, 2 wire 010101 = Pt500 -200 °C…150 °C, 2 wire 010110 = Pt1000 -200 °C…850 °C, 2 wire 010111 = Pt1000 -200 °C…150 °C, 2 wire 011000 = Pt100 -200 °C…850 °C, 3 wire 011001 = Pt100 -200 °C…150 °C, 3 wire 011010 = Pt200 -200 °C…850 °C, 3 wire 011011 = Pt200 -200 °C…150 °C, 3 wire 011100 = Pt500 -200 °C…850 °C, 3 wire 011101 = Pt500 -200 °C…150 °C, 3 wire 011110 = Pt1000 -200 °C…850 °C, 3 wire 011111 = Pt1000 -200 °C…150 °C, 3 wire
	100000 = Ni100, -60 °C…250 °C, 2 wire 100001 = Ni100, -60 °C…150 °C, 2 wire 100010 = Ni100, -60 °C…250 °C, 2 wire 100011 = Ni1000,-60 °C…150 °C, 2-wire 100100 = Ni1000TK5000, -60 °C…250 °C, 2 wire 101000 = Ni100, -60 °C…250 °C, 3 wire 101001 = Ni100, -60 °C…150 °C, 3 wire 101010 = Ni100, -60 °C…250 °C, 3 wire 101011 = Ni1000,-60 °C…150 °C, 3-wire 101100 = Ni1000TK5000, -60 °C…250 °C, 3 wire 110000 = resistance, 0…400 Ω 110001 = resistance, 0…800 Ω 110011 = resistance, 0…2000 Ω 110100 = resistance, 0…4000 Ω
Data format	**0 = 15 bit + sign** 1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no** 1 = yes

8.8.6 Process input data

For input-parameterization as Pt-/Ni-or R, the measurement value can be found in the channel with the lower number of the used channels (K1, K3, K5, K7).

Chan-nel	B7	B6	B5	B4	B3	B2	B1	B0	B7	B6	B5	B4	B3	B2	B1	B0
	MSB															LSB
1	Byte 1								Byte 0							
2	Byte 3								Byte 2							
3	Byte 5								Byte 4							
4	Byte 7								Byte 6							
5	Byte 9								Byte 8							
6	Byte 11								Byte 10							
7	Byte 13								Byte 12							
8	Byte 15								Byte 14							

8.8.7 Standard value representation for voltage/current

16-bit representation

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		at DIA Measured value out of range ON	32767	7FFF
≤ 10,0500 V		at DIA Measured value out of range Off	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
0.000000 V			0	0000
-0.000305 V			-1	FFFF
…			…	…
-5.0000 V			-16384	C000
…			…	…
-9.9997 V			-32767	8001
≤ -10,0000 V			-32768	8000
≥ -10,0500 V		at DIA Measured value out of range Off	-32768	8000
< -10.1000 V		at ↓ DIA Measured value out of range ON	-32768	8000

0…10 V	unipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 3.052 × 10^{-4}) V				
> 10.1000 V		at ↑ DIA Measured value out of range ON	32767	7FFF
≤ 10,0500 V		at ↓ DIA Measured value out of range Off	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.000305 V			1	0001
≤ 0,000000 V			0	0000
≥ -0,0500 V		at ↑ DIA Measured value out of range Off	0	0000
< -0.1000 V		at↓ DIA Measured value out of range ON	0	0000

0…20 mA	unipolar	Diagnostics	dec.	hex.
current $value_M$ = (dec. value × 6.104 × 10^{-4}) mA				
> 20.2000 mA		at↑ DIA Measured value out of range ON	32767	7FFF
≤ 20,1000 mA		at ↓ DIA Measured value out of range Off	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9994 mA			32766	7FFE
…			…	…
10.0003 mA			16384	4000
…			…	…
0.0006104 mA			1	0001
≤ 0,0000 mA			0	0000
≥ -0.1 mA		at ↑ DIA Measured value out of range Off	0	0000
< -0.2 mA		at ↓ DIA Measured value out of range ON	0	0000

4…20 mA	unipolar	Diagnostics	dec.	hex.
		current value$_M$ = (dec. value × 4,883 × 10^{-4}) + 4 mA		
> 20.2000 mA		at↑ DIA Measured value out of range ON	32767	7FFF
≤ 20,1000 mA		at ↓ DIA Measured value out of range Off	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9995 mA			32766	7FFE
…			…	…
12.00024 mA			16384	4000
…			…	…
4.0004883 mA			1	0001
≤ 4,0000 mA			0	0000
≥ 3.7000 mA		at ↑ DIA Measured value out of range Off	0	0000
< 3.6000 mA		at ↓DIA Measured value out of range ON	0	0000
≥ 3.0000 mA		at ↑ DIA Wire break Off	0	0000
< 2.9000 mA		at ↓DIA Wire break ON	0	0000

12-bit-representation (left-justified)

NOTE

If the measurement value representation is parameterized as "12bit left-justified" the diagnostic data will be transferred with the process data bits 0…3 of the respective channel.

-10…10 V	**bipolar**	**Diagnostics**	**dec.**	**hex.**
Voltage value U_M = (dec. value/ 16 × 4,885 × 10^{-3}) V				
> 10.1000 V		at↑ DIA Measured value out of range ON	2047 × 16	7FFF
≤ 10,0500 V		at ↓DIA Measured value out of range Off	2047 × 16	7FFF
10.0000 V	nominal range		2047 × 16	7FFF
9.9951 V			2046 × 16	7FE×
…			…	…
5.00244 V			1024 × 16	400×
…			…	…
0.00488 V			1 × 16	001×
0.000000 V			0	000×
-0.000488 V			-1 × 16	FFF×
…			…	…
-5.0000 V			-1024 × 16	C00×
…			…	…
-9.99511 V			-2047 × 16	801×
≤ -10,0000 V			-2048 × 16	800×
≥ -10,0500 V		at ↑ DIA Measured value out of range Off	-2048 × 16	800×
< -10.1000 V		at ↓DIA Measured value out of range ON	-2048 × 16	800×

0…10 V	unipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value/ 16 × 2,442 × 10^{-3}) V				
> 10.1000 V		at↑ DIA Measured value out of range ON	4095 × 16	FFF×
≤ 10,0500 V		at ↓ DIA Measured value out of range Off	4095 × 16	FFF×
10.0000 V			4095 × 16	FFF×
9.9976 V			4094 × 16	FFE×
…	nominal range		…	…
5.0012 V			2048 × 16	800×
…			…	…
0.00244 V			1 × 16	001×
≤ 0,0000 V			0	000×
≥ -0,0500 V		at ↑ DIA Measured value out of range Off	0	000×
< -0.1000 V		at ↓ DIA Measured value out of range ON	0	000×

0…20 mA	unipolar	Diagnostics	dec.	hex.
current $value_M$ = (dec. value/16 × 4.884 × 10^{-3}) mA				
> 20.2000 mA		at↑ DIA Measured value out of range ON	4095 × 16	FFF×
≤ 20,1000 mA		at ↓ DIA Measured value out of range Off	4095 × 16	FFF×
≥ 20.0000 mA			4095 × 16	FFF×
19.9951 mA			4094 × 16	FFE×
…	nominal range		…	…
10.0024 mA			2048 × 16	800×
…			…	…
0.00488 mA			1 × 16	001×
≤ 0.0000 mA			0	000×
≥ -0.1 mA	underflow	at ↑ DIA Measured value out of range Off	0	000×
< -0.2 mA		at ↓ DIA Measured value out of range ON	0	000×

4…20 mA	unipolar	Diagnostics	dec.	hex.
current value$_M$ = (dec. value/16 × 3,907 × 10^{-3}) + 4) mA				
> 20.2000 mA		at ↑ DIA Measured value out of range ON	4095 × 16	FFF×
≤ 20,1000 mA		at ↓ DIA Measured value out of range Off	4095 × 16	FFF×
≥ 20.0000 mA	nominal range		4095 × 16	FFF×
19.9961 mA			4094 × 16	FFE×
…			…	…
12.0020 mA			2048 × 16	800×
…			…	…
4.0039 mA			1 × 16	001×
≤ 4,0000 mA			0	000×
≥ 3.7000 mA		at ↑ DIA Measured value out of range Off	0	000×
< 3.6000 mA		at ↓ DIA Measured value out of range ON	0	000×
≥ 3.0000 mA		at ↑ DIA Wire break Off	0	000×
< 2.9000 mA		at ↓ DIA Wire break ON	0	000×

8.8.8 Extended Range - value representation for voltage/current

16-bit representation

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 3.617 × 10^{-4}) V				
≥ 11,851490 V	Overflow		32767	7FFF
≥ 11,7593 V		at ↑ DIA Measured value out of range ON	32512	7F00
11.7589 V	out of range		32511	7EFF
≤ 11,603010 V		at↓ DIA Measured value out of range Off	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.0003617 V			1	0001
0.000000 V			0	0000
-0.0003617 V			-1	FFFF
…			…	…
-5.000000 V			-13824	CA00
…			…	…
-10.000000V			-27648	9400
-10,000362 V	Underflow		-27649	93FF
≥ -11,60301 V		at↑ DIA Measured value out of range Off	-32080	82B0
-11.758897 V			-32511	8100
-11.759259 V	Underflow	at↓ DIA Measured value out of range ON	-32512	80FF
≤ -11,851851 V			-32768	8000

0…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 3.617 × 10^{-4}) V				
≥ 11,851 V	Overflow		32767	7FFF
≥ 11,7593 V		at ↑ DIA Measured value out of range ON	32512	7F00
11.7589 V	out of range		32511	7EFF
≤ 11,603010 V		at↓ DIA Measured value out of range Off	32080	7D50
10.000305 V			27649	6C01
10.000000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.000361 V			1	0001
0.000000 V			0	0000
< 0.000000 V			0	0000
≥ -0,050 V	Underflow	at ↑ DIA Overflow/ underflow, OUFL Off	0	0000
< -0.100 V		at ↓ DIA Overflow/ underflow, OUFL ON	0	0000

0…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 7.234 × 10^{-4}) mA				
≥ 23.70298 mA	Overflow		32767	7FFF
≥ 23.51852 mA		at ↑ DIA Measured value out of range ON	32512	7F00
23.517795 mA	out of range		32511	7EFF
≤ 23,2060 mA		at↓ DIA Measured value out of range Off	32080	7D50
20.000723 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
10.0000 mA			13824	3600
…			…	…
0.0007234 mA			1	0001
0.000000 mA			0	0000
≥ -0.1 mA	Underflow	at ↑ DIA Overflow/underflow, OUFL Off	0	000×
< -0.2 mA		at ↓ DIA Overflow/underflow, OUFL ON	0	000×

4…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 5,787 × 10^{-4}) mA				
≥ 22.96238 mA	Overflow		32767	7FFF
≥ 22.81481 mA		at ↑ DIA Measured value out of range ON	32512	7F00
22.814236 mA	out of range		32511	7EFF
≤ 22,56482 mA		at↓ DIA Measured value out of range Off	32080	7D50
20.000579 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
12.0000 mA			13824	3600
…			…	…
4.0005787 mA			1	0001
4.000000 mA			0	0000
3.999421 mA	Underflow		-1	FFFF
≥ 1.5567 mA		at↑ DIA Measured value out of range Off	-4222	EEBA
1.185185			-4864	ED00
≤ 1,184606 mA	Underflow	at↓ DIA Measured value out of range ON	-4865	ECFF
≤ 0.0000 mA			-6912	E500

12-bit-representation (left-justified)

The representation of the 12 bit values corresponds to that of the 16 bit values. Only bits 0 to 3 are set to "0". Diagnostic data are not mapped to the process data.

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value/ 16 × 5,787 × 10^{-3}) V				
≥ 11,8460 V	Overflow		2047 × 16	7FF0
≥ 11,7592 V		at ↑ DIA Measured value out of range ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11,6030 V		at↓ DIA Measured value out of range Off	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
…			…	…
5.0000 V			864 × 16	3600
…			…	…
0.000578 V			1 × 16	0010
0.000000 V			0	0000
-0.000578 V			-1 × 16	FFF0
…			…	…
-5.000000 V			-864 × 16	CA00
…			…	…
-10.000000V			-1728 × 16	9400
-10,0058 V	Underflow		-1729 × 16	93F0
≥ -11,6030 V		at↑ DIA Measured value out of range Off	-2005 × 16	82B0
-11.7592 V			-2032 × 16	8100
-11.7650 V	Underflow	at↓ DIA Measured value out of range ON	-2033 × 16	80F0
≤ -11,8518 V			-2048 × 16	8000

0…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value/ 16 × 5,787 × 10^{-3}) V				
≥ 11,8460 V	Overflow		2047 × 16	7FF0
≥ 11,7592 V		at ↑ DIA Measured value out of range ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
≤ 11,6030 V		at↓ DIA Measured value out of range Off	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.000000 V	nominal range		1728 × 16	6C00
…			…	…
5.0000 V			864 × 16	3600
…			…	…
0.000578 V			1 × 16	0010
0.00000 V			0	0000
≥ -0,050 V	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	0000
< -0.100 V		at↓ DIA Overflow/underflow, OUFL ON	0	0000

0…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value/16 × 0,01157) mA				
≥ 23.6921 mA	Overflow		2047 × 16	7FF0
≥ 23.51852 mA		at ↑ DIA Measured value out of range ON	2032 × 16	7F00
23.5069 mA	out of range		2031 × 16	7EF0
≤ 23,2060 mA		at↓ DIA Measured value out of range Off	2005 × 16	7D50
20.0116 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
…			…	…
10.0000 mA			864 × 16	3600
…			…	…
0.01157 mA			1 × 16	0010
≤ 0,0000 mA			0	0000
≥ -0.1 mA	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	0000
< -0.2 mA		at↓ DIA Overflow/underflow, OUFL ON	0	0000

4…20 mA	bipolar	Diagnostics	dec.	hex.
Current value $I_M = (\text{dec. value}/16 \times 9{,}259 \times 10^{-3}) + 4)$ mA				
≥ 22.9537 mA	Overflow		2047 × 16	7FF0
≥ 22.8148 mA		at ↑ DIA Measured value out of range ON	2032 × 16	7F00
22.8056 mA	out of range		2031 × 16	7EF0
≤ 22,5648 mA		at↓ DIA Measured value out of range Off	2005 × 16	7D50
20.0093 mA			1729 × 16	6C10
20.000000 mA	nominal range		1728 × 16	6C00
…			…	…
12.0000 mA			864 × 16	3600
…			…	…
4.00925 mA			1 × 16	0010
4,0000 mA			0	0000
3,9907 mA	Underflow		-1 × 16	FFF0
≥ 1.2963 mA		at↑ DIA Measured value out of range Off	-292 × 16	EDC0
1.1851 mA			-304 × 16	ED00
≤ 1,1759 mA	Underflow	at↓ DIA Measured value out of range ON	-305 × 16	ECF0
≤ 0,000 mA			-432 × 16	E500

8.8.9 Value representation for process automation (NE 43) for voltage/current

16-bit representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

Example:

Input current:	15.02 mA
Process value:	
dec.	15020
hex.	3AAC

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 0,001) V				
≥ 11,000 V	Overflow	at↑ DIA Overflow/underflow, OUFL ON	11000	2AF8
≤ 10,999 V		at↓ DIA Overflow/underflow, OUFL Off	10999	2AF7
10.501 V		at↑ DIA Measured value out of range ON	10501	2905
≥ 10,500 V	out of range		10500	2904
≤ 10,250 V		at↓ DIA Measured value out of range Off	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
…			…	…
5.000 V			5000	1388
…			…	…
0.001 V			1	0001
0.0000 V			0	0000
-0.001 V			-1	FFFF
…			…	…
-5.0000 V			-5000	EC78
…			…	…
-10.000 V			-10000	D8F0

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 0,001) V				
- 10.001 V	out of range		-10001	D8EF
-10.250 V		at↑ DIA Measured value out of range Off	-10250	D7F6
-10.500 V		at↓ DIA Measured value out of range ON	-10500	D6FC
-10.501 V	Underflow		-10501	D6FB
-10.999 V		at↑ DIA Overflow/underflow, OUFL Off	-10999	D509
≤ -11,000 V		at↓ DIA Overflow/underflow, OUFL ON	-11000	D508

0…10 V	unipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 0,001) V				
≥ 11,000 V	Overflow	at↑ DIA Overflow/underflow, OUFL ON	11000	2AF8
≤ 10,999 V		at↓ DIA Overflow/underflow, OUFL Off	10999	2AF7
10.501 V		at↑ DIA Measured value out of range ON	10501	2905
≥ 10,500 V	out of range		10500	2904
≤ 10,250 V		at↓ DIA Measured value out of range Off	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
…			…	…
5.000 V			5000	1388
…			…	…
0.001 V			1	0001
0.000 V			0	0000
≥ - 0,05 V	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	0000
< -0.10 V		at↓ DIA Overflow/underflow, OUFL ON	0	0000

0…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 0,001) mA				
≥ 22.000 mA	Overflow	at↑ DIA Overflow/underflow, OUFL ON	22000	55F0
≤ 21,999 mA		at ↓ DIA Overflow/underflow, OUFL Off	21999	55EF
21.001 mA		at↑ DIA Measured value out of range ON	21001	5209
≥ 21.000 mA	out of range		21000	5208
≤ 20,500 mA		at↓ DIA Measured value out of range Off	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2712
…			…	…
0.001 mA			1	0001
0.0000 mA			0	0000
≥ -0.1 mA	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	0000
< -0.2 mA		at↓ DIA Overflow/underflow, OUFL ON	0	0000

4…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 0,001) mA				
≥ 22.000 mA	Overflow	at↑ DIA Overflow/underflow, OUFL ON	22000	55F0
≤ 21,999 mA		at ↓ DIA Overflow/underflow, OUFL Off	21999	55EF
21.001 mA		at↑ DIA Measured value out of range ON	21001	5209
≥ 21.000 mA	out of range		21000	5208
≤ 20,500 mA		at ↓ DIA Measured value out of range Off	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.001 mA			4001	0FA1
4.000 mA			4000	0FA0
3.999 mA	out of range		3999	0F9F
≥ 3.800 mA		at↑ DIA Measured value out of range Off	3800	0ED8
3.600 mA		at↓ DIA Measured value out of range ON	3600	0E10
3.599 mA	Underflow		3599	0E0F
≥ 2.001 mA		at↑ DIA Wire break Off	2001	07D1
≤ 2,000 mA		at↓ DIA Wire break ON	2000	07D0
0.000 mA			0000	0000

12-bit-representation (left-justified)

The ”12-bit-representation (left-justified)” in process automation corresponds to the 16-bit-representation in which the lower 4 bits of the analog value are overwritten with diagnostic data.

-10…10 V	bipolar	Diagnostics	dec.	hex.
Voltage value U_M = (dec. value × 0,001) V				
≥ 11,008 V	Overflow	at↑ DIA Overflow/underflow, OUFL ON	11008	2B0×
≤ 10,992 V		at↓ DIA Overflow/underflow, OUFL Off	10992	2AF×
10.512 V		at↑ DIA Measured value out of range ON	10512	291×
≥ 10,496 V	Overflow		10496	290×
≤ 10,256 V		at↓ DIA Measured value out of range Off	10256	281×
10.016 V			10016	272×
10.000 V	nominal range		10000	271×
…				
4.992 V			4992	138×
…			…	…
0.016 V			16	001×
0.0000 V			0	000×
-0.016 V			-16	FFF×
…			…	…
-4.992 V			-4992	EC8×
…			…	…
-10.000 V			-10000	D8F×
- 10.016 V	out of range		-10016	D8E×
-10.256 V		at↑ DIA Measured value out of range Off	-10256	D7F×
-10.496 V			-10496	D70×
-10.512 V	Underflow	at↓ DIA Measured value out of range ON	-10512	D6F×
-10.992 V		at↑ DIA Overflow/underflow, OUFL Off	-10992	D51×
≤ -11,008 V		at↓ DIA Overflow/underflow, OUFL ON	-11008	D50×

0…10 V	bipolar	Diagnostics	dec.	hex.
		Voltage value U_M = (dec. value × 0,001) V		
≥ 11,008 V	Overflow	at↑ DIA Overflow/underflow, OUFL ON	11008	2B0×
≤ 10,992 V		at↓ DIA Overflow/underflow, OUFL Off	10992	2AF×
10.512 V		at↑ DIA Measured value out of range ON	10512	291×
≥ 10,496 V	out of range		10496	290×
≤ 10,256 V		at↓ DIA Measured value out of range Off	10256	281×
10.016 V			10016	272×
10.000 V	nominal range		10000	271×
…				
4.992 V			4992	138×
…			…	…
0.016 V			16	001×
≤ 0,0000 V			0	000×
≥ -0,05 V	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	000×
< -0.1 V		at↓ DIA Overflow/underflow, OUFL ON	0	000×

0…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value/16 × 0,001) mA				
≥ 22.000 mA	Overflow	at↑ DIA Overflow/underflow, OUFL ON	22000	55F×
≤ 21,984 mA		at ↓ DIA Overflow/underflow, OUFL Off	21984	55E×
21.024 mA			21024	522×
≥ 21.008 mA	out of range	at↑ DIA Measured value out of range ON	21008	521×
≤ 20,496 mA		at↓ DIA Measured value out of range Off	20496	501×
20.016 mA			20016	4E3×
20.000 mA	nominal range		20000	4E2×
…			…	…
10.000 mA			10000	271×
…			…	…
0.016 mA			16	001×
0.0000 mA			0	000×
≥ -0.1 mA	Underflow	at↑ DIA Overflow/underflow, OUFL Off	0	000×
< -0.2 mA		at↓ DIA Overflow/underflow, OUFL ON	0	000×

4…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value/16 × 0,001) mA				
≥ 22.000 mA	Overflow	at↑ DIA Overflow/underflow, OUFL ON	22000	55F×
≤ 21,984 mA		at ↓ DIA Overflow/underflow, OUFL Off	21984	55E×
≥ 21.008 mA	out of range	at↑ DIA Measured value out of range ON	21008	521×
≤ 20,992 mA			20496	5010
≤ 20,496 mA		at↓ DIA Measured value out of range Off		
20.016 mA			20016	4E3×
20.000 mA	nominal range		20000	4E2×
…			…	…
12.000 mA			12000	2EE×
…			…	…
4.016 mA			4016	0FB×
4.000 mA			4000	0FA×
3.984 mA	out of range		3984	0F9×
≥ 3.792 mA		at↑ DIA Measured value out of range Off	3792	0ED×
< 3.600 mA		at↓ DIA Measured value out of range ON	3600	0E1×
3.584 mA	Underflow		3584	0E0×
≥ 2.001 mA		at↑ DIA Wire break Off	2001	07D×
< 2.000 mA		at↓ DIA Wire break ON	2000	07D×
0.000 mA			0000	000×

8.8.10 Standard value representation for Pt-/ Ni- and resistance measurement

Wire break and short circuit diagnostic in Pt-/Ni-measurement

- Wire break (WB)
  if resistance = end value of measurement range
- Short circuit (SC) if resistance = loop resistance < 5 Ω

16-bit representation

	Measurement range, Pt 200...850 °C		Transmitted value	
	Pt100, Pt200, Pt500, Pt1000		dec.	hex.
temperature T_M = (dec. value × 0,1) °C				
101.0 %	≥ 858,5 °C	at↑ DIA Measured value out of range ON	8500	2134
100.5 %	≤ 854,2 °C	at ↓DIA Measured value out of range Off	8500	2134
> 100,0 %	850.0 °C	Nominal value	8500	2134
…	…		…	…
	0.1 °C		1	0001
0.0 %	0 °C		0	0000
	-0.1 °C		-1	FFFF
…				
-100 %	-200.0 °C		-2000	F830
-100.5 %	≥ -201,0 °C	at ↑ DIA Measured value out of range Off	-2000	F830
-101.0 %	≤ -202,0 °C	at ↓ DIA Measured value out of range ON	-2000	F830

	Measurement range, Pt 200...150 °C		Transmitted value	
	Pt100, Pt200, Pt500, Pt1000		dec.	hex.
temperature T_M = (dec. value × 0,01) °C				
101.0 %	≥ 151,50 °C	at↑ DIA Measured value out of range ON	15000	3A98
100.5 %	≤ 150,80 °C	at ↓DIA Measured value out of range Off	15000	3A98
> 100,0 %	150.00 °C	Nominal value	15000	3A98
…	…		…	…
	0.01 °C		1	0001
0.0 %	0 °C		0	0000
	-0.01 °C		-1	FFFF
…				
-100 %	-200.0 °C		-20000	F830
-100.5 %	≥ -201,0 °C	at ↑ DIA Measured value out of range Off	-20000	F830
-101.0 %	≤ -202,0 °C	at ↓ DIA Measured value out of range ON	-20000	F830

	Measurement range, Ni -60…250 °C		Transmitted value	
	Ni100, Ni1000, Ni100TK5000		dec.	hex.
temperature T_M = (dec. value × 0,1) °C				
101.0 %	≥ 252,50 °C	at↑ DIA Measured value out of range ON	2500	09C4
100.5 %	≤ 251,20 °C	at ↓DIA Measured value out of range Off	2500	09C4
> 100,0 %	250.00 °C	Nominal value	2500	09C4
…	…		…	…
	0.1 °C		1	0001
0.0 %	0 °C		0	0000
	-0.1 °C		-1	FFFF
…				
-100 %	-60.00 °C		-600	FDA8
-100.5 %	≥ -60,30 °C	at ↑ DIA Measured value out of range Off	-600	FDA8
-101.0 %	≤ -60,60 °C	at ↓ DIA Measured value out of range ON	-600	FDA8

	Measurement range, Ni -60…150 °C		Transmitted value	
	Ni100, Ni1000		dec.	hex.
temperature T_M = (dec. value × 0,01) °C				
101.0 %	≥ 151,50 °C	at ↑ DIA Measured value out of range ON	15000	3A98
100.5 %	≤ 150,70 °C	at ↓ DIA Measured value out of range Off	15000	3A98
> 100,0 %	150.0 °C	Nominal value	15000	3A98
…	…		…	…
	0.01 °C		1	0001
0.0 %	0 °C		0	0000
	-0.01 °C		-1	FFFF
…				
-100 %	-60.00 °C		-6000	E890
-100.5 %	≥ -60,30 °C	at ↑ DIA Measured value out of range Off	-6000	E890
-101.0 %	≤ -60,6 0°C	at ↓ DIA Measured value out of range ON	-6000	E890

	Measurement range, R		Transmitted value	
	0…250 Ω		dec.	hex.
Resistance R_M = (dec. value × 0,00762963) Ω				
101.0 %	≥ 252,5 Ω	at↑ DIA Measured value out of range ON	32767	7FFF
100.5 %	≤ 251,75 Ω	at ↓DIA Measured value out of range Off	32767	7FFF
> 100,0 %	> 250.0 Ω	Nominal value	32767	7FFF
100.0 %	250,0 Ω		32767	7FFF
99.997 %	249,992 Ω		32766	7FFE
…	…		…	…
50.002 %	125,0038 Ω		16384	4000
49.998 %	124,9962 Ω		16383	3FFF
…	…		…	…
0.003 %	0,00763 Ω		1	0001
0 %	≤ 0,0000 Ω		0	0000

	Measurement range, R		Transmitted value	
	0…400 Ω		**dec.**	**hex.**
Resistance R_M = (dec. value ×0.012207) Ω				
101.0 %	≥ 404,0 Ω	at↑ DIA Measured value out of range ON	32767	7FFF
100.5 %	≤ 402,0 Ω	at ↓DIA Measured value out of range Off	32767	7FFF
100.0 %	400,0 Ω	Nominal value	32767	7FFF
99.997 %	399,988 Ω		32766	7FFE
…	…		…	…
50.002 %	200,0061 Ω		16384	4000
49.998 %	199,9939 Ω		16383	3FFF
…	…		…	…
0.003 %	0,01221 Ω		1	0001
0 %	≤ 0,0000 Ω		0	0000

	Measurement range, R		Transmitted value	
	0…800 Ω		**dec.**	**hex.**
Resistance R_M = (dec. value × 0,0244148) Ω				
101.0 %	≥ 808,0 Ω	at↑ DIA Measured value out of range ON	32767	7FFF
100.5 %	≤ 804,0 Ω	at ↓DIA Measured value out of range Off	32767	7FFF
100.0 %	800,0 Ω	Nominal value	32767	7FFF
99.997 %	799,976 Ω		32766	7FFE
…	…		…	…
50.002 %	400.012 Ω		16384	4000
49.998 %	399,988 Ω		16383	3FFF
…	…		…	…
0.003 %	0.02441 Ω		1	0001
0 %	≤ 0,0000 Ω		0	0000

	Measurement range, R		Transmitted value	
	0…2000 Ω		**dec.**	**hex.**
Resistance R_M = (dec. value × 0,061037) Ω				
101.0 %	≥ 2020,0 Ω	at↑ DIA Measured value out of range ON	32767	7FFF
100.5 %	≤ 2010,0 Ω	at ↓DIA Measured value out of range Off	32767	7FFF
100.0 %	2000,0 Ω	Nominal value	32767	7FFF
99.997 %	1999,94 Ω		37766	7FFE
…	…		…	…
50.002 %	1000,03 Ω		16384	4000
49.998 %	999,969 Ω		16843	3FFF
…	…		…	…
0.003 %	0,06104 Ω		1	0001
0 %	≤ 0,0000 Ω		0	0000

	Measurement range, R		Transmitted value	
	0…4000 Ω		**dec.**	**hex.**
Resistance R_M = (dec. value ×0.12207) Ω				
101.0 %	≥ 4040,0 Ω	at↑ DIA Measured value out of range ON	32767	7FFF
100.5 %	≤ 4020,0 Ω	at ↓DIA Measured value out of range Off	32767	7FFF
> 100,0 %	> 4000.0 Ω	Nominal value	32767	7FFF
99.997 %	3999,88 Ω		32766	7FFE
…	…		…	…
50.002 %	2000,06 Ω		16384	4000
49.998 %	1999,94 Ω		16383	3FFF
…	…		…	…
0.003 %	0,12207 Ω		1	0001
0 %	≤ 0,0000 Ω		0	0000

12-bit-representation (left-justified)

	Measurement range, Pt 200...850 °C		Transmitted value	
	Pt100, Pt200, Pt500, Pt1000		dec.	hex.
temperature T_M = (dec. value/16 × 0,5) °C				
101.0 %	≥ 858,5 °C	at↑ DIA Measured value out of range ON	1700 × 16	6A4×
100.5 %	≤ 854,2 °C	at ↓DIA Measured value out of range Off	1700 × 16	6A4×
> 100,0 %	850.0 °C	Nominal value	1700 × 16	6A4×
…	…		…	…
	0.5 °C		1 × 16	001x
0.0 %	0 °C		0	000×
	-0.5 °C		-1 × 16	FFFx
…				
-100 %	-200.0 °C		-400 × 16	E70×
-100.5 %	≥ -201,0 °C	at ↑ DIA Measured value out of range Off	-400 × 16	E70×
-101.0 %	≤ -202,0 °C	at ↓ DIA Measured value out of range ON	-400 × 16	E70×

	Measurement range, Pt 200...150 °C		Transmitted value	
	Pt100, Pt200, Pt500, Pt1000		dec.	hex.
temperature T_M = (dec. value/16 × 0,1) °C				
101.0 %	≥ 151,50 °C	at↑ DIA Measured value out of range ON	1500 × 16	5DC×
100.5 %	≤ 150,80 °C	at ↓DIA Measured value out of range Off	1500 × 16	5DC×
> 100,0 %	150.00 °C	Nominal value	1500 × 16	5DC×
…	…		…	…
	0.1 °C		1	001×
0.0 %	0 °C		0	000×
	-0.1 °C		-1	FFF×
…				
-100 %	-200.0 °C		-2000 × 16	830×
-100.5 %	≥ -201,0 °C	at ↑ DIA Measured value out of range Off	-2000 × 16	830×
-101.0 %	≤ -202,0 °C	at ↓ DIA Measured value out of range ON	-2000 × 16	830×

	Measurement range, Ni -60…250 °C		Transmitted value	
	Ni100, Ni1000, Ni100TK5000		**dec.**	**hex.**
temperature T_M = (dec. value/16 × 0,5) °C				
101.0 %	≥ 252,50 °C	at↑ DIA Measured value out of range ON	500 × 16	1F4×
100.5 %	≤ 251,20 °C	at ↓DIA Measured value out of range OFFOFF	500 × 16	1F4×
> 100,0 %	250.00 °C	Nominal value	500 × 16	1F4×
…	…		…	…
	0.5 °C		1 × 16	001×
0.0 %	0 °C		0	000×
	-0.5 °C		-1 × 16	FFF×
…				
-100 %	-60.00 °C		-120 × 16	F88x
-100.5 %	≥ -60,30 °C	at ↑ DIA OffOFF	-120 × 16	F88×
-101.0 %	≤ -60,60 °C	at ↓ DIA Measured value out of range ON	-120 × 16	F88×

	Measurement range, Ni -60…150 °C		Transmitted value	
	Ni100, Ni1000		**dec.**	**hex.**
temperature T_M = (dec. value/16 × 0,1) °C				
101.0 %	≥ 151,50 °C	at↑ DIA Measured value out of range ON	1500 ×16	5DC×
100.5 %	≤ 150,70 °C	at ↓DIA Measured value out of range Off	1500 ×16	5DC×
> 100,0 %	150.0 °C	Nominal value	1500 ×16	5DC×
…	…		…	…
	0.1 °C		1 × 16	001×
0.0 %	0 °C		0	000×
	-0.1 °C		-1 × 16	FFF×
…				
-100 %	-60.00 °C		-600 × 16	DA8×
-100.5 %	≥ -60,30 °C	at ↑ DIA Measured value out of range Off	-600 × 16	DA8×
-101.0 %	≤ -60,6 0°C	at ↓ DIA Measured value out of range ON	-600 × 16	DA8×

	Measurement range, R		Transmitted value	
	0…250 Ω		dec.	hex.
Resistance R_M = (dec. value/16 × 0.06105) Ω				
101.0 %	≥ 252,5 Ω	at↑ DIA Measured value out of range ON	4095 × 16	FFF×
100.5 %	≤ 251,75 Ω	at ↓DIA Measured value out of range Off	4095 × 16	FFF×
100.0 %	250,0 Ω	Nominal value	4095 × 16	FFF×
99.976 %	249,939 Ω		4094 × 16	FFEx
…	…		…	…
50.012 %	125,030 Ω		2048 × 16	800×
49.988 %	124.969 Ω		2047 × 16	7FFF
…	…		…	…
0.024 %	0,06105 Ω		1 × 16	001×
0 %	≤ 0,0000 Ω		0 × 16	000×

	Measurement range, R		Transmitted value	
	0…400 Ω		dec.	hex.
Resistance R_M = (dec. value/16 ×0.09768) Ω				
101.0 %	≥ 404,0 Ω	at↑ DIA Measured value out of range ON	4095 × 16	FFF×
100.5 %	≤ 402,0 Ω	at ↓DIA Measured value out of range Off	4095 × 16	FFF×
100.0 %	400,0 Ω	Nominal value	4095 × 16	FFF×
99.976 %	399,902 Ω		4094 × 16	FFEx
…	…		…	…
50.012 %	200,0488 Ω		2048 × 16	800×
49.988 %	199,9512 Ω		2047 × 16	7FFF
…	…		…	…
0.024 %	0,09768 Ω		1 × 16	001×
0 %	≤ 0,0000 Ω		0 × 16	000×

	Measurement range, R		Transmitted value	
	0…800 Ω		dec.	hex.
Resistance R_M = (dec. value/16 × 0.19536) Ω				
101.0 %	≥ 808,0 Ω	at↑ DIA Measured value out of range ON	4095 × 16	FFF×
100.5 %	≤ 804,0 Ω	at ↓DIA Measured value out of range Off	4095 × 16	FFF×
100.0 %	800,0 Ω	Nominal value	4095 × 16	FFF×
99.976 %	799,805 Ω		4094 × 16	FFEx
…	…		…	…
50.012 %	400,098 Ω		2048 × 16	800×
49.988 %	399.902 Ω		2047 × 16	7FFF
…	…		…	…
0.024 %	0.19536 Ω		1 × 16	001×
0 %	≤ 0,0000 Ω		0 × 16	000×

	Measurement range, R		Transmitted value	
	0…2000 Ω		dec.	hex.
Resistance R_M = (dec. value/16 × 0.4884) Ω				
101.0 %	≥ 2020,0 Ω	at↑ DIA Measured value out of range ON	4095 × 16	FFF×
100.5 %	≤ 2010,0 Ω	at ↓DIA Measured value out of range Off	4095 × 16	FFF×
100.0 %	2000,0 Ω	Nominal value	4095 × 16	FFF×
99.976 %	1999,51 Ω		4094 × 16	FFEx
…	…		…	…
50.012 %	1000,24 Ω		2048 × 16	800×
49.988 %	999,756 Ω		2047 × 16	7FFF
…	…		…	…
0.024 %	0,4884 Ω		1 × 16	001×
0 %	≤ 0,0000 Ω		0 × 16	000×

	Measurement range, R		Transmitted value	
	0…4000 Ω		dec.	hex.
Resistance R_M = (dec. value/16 ×0.9768) Ω				
101.0 %	≥ 4040,00 Ω	at↑ DIA Measured value out of range ON	4095 × 16	FFF×
100.0 %	4000,00 Ω	at ↓ DIA Measured value out of range Off	4095 × 16	FFF×
99.976 %	3999,02 Ω		4094 × 16	FFEx
…	…		…	…
50.012 %	2000.49 Ω		2048 × 16	800×
49.988 %	1999,51 Ω		2047 × 16	7FFF
…	…		…	…
0.024 %	0.9768 Ω		1 × 16	001×
0 %	≤ 0,0000 Ω		0 × 16	000×

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8.9 Analog input module, 2 AI, current, HART

This analog input module provides 2 HART inputs for current measurement.

The two channels of the module are galvanically isolated. Additionally, the modules provides galvanic isolation between field level and module bus connection.

NOTE
The following restriction is only valid for the use of PROFIBUS gateways:
The BL20-2AOH-I can only be used with the BL20-DPV1-gateways (BL20-GW-DPV1, BL20-E-GW-DP)!

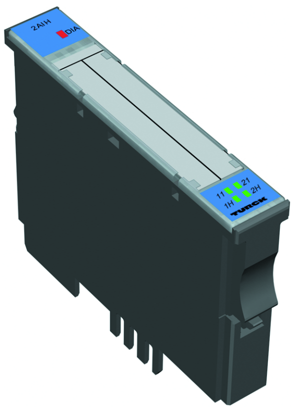


Fig. 152: BL20-2AIH-I

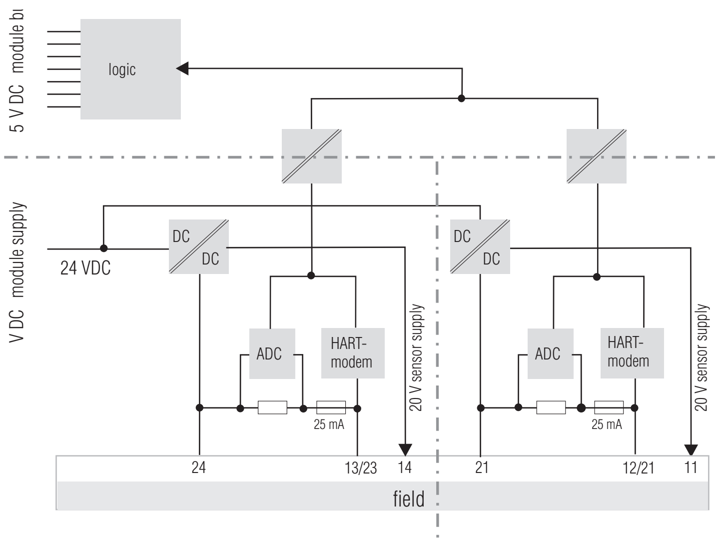


Fig. 153: Block Diagram

8.9.1 Technical data

Technical data	
Designation	BL20-2AIH-I
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC (18 VDC…30 VDC)
Nominal current from supply terminal I_L	typ. 35 mA (without measurement signal)
Nominal current from module bus I_{MB}	< 30 mA
Power loss of module, typical	< 1 W
Max. input current I_{max}	24 mA
Max. output voltage	20 V
Input resistance (burden) R_L	
Cutoff frequency f_G	1.5 Hz
Basic error (nominal range at 23 °C)	0.1 %
Repeatability	0,2 %
Temperature coefficient	< 200 ppm/°C from end value
resolution	12 bit
Linearity	0.1 %
Galvanic isolation	electronic/ field level, channel/channel
Isolation voltage	500 V
Measurement value representation	16 bit signed integer, NE 43 (PA), extended range

8.9.2 Base modules

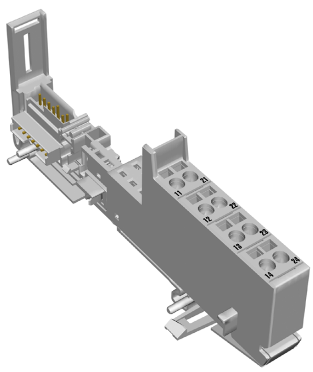
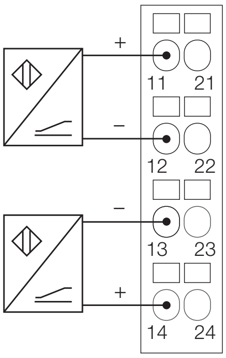


Fig. 154: Base module BL20-S4T-SBBS

8.9.3 Wiring diagram

2 wire-connection for passive HART-sensors:



4 wire-connection for passive HART-sensors:

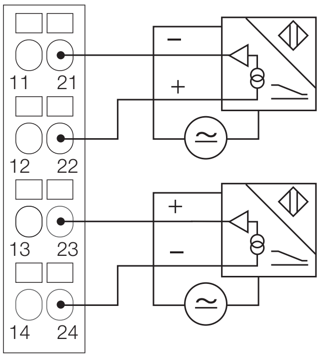


Fig. 155: Connection options with base module BL20-S4x-SBBS

8.9.4 Process data mapping

Data	Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	n + 1	AI1 LSB							
	n + 1	n	AI1 MSB							
	n + 2	n + 3	AI2 LSB							
	n + 3	n + 2	AI2 MSB							
	n + 4	n + 7	Parameterizable HART-variable A without unit							
	n + 5	n + 6								
	n + 6	n + 5								
	n + 7	n + 4								
	n + 8	n + 11	Parameterizable HART-variable B without unit							
	n + 9	n + 10								
	n + 10	n + 9								
	n + 11	n + 8								
	n + 12	n + 15	Parameterizable HART-variable C without unit							
	n + 13	n + 14								
	n + 14	n + 13								
	n + 15	n + 12								
	n + 16	n + 19	Parameterizable HART-variable D without unit							
	n + 17	n + 18								
	n + 18	n + 17								
	n + 19	n + 16								

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Representation of HART-variables without unit according to ANSI/IEEE 754-1985 ”Standard for Binary Floating-Point Arithmetic for microprocessor systems”.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.9.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Description/remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11/21	Red flashing 0.5 Hz	Wire break/short circuit (if parameterized as diagnostics)	
	Red	Over- or underflow of the measurement value (if channel is parameter-ized as 4...20 mA)	
	Red, 4 Hz both LEDs alternating	Hardware error	Exchange the module..
	Off	Channel ok	
1H/ 2H	Green	HART-communication ok	The HART-status is only shown in active HART-com-munication. The status-display is either realized acyclically or via polling operation (depending on the parameterization). With acyclical monitoring the information (LED) is turned off after 1.5 sec-onds. Further HART-communication retriggers the LED.
	Red flashing 0.5 Hz	HART communication error no communication or high number of CRC-errors	
	Red	HART-status-flag (if HART-status polling has been parameterized, see parameter Mode)	
	Off	No HART communica-tion	

NOTE

The LEDs 11 and 1H are assigned to channel 1 and the LEDs 21 and 2H to channel 2 of the module.

Diagnostics

This module has the following diagnostic data **per channel**:

Byte	B7	B6	B5	B4	B3	B2	B1	B0
	Channel 1							
0	hard-ware error	Invalid Parame-ters	HART comm. error	HART status error	Measured value under-range	over-current	Wire break	Measured value over-range
1	-							
	Channel 2							
2	hard-ware error	Invalid parame-ter	HART comm. error	HART status error	Measured value under-range	over-current	Wire break	Measured value over-range
3	-							

Diagnostics	Meaning
Measured value overrange	The measurement value exceeds the value ranges and the device is not able to capture these values.
Wire break	Displays an open circuit in the signal line.
Overcurrent	Displays a short circuit in the signal line.
Measured value underrange	The measurement value is below the value ranges and the device is not able to capture these values.
HART status error	The connected HART-device set a bit in the HART status-informa-tion ("status - polling").
HART communication error	The channel does not allow communication with the HART-device.
Invalid parameter	Possible sources: Setting of a reserved parameter bit Module behavior: Input value = 0 mA The return value of the HART-variable in the process data is 0×0000 0000.
Hardware error	Shows common errors of the module hardware. The return analog value in case of an error is "0".

NOTE
If an error message from the sensor occurs, the HART-status is set to "1".

8.9.6 Module parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross reference list parameters (page 523)**).

	Standard Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 1		Bit 0		Bit 0		Bit 0	Deactivate channel
		Bit 1		Bit 1		Bit 1	Activate overcurrent diagnostics
		Bit 2		Bit 2		Bit 2	Activate wire break diagnostics
		Bit 3		Bit 3		Bit 3	Mode
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	reserved
		Bit 6		Bit 6		Bit 6	
	Byte 0	Bit 7		Bit 7	Byte 0	Bit 7	Activate HART diagnostics
		Bit 0		Bit 8		Bit 0	Data representation
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	reserved
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 1	Bit 7	Word 0	Bit 15	Byte 1	Bit 7	

	Standard				PROFIBUS PROFINET		Parameters
	Byte oriented		Word oriented				
Channel 2		Bit 0		Bit 0		Bit 0	Deactivate channel
		Bit 1		Bit 1		Bit 1	Activate overcurrent diagnostics
		Bit 2		Bit 2		Bit 2	Activate wire break diagnostics
		Bit 3		Bit 3		Bit 3	Mode
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	reserved
		Bit 6		Bit 6		Bit 6	
	Byte 2	Bit 7		Bit 7	Byte 2	Bit 7	Activate HART diagnostics
		Bit 0		Bit 8		Bit 0	Data representation
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	reserved
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 3	Bit 7	Word 1	Bit 15	Byte 3	Bit 7	
HART-Var. A		Bit 0		Bit 0		Bit 0	Mapped channel VA
		Bit 1		Bit 1		Bit 1	reserved
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Mapped variable VA
	Byte 4	Bit 7		Bit 7	Byte 4	Bit 7	
HART-Var.B		Bit 0		Bit 8		Bit 0	Mapped channel VB
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Mapped variable VB
	Byte 5	Bit 7	Word2	Bit 15	Byte 5	Bit 7	

	Standard Byte oriented		Standard Word oriented		PROFIBUS PROFINET		Parameters
HART-Var.C	Byte 6	Bit 0		Bit 0	Byte 6	Bit 0	Mapped channel VC
		Bit 1		Bit 1		Bit 1	reserved
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Mapped variable VC
		Bit 7		Bit 7		Bit 7	
HART-Var. D	Byte 7	Bit 0	Word 3	Bit 8	Byte 7	Bit 0	Mapped channel VD
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Mapped variable VD
		Bit 7		Bit 15		Bit 7	

Parameters	Settings
Deactivate channel	**0 = no** 1 = yes
Activate overcurrent diagnostics	0 = no **1 = yes**
Activate wire break diagnostics	0 = no **1 = yes**
Mode	0 = 0… 20 mA (HART-status polling not possible) 0 = 0… 20 mA (HART-status polling not possible) **2 = 4…20 mA HART active** Cyclic polling of the HART-Status is activated.
Activate HART diagnostics	**0 = yes** 1 = no
Data representation	**0 = 15 bit + sign** 1 = NE 43 2 = Extended Range
Mapped channel Vx	Defines the channel of which the HART-variable is read. 0 = channel 1 1 = channel 2

Parameters	Settings
Mapped variable Vx	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)

8.9.7 Standard value representation, 16 bit integer

0…20 mA	unipolar	Diagnostics	dec.	hex.
current value$_M$ = (dec. value × 6.104 × 10^{-4}) mA				
approx. 22 mA	Overcurrent	at ↑ DIA Overcurrent ON	32767	7FFF
> 20.2000 mA	Overflow		32767	7FFF
≤ 20,1000 mA		at↑ DIA Measured value over-range ON	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9994 mA			32766	7FFE
…			…	…
10.0003 mA			16384	4000
…			…	…
0.0006103 mA			1	0001
≤ 0,0000 mA			0	0000

4…20 mA	unipolar	Diagnostics	dec.	hex.
current value$_M$ = (dec. value × 4,883 × 10^{-4}) mA				
approx. 22 mA	Overcurrent	at ↑ DIA Overcurrent ON	32767	7FFF
> 20.2000 mA	Overflow		32767	7FFF
≤ 20,1000 mA		at↑ DIA Measured value under-range ON	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9995 mA			32766	7FFE
…			…	…
12.00024 mA			16384	4000
…			…	…
4.0004883 mA			1	0001
≤ 4,0000 mA			0	0000
≥ 3.7000 mA	Underflow	at ↓DIA Measured value under-range ON	0	0000
< 3.6000 mA			0	0000
≥ 3.0000 mA	Wire break	at ↓DIA Wire break ON	0	0000
< 2.9000 mA			0	0000

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Extended Range value representation, 16-bit-representation

0…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 7.234 × 10^{-4}) mA				
≥ 23.70298 mA	Overflow		32767	7FFF
≥ 23.51852 mA		at ↑ DIA Measured value over-range ON	32512	7F00
23.517795 mA	out of range		32511	7EFF
≤ 23,2060 mA		at↓ DIA Measured value over-range Off	32080	7D50
20.000723 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
10.0000 mA			13824	3600
…			…	…
0.0007234 mA			1	0001
0.000000 mA			0	0000
≥ -0.1 mA	Underflow	at ↑ DIA Measured value under-range Off	0	000×
< -0.2 mA		at ↓ DIA Measured value under-range ON	0	000×

4…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 5,787 × 10^{-4}) mA				
≥ 22.96238 mA	Overflow		32767	7FFF
≥ 22.81481 mA		at ↑ DIA Measured value over-range ON	32512	7F00
22.814236 mA	out of range		32511	7EFF
≤ 22,56482 mA		at↓ DIA Measured value over-range Off	32080	7D50
20.000579 mA			27649	6C01
20.000000 mA	nominal range		27648	6C00
…			…	…
12.0000 mA			13824	3600
…			…	…
4.0005787 mA			1	0001
4.000000 mA			0	0000
3.999421 mA	out of range		-1	FFFF
≥ 1.5567 mA		at↑ DIA Measured value under-range Off	-4222	EEBA
1.185185			-4864	ED00

4…20 mA	bipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 5,787 × 10^{-4}) mA				
≤ 1,184606 mA	Underflow	at ↓ DIA Measured value under-range ON	-4865	ECFF
≤ 0.0000 mA			-6912	E500

8.9.8 Value representation process automation (NE 43), 16 bit representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

Example:

Input current:	15.02 mA
Process value:	
dec.	15020
hex.	3AAC

0…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 0,001) mA				
approx. 22 mA	Overcurrent	at↑ DIA Overcurrent ON	22000	55F0
≥ 21.008 mA	Overflow		21008	5210
≤ 20,496 mA		at↑ DIA Measured value over-range ON	20496	5010
20.016mA			20016	4E30
20.000 mA	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2710
…			…	…
0.016 mA			16	0010
0.0000 mA			0	0000

4…20 mA	unipolar	Diagnostics	dec.	hex.
Current value I_M = (dec. value × 0,001) mA				
approx. 22 mA	Overcurrent	at ↑ DIA Overcurrent ON	22000	55F0
≥ 21.008 mA	Overflow		21008	5210
≤ 20,496 mA		at↑ DIA Measured value over-range ON	20496	5010
20.016mA			20016	4E30
20.000 mA	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.016 mA			4016	0FB0
4.000 mA			4000	0FA0
≥ 3.792 mA	Underflow	at↓ DIA Measured value under-range ON	3800	0ED0
< 3.600 mA			3600	0E10
≥ 2.496 mA	Wire break	at ↓ DIA Wire break ON	2496	09C0
< 2,000 mA			2000	07D0

8.10 Analog input module, 4 AI, thermocouples

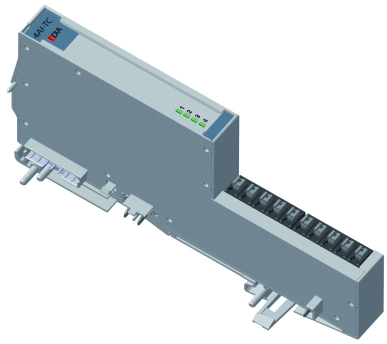


Fig. 156: BL20-E-4AI-TC

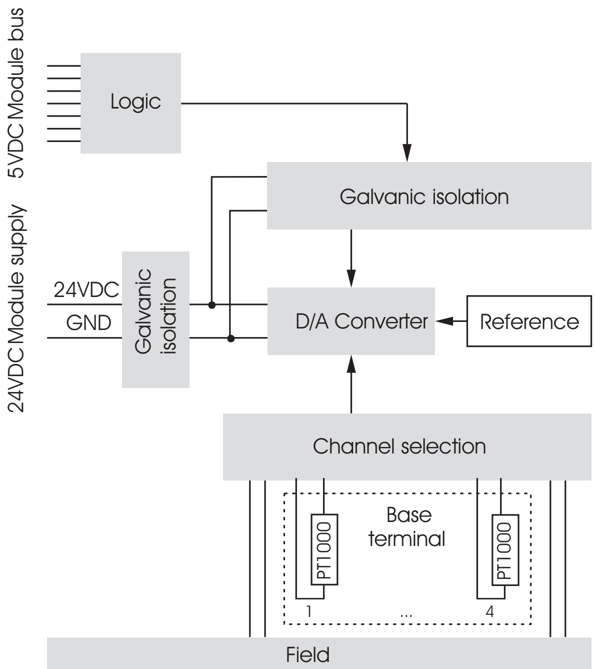


Fig. 157: Block Diagram

8.10.1 Technical data

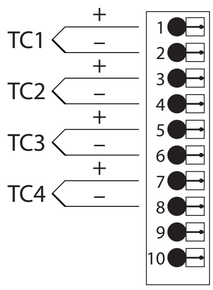
Technical data	
Designation	BL20-E-4AI-TC
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	≤ 50 mA
Power loss of the module, typical	< 1 W
Input resistance	> 7 MΩ
Potential isolation	Electronic to field
Sensors	According to IEC 584, class 1, 2, 3
Temperature ranges	
Type B	100…1820 °C
Type C	0…2315 °C (15 bit + sign) 0…2047 °C (12 bit)
Type E	-270…1000 °C
Type G	0…2315 °C (15 bit + sign) 0…2047 °C (12 bit)
Type J	-210…1200 °C
type K	-270…1370 °C
type N	-270…1300 °C
Type R	-50…1760 °C
Type S	-50…1760°C
Type T	-270…400 °C
Voltage measurement (resolution)	
± 50 mV	< 2 µV
± 100 mV	< 4 µV
± 500 mV	< 20 µV
± 1 V	< 50 µV
Measurement value representation	16 bit signed integer/ 12 bit full range, left-justified
Basic error (nominal range at 23 °C)	see table s. p. 208
Limit frequency analog	70 Hz
Repeatability	0,5 % from end value
Temperature coefficient	≤ 150 ppm/°C from end value

Basic errors and repeat accuracies

Thermocouple	**Nominal range for Basic error at 23 °C / 73.4 °F** **0,2 % from end value**	**Repeat accuracy/ % of positive end value**
Type B	750…1820 °C	0.05
Type C	0…2315 °C (15 bit + sign) 0…2047 °C (12 bit)	0.05
Type G	0…2315 °C (15 bit + sign) 0…2047 °C (12 bit)	0.05
Type E	-200…1000 °C	0.05
Type J	-210…1200 °C	0.05
type K	-200…1370 °C	0.05
type N	-200…1300 °C	0.05
Type R	75…1760 °C	0.05
Type S	75…1760 °C	0.05
Type T	-200…400 °C	0.05
Voltage measurement	all measurement ranges	0.05

For temperatures outside the defined measurement range, higher deviations for basic error and repeat accuracy are possible.

8.10.2 Wiring diagram



Cold junction compensation with integrated Pt1000-sensors

Fig. 158: Wiring diagram

8.10.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	AI1 LSB							
	n + 1	AI1 MSB							
	n + 2	AI2 LSB							
	n + 3	AI2 MSB							
	n + 4	AI3 LSB							
	n + 5	AI3 MSB							
	n + 6	AI4 LSB							
	n + 7	AI4 MSB							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AI1 LSB	low byte of the analog value
AIx MSB	high byte of the analog value

8.10.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostics pending	Check the cause for the diagnosis
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
0…3	green	Channel activated, normal operation	–
	green, flashing, 0.5 Hz	Channel diagnostics pending	Check the cause for the diagnosis
	Off	Channel deactivated	–

Diagnostics

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Hardware error	-	-	-	Common Mode voltage out of range	Cold junction error Wire break	Wire break thermo couple	Measured value out of range

Diagnostics	Meaning
Measured value out of range	Indicates an exceed or undercut of the value ranges. The permissible measurement value limits are exceeded, it is thus possible that no valid measurement value can be detected.
Wire break thermo couple	Displays a wire break in the signal line.
Cold junction error Wire break	The Pt1000-sensor for the respective channel in the base module is defective. → the Pt1000-sensor of the other channel is taken as cold junction. → a cold junction temperature of 23°C is presumed.
Common Mode voltage out of range	Potential difference between measurement voltages too high. Monitoring of the potential difference between the measurement voltages within one sensor group (sensor groups: channel 0/1 or channel 2/3). Remedy: Check the isolation of the sensors. In case of non- insulated sensors, check the potential equalization between the sensors. If non-insulated sensors are used, it can be necessary to connect the sensors to channels of different sensor groups (i.e. channel 1 and channel 3).

Diagnostics	Meaning
Hardware error	Shows common errors of the module hardware. The return analog value in case of an error is "0".

8.10.5 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see Cross reference list parameters (page 523)).

	Standard Byte oriented		Standard Word oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0		Bit 0	Byte 0	Bit 0	reserved
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Thermocouple type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
Channel 2	Byte 1	Bit 0	Word 0	Bit 8	Byte 1	Bit 0	reserved
		Bit 1		Bit 9		Bit 1	Data format
		Bit 2		Bit 10		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 11		Bit 3	Deactivate channel
		Bit 4		Bit 12		Bit 4	Thermocouple type
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

	Standard Byte oriented		Word oriented		PROFIBUS PROFINET		Parameters
Channel 3		Bit 0		Bit 0		Bit 0	reserved
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Thermocouple type
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 2	Bit 7		Bit 7	Byte 2	Bit 7	
Channel 4		Bit 0		Bit 8		Bit 0	reserved
		Bit 1		Bit 9		Bit 1	Data format
		Bit 2		Bit 10		Bit 2	Deactivate all diagnostics
		Bit 3		Bit 11		Bit 3	Deactivate channel
		Bit 4		Bit 12		Bit 4	Thermocouple type
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 3	Bit 7	Word 1	Bit 15	Byte 3	Bit 7	

Parameters	settings
Data format	**0 = 15 bit + sign** 1 = 12 bit (left-justified)
Deactivate channel	**0 = no** 1 = yes
Deactivate all diagnostics	**0 = no** 1 = yes
Thermocouple type	**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…1760 °C 0111 = Type T, -270…400 °C 1000 = ±50 mV 1001 = ±100 mV 1010 = ±500 mV 1011 = ±1000 mV 1100 = Type K, -454..2498 °F 1101 = Type K, -454..2498 °F 1110 = Type C 0… 2315 °C 1111 = Type G 0… 2315 °C

8.10.6 Measurement value representation

Temperature measurement

- 16-bit representation
  The measured temperature is multiplied by 10.
  Example:
  10,1 °C → 101 → 0x0065
- 12-bit representation
  Value representation depends on the measuring unit (°C or °F).
  Celsius:
  The measured temperature is shifted 4 bit to the left.
  Example (°C): 10,1 °C → 10 → (0x000A <<4) → 0x00A0
  Fahrenheit:
  The measured temperature is divided by 2 shifted 4 bit to the left.
  Example (°F): 10,1 °C → 5 → (0x0005 << 4) → 0x0050

Example of a value representation (thermocouple type K)

Measurement [°C]	0 = 15 bit + sign		12 bit [°C]		12 bit (°F)	
	dec.	hex.	dec.	hex.	dec.	hex.
-270	-2700	F574	-4320	EF20	-2160	F790
-269.9	-2699	F575	-4320	EF30	-2144	F7A0
-269	-2690	F57E	-4304	EF30	-2144	F7A0
-200	-2000	F830	-3200	F380	-1600	F9C0
-100	-1000	FC18	-1600	F9C0	-800	FCE0
-50	-500	FE0C	-800	FCE0	-400	FE70
-1	-10	FFF6	-16	FFF0	0	0000
0.1	-1	FFFF	0	0000	0	0000
0	0	0000	0	0000	0	0000
0.1	1	0001	0	0000	0	0000
1	10	000A	16	0010	0	0000
500	5000	1388	8000	1F40	4000	0FA0
1000	10000	2710	16000	3E80	8000	1F40
1500	15000	3A98	24000	5DC0	12000	2EE0
1819	18190	470E	29104	71B0	14544	38D0
1819.9	18199	4717	29104	71B0	14544	38D0
1820	18200	4718	29120	71C0	14560	38E0

NOTE
In 12 bit representation, the module's diagnostic data are mapped into bit 0 - 3 of the input data.

Voltage measurement

Measurement [mV]				0 = 15 bit + sign		12 bit	
50	100	500	1000	dec.	hex.	dec.	hex.
-50	-100	-500	-1000	-31768	8000	-32768	8000
-49.998	-99.997	-499.985	-999.969	-32767	8001	-32767	8001
-49.976	-99.951	-499.756	-999.512	-32752	8010	-32752	8010
-0.024	-0.049	-0.244	-0.488	-16	FFF0	-16	FFF0
-0.002	-0.003	-0.015	-0.031	-1	FFFF	0	0000
0	0	0	0	0	0000	0	0000
0.002	0.003	0.015	0.031	1	0001	0	0000
0.024	0.049	0.244	0.488	16	0010	16	0010
49.951	99.902	499.512	999.023	32736	7FE0	32736	7FE0
49.997	99.994	499.969	999.939	32766	7FFE	32752	7FF0
49.998	99.997	499.985	999.969	32767	7FFF	32752	7FF0

NOTE
In 12 bit representation, the module's diagnostic data are mapped into bit 0 - 3 of the input data.

9 Digital Output Modules

Digital output modules (DO) receive output values from the gateway via the internal module bus. The modules convert these values and transmit the corresponding high or low level signals for each channel to the field level via the base modules. The outputs are rated according to EN 61 131-2 Type 2. The module bus electronics of the digital output modules are galvanically isolated from the field level via an optocoupler.

The digital output modules are not be parameterizable.

ATTENTION

High voltages when disconnecting inductive loads

Destruction of electronics!

➤ Provide an external suppressor.

9.0.1 LED status indicators

Channel statuses are indicated by LEDs. Error signals from the I/O level are indicated by each module via the "DIA" LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits. A continuously lit up red "DIA" LED indicates the failure of the module bus communication at the digital input module.

9.0.2 Module overview

	Number of channels	positive switching	negative switching	Output current, max.	galvanically isolated
BL20-2DO-24VDC-0.5A-P	2	✓		0,5 A	✓
BL20-2DO-24VDC-0.5A-N	2		✓	0,5 A	✓
BL20-2DO-24VDC-2A-P	2	✓		2 A	✓
BL20-4DO-24VDC-0.5A-P	4	✓		0,5 A	✓
BL20-E-8DO-24VDC-0.5A-P	8	✓		0,5 A	✓
BL20-16DO-24VDC-0.5A-P	16	✓		0,5 A	✓
BL20-E-16DO-24VDC-0.5A-P	16	✓		0,5 A	✓
BL20-E-16DO-24VDC-0.5A-N	16		✓	0,5 A	✓
BL20-32DO-24VDC-0.5A-P	32	✓		0,5 A	✓
BL20-2DO-120/230VAC-0.5A	2			0,5 A	✓

9.1 Digital output module, 2DO, 0.5 A, positive switching (sourcing)

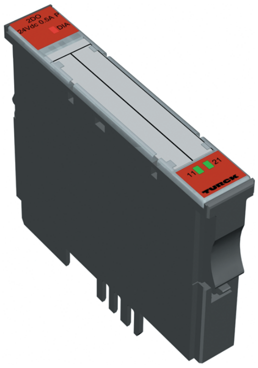


Fig. 159: BL20-2DO-24VDC-0.5A-P

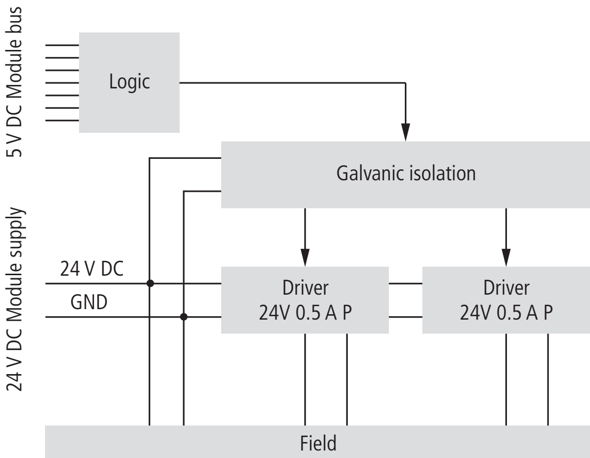


Fig. 160: Block Diagram

9.1.1 Technical data

Technical data	
Designation	BL20-2DO-24VDC-0.5A-P
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 20 mA (if load current = 0)
Nominal current from module bus I_{MB}	≤ 32 mA
Power loss of the module, typical	< 1 W
Output voltage (loaded)	
High level U_{HIGH}	Min. L+ (-1 V)
Output current	
High level (nominal)	0.5 A
High level I_{HIGH} (nominal)	< 0.6 A

Technical data	
Delay at signal change and resistive load	
From low to high level	< 100 µs
From high to low level	< 100 µs
Load impedance range	Ω1 kΩ
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	Min. 48 Ω
Load impedance, inductive R_{LI}	Max. 1.2 H
Lamp load R_{LL}	Max. 3 W
Switching frequency	
Resistive load	5 kHz (R_{LO} < 1 kΩ)
Lamp load	10 Hz
Short-circuit proof	According to EN 61 131

9.1.2 Base modules

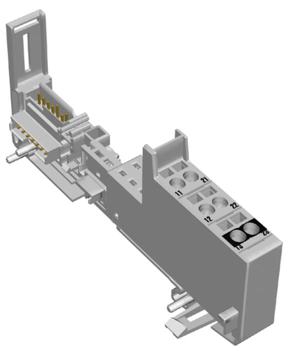


Fig. 161: Base module BL20-S3T-SBC

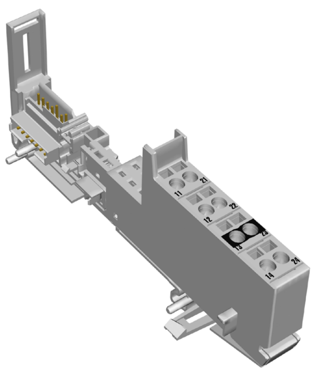


Fig. 162: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S3T-SBC
  BL20-S4T-SBCS
- with screw connection
  BL20-S3S-SBC
  BL20-S4S-SBCS

9.1.3 Wiring diagram

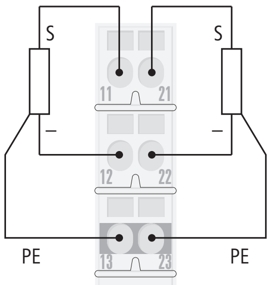


Fig. 163: Wiring diagram BL20-S3x-SBC

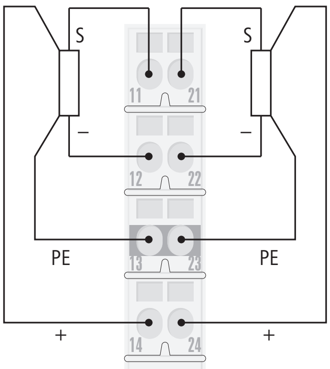


Fig. 164: Wiring diagram BL20-S4x-SBCS

9.1.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.1.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	red, flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	overcurrent (short-circuit) channel 1	overcurrent (short-circuit) channel 0

9.2 Digital output module, 2DO, 0.5 A, negative switching (sinking)

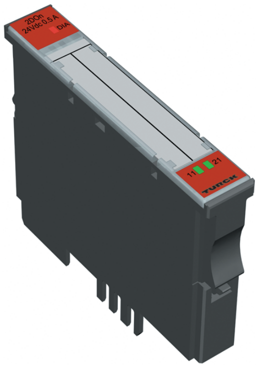


Fig. 165: BL20-2DO-24VDC-0.5A-N

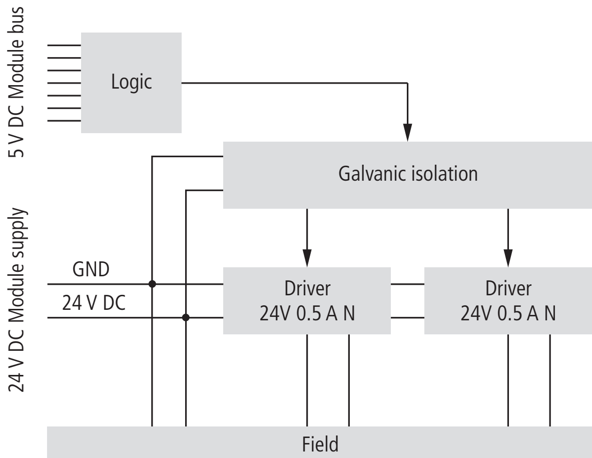


Fig. 166: Block Diagram

9.2.1 Technical data

Technical data	
Designation	BL20-2DO-24VDC-0.5A-N
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 20 mA (if load current = 0)
Nominal current from module bus I_{MB}	≤ 32 mA
Power loss of the module, typical	< 1 W
Output voltage (loaded)	
High level U_A	Max. GND +1 V
Output current	
High level $_A$ (nominal value)	0.5 A

Technical data	
Permissible	< 0.6 A
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	< 100 µs
From high to low level	< 100 µs
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	Min. 48 Ω
Load impedance, inductive R_{LI}	Max. 1.2 H
Lamp load R_{LL}	Max. 12 W
Switching frequency	
Resistive load	100 Hz (R_{LO} < 1 kΩ)
Inductive load resistance	2 Hz
Lamp load	10 Hz
Short-circuit proof	According to EN 61131-2 Automatic restart after disconnecting the load and elimi-nating the reason for the short-circuit

9.2.2 Base modules

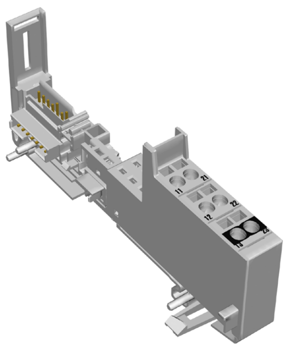


Fig. 167: Base module BL20-S3T-SBC

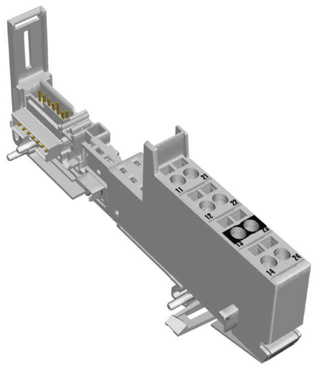


Fig. 168: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S3T-SBC
  BL20-S4T-SBCS
- with screw connection
  BL20-S3S-SBC
  BL20-S4S-SBCS

9.2.3 Wiring diagram

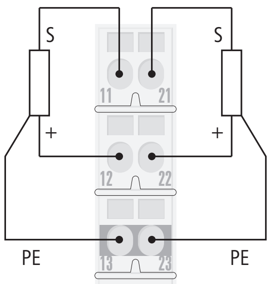


Fig. 169: Wiring diagram BL20-S3x-SBC

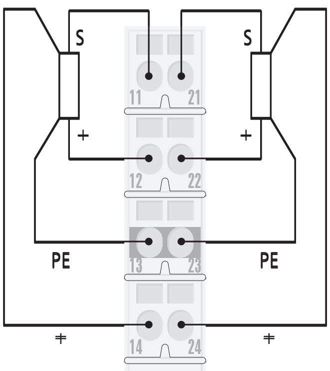


Fig. 170: Wiring diagram BL20-S4x-SBCS

9.2.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.2.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	overcurrent Channel 1	overcurrent (short-circuit channel 0)

9.3 Digital output module, 2DO, 2 A, positive switching (sourcing)

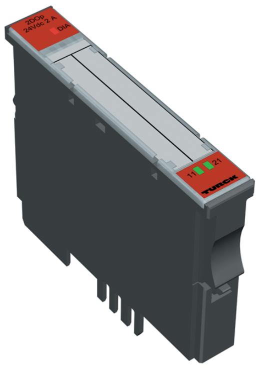


Fig. 171: BL20-2DO-24VDC-2A-P

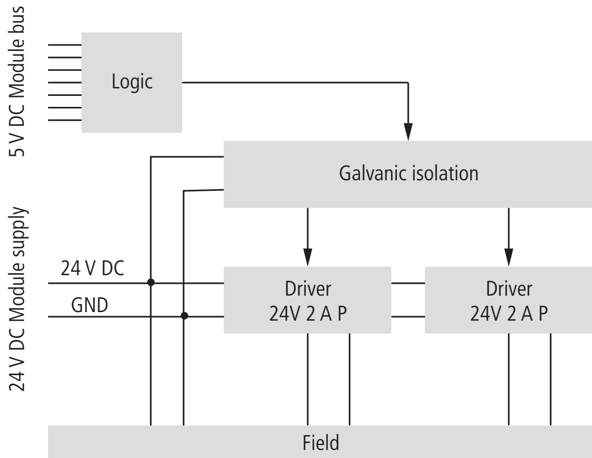


Fig. 172: Block Diagram

9.3.1 Technical data

Technical data	
Designation	BL20-2DO-24VDC-2A-P
Number of channels	2
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 50 mA (if load current = 0)
Nominal current from module bus I_{MB}	≤ 33 mA
Power loss of the module, typical	< 1 W
Output voltage (loaded)	
High level U_A	Min. L+ (-1 V)
Output current	
High level (nominal)	2 A
Permissible	< 2.4 A
High level (inductive load)	Max. 1 A at 1.2 H
Delay at signal change and resistive load	
From low to high level	< 100 µs
From high to low level	< 100 µs
Load impedance range	12 Ω…1 kΩ
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	Min. 12 Ω
Load impedance, inductive R_{LI}	Max. 1.2 H
Lamp load R_{LL}	Max. 6 W
Switching frequency	
Resistive load	5 kHz (R_{LO} < 1 kΩ)
Lamp load	10 Hz
Short-circuit proof	According to EN 61131-2

9.3.2 Base modules

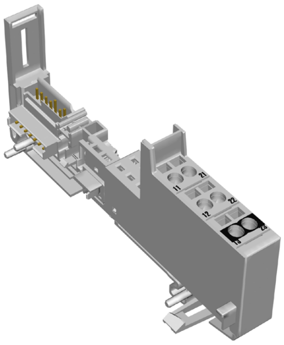


Fig. 173: Base module BL20-S3T-SBC

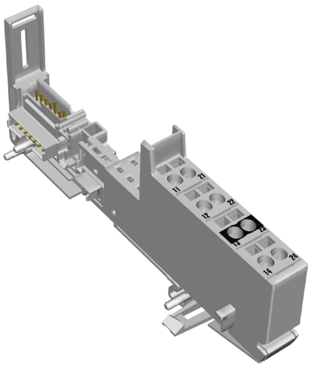


Fig. 174: Base module BL20-S3T-SBC

- with tension clamp connection
  BL20-S3T-SBC
  BL20-S4T-SBCS
- with screw connection
  BL20-S3S-SBC
  BL20-S4S-SBCS

9.3.3 Wiring diagram

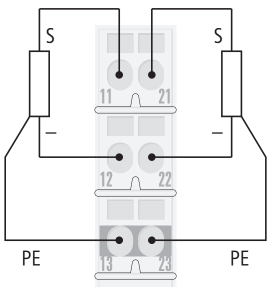


Fig. 175: Wiring diagram BL20-S3x-SBC

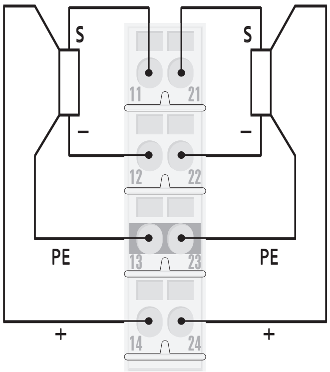


Fig. 176: Wiring diagram BL20-S4x-SBCS

9.3.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.3.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	overcurrent (short-circuit) channel 1	overcurrent (short-circuit) channel 0

9.4 Digital output module, 4DO, 0.5 A, positive switching (sourcing)

Fig. 177:

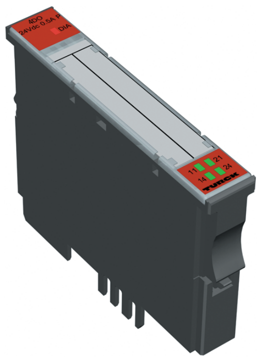


Fig. 178:

Fig. 179: BL20-4DO-24VDC-0.5A-P

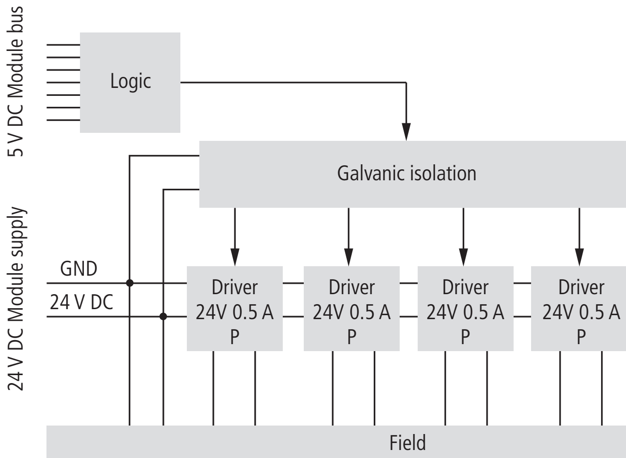


Fig. 180: Block Diagram

9.4.1 Technical data

Technical data	
Designation	BL20-4DO-24VDC-0.5A-P
Number of channels	4
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 25 mA (if load current = 0)
Nominal current from module bus I_{MB}	≤ 30 mA
Power loss of the module, typical	< 1 W
Output voltage (loaded)	Min. L+ (-1 V)
Output current	
High level (nominal)	0.5 A
High level I_{HIGH} (short-time overload)	< 1,0 A, max. 5 minutes

Technical data	
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	< 250 µs
From high to low level	< 250 µs
Load impedance range	48 Ω…1 kΩ
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	Min. 48 Ω
Load impedance, inductive R_{LI}	Max. 1.2 H
Lamp load R_{LL}	Max. 6 W
Switching frequency	
Resistive load	1 kHz (R_{LO} < 1 kΩ)
Inductive load resistance	2 Hz
Lamp load	10 Hz
Short-circuit proof	According to EN 61131-2

NOTE
In order to increase the maximum output current up to 2 A, the parallel switching of outputs is possible.

9.4.2 Base modules

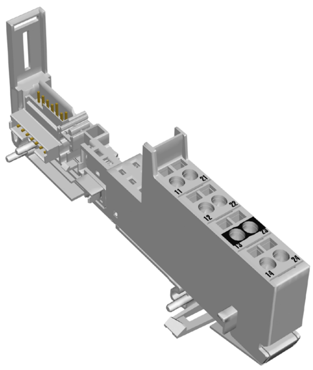


Fig. 181: Base module BL20-S4T-SBCS

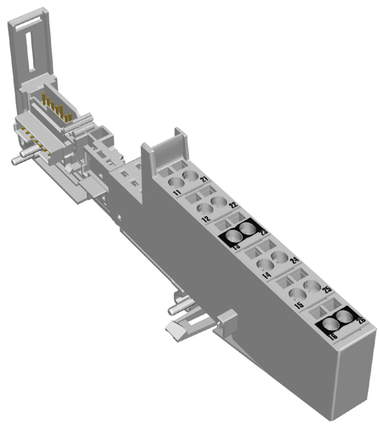


Fig. 182: BL20-S6T-SBCSBC

- with tension clamp connection
  BL20-S4T-SBCS
  BL20-S6T-SBCSBC
- with screw connection
  BL20-S4S-SBCS
  BL20-S6S-SBCSBC

9.4.3 Wiring diagram

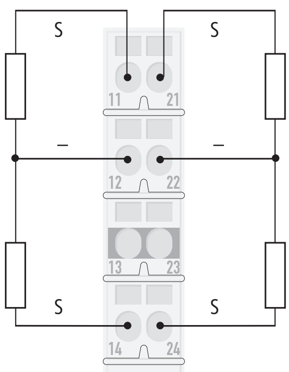


Fig. 183: Wiring diagram BL20-S4x-SBCS

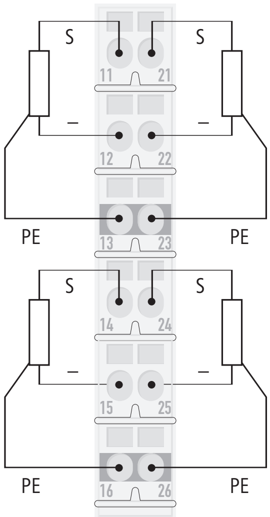


Fig. 184: Wiring diagram BL20-S6x-SBCSBC

9.4.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	DO4	DO3	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.4.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
14	Green	Status channel 3 = 1	
	Off	Status channel 3 = 0	
24	Green	Status channel 4 = 1	
	Off	Status channel 4 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	-	-	-	overcurrent (short circuit)

- "Overcurrent"
  (at least 1 channel sends diagnostics)

NOTE
If overcurrent is diagnosed the overloaded channel has to be switched off.

9.5 Digital input module, BL20 Economy, 8 DO, 0.5 A, positive switching (sourcing)

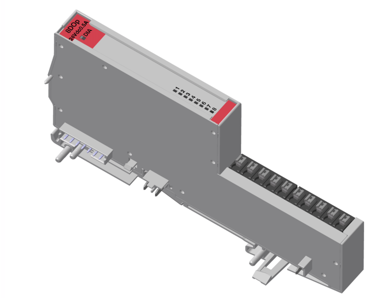


Fig. 185: BL20-8DO-24VDC-0.5A-P

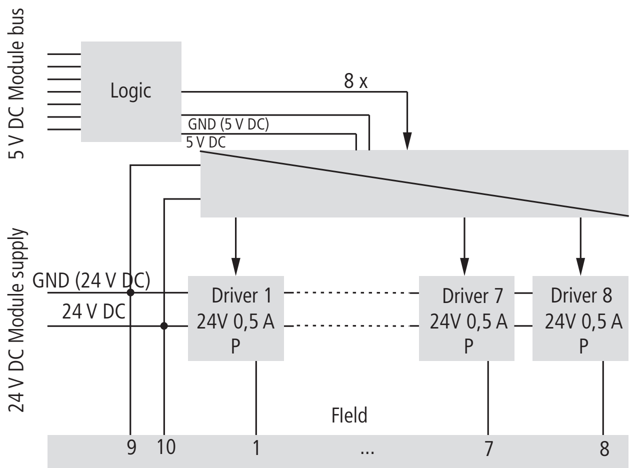


Fig. 186: Block Diagram

9.5.1 Technical data

Technical data	
Designation	BL20-E-8DO-24VDC-0.5A-P
Number of channels	8
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L (for supplying the module electronic with inactive outputs/maximum)	< 10 mA The total current needed for every module is the sum of all partial currents.
Nominal current from module bus I_{MB}	< 15 mA
Output voltage (loaded)	
High level U_{HIGH}	Min. L+ (-1 V)
Output current	
High level (nominal)	0.5 A
Permissible (max. for 5 minutes)	1 A
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	300 µs
From high to low level	300 µs
Simultaneity factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	≥ 48 Ω
Load impedance, inductive R_{LI}	Category DC 13 according to EN 60 947-5-1
Lamp load R_{LL}	< 6 W
Switching frequency	
Resistive load	< 100 Hz
Inductive load	category DC 13 according to EN 60 947-5-1
Lamp load	< 10 Hz
Isolation voltage	
Module bus/ channels	500 V_{eff}
Short-circuit proof	According to EN 61131-2
Reset after eliminating a short circuit	Automatic

9.5.2 Wiring diagram

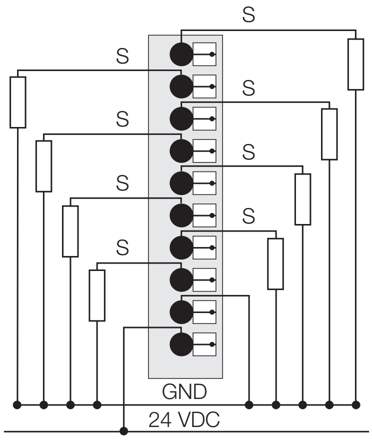


Fig. 187: Wiring diagram

9.5.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.5.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
8	Green	Status channel 8 = 1	
	Off	channel 8 = 0	

9.6 Digital output module, 16DO, 0.5 A, positive switching (sourcing)

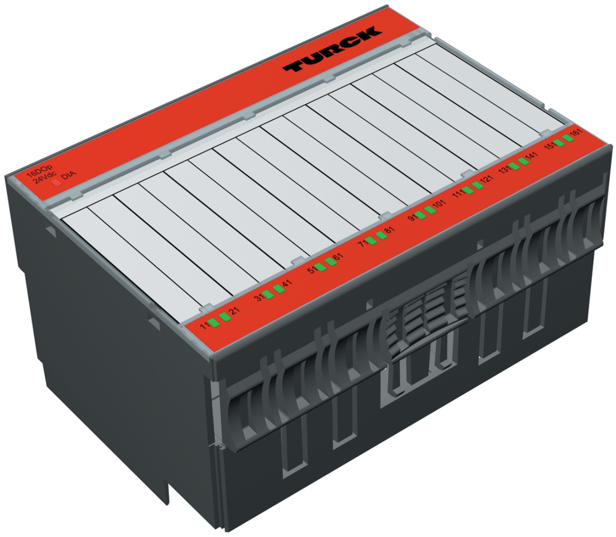


Fig. 188: BL20-16DO-24VDC-0.5A-P

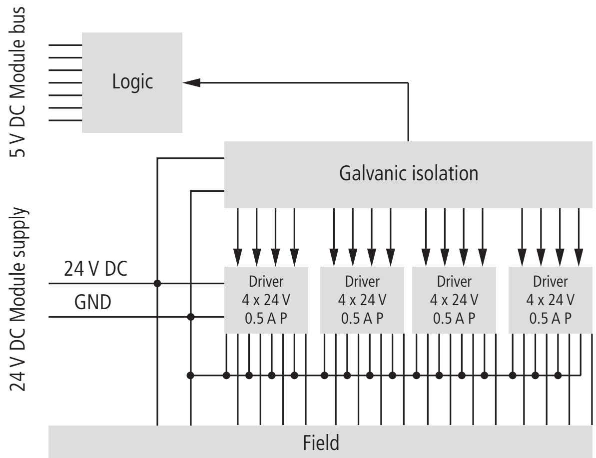


Fig. 189: Block Diagram

9.6.1 Technical data

Technical data	
Designation	BL20-16DO-24VDC-0.5A-P
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 30 mA
Nominal current from module bus I_{MB}	< 120 mA
Power loss of the module, typical	< 4 W
Output voltage (loaded)	

Technical data	
High level U_{HIGH}	Min. L+ (-1 V)
Output current	
High level (nominal)	0.5 A
Permissible	< 0.6 A
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	typ. 100 µs
From high to low level	typ. 100 µs
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	≥ 48 Ω
Load impedance, inductive R_{LI}	Category DC 13 according to EN 60 947-5-1
Lamp load R_{LL}	Max. 3 W
Switching frequency	
Resistive load	100 Hz (R_{LO} < 1 kΩ)
Short-circuit proof	According to EN 61131-2

9.6.2 Base modules

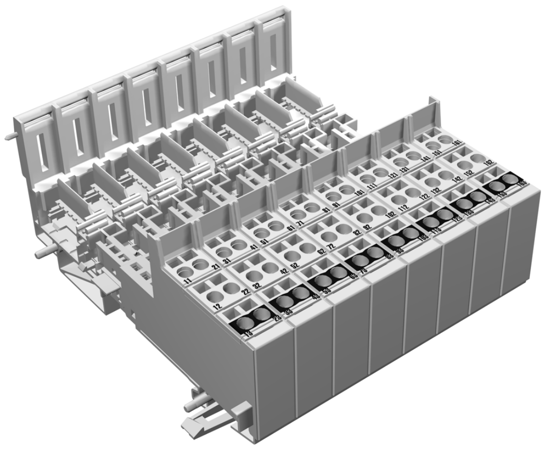


Fig. 190: Base module BL20-B3T-SBCS

- with tension clamp connection
  BL20-B3T-SBC
- with screw connection
  BL20-B3S-SBC

9.6.3 Wiring diagram

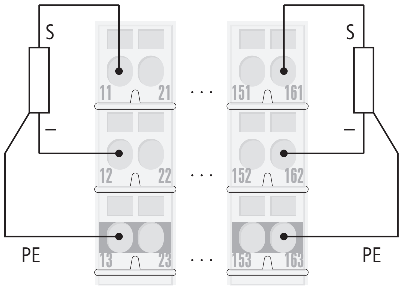


Fig. 191: Wiring diagram BL20-B3x-SBC

9.6.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
	m + 1	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO9

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.6.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
…			
161	Green	Status channel 16 = 1	
	Off	Status channel 16 = 0	

NOTE
The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

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Diagnostics

This module has the following diagnostic data per channel (**group** short-circuit recognition):

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	-	overcurrent (short-circuit) channel 13-16	overcurrent (short-circuit) channel 9-12	overcurrent (short-circuit) channel 5-8	overcurrent (short-circuit) channel 1-4

9.7 Digital output module, BL20 Economy, 16 DO, 0.5 A, positive switching (sourcing)

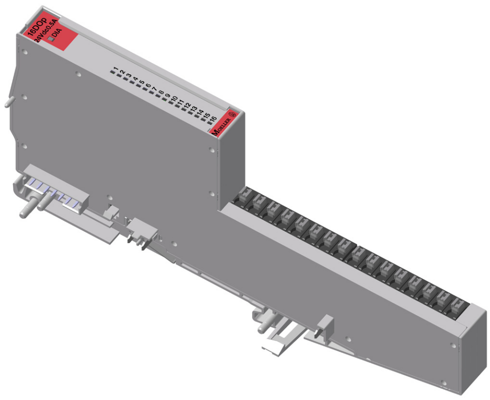


Fig. 192: BL20-E-16DO-24VDC-0.5A-P

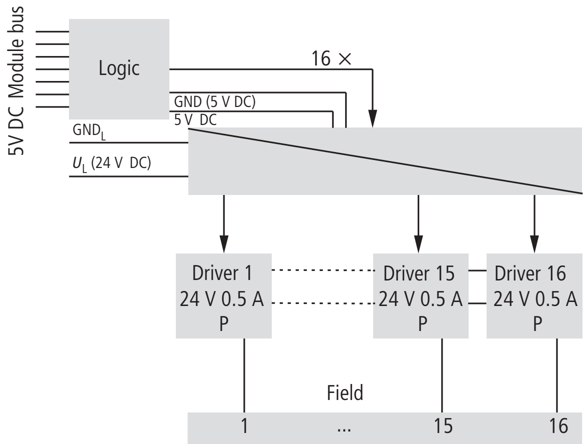


Fig. 193: Block Diagram

9.7.1 Technical data

Technical data	
Designation	BL20-E-16DO-24VDC-0.5A-P
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L (for supplying the module electronic with inactive outputs/maximum)	The total current needed for every module is the sum of all partial currents.
≤ VN 01-02	< 3 mA
≥ VN 02-00	< 2mA
Nominal current from module bus I_{MB}	
≤ VN 01-02	< 25 mA

Technical data	
≥ VN 02-00	< 15 mA (outputs inactive) < 30 mA (outputs active)
Output voltage (loaded)	
High level U_{HIGH}	Min. L+ (-1 V)
Output current	
High level (nominal)	0.5 A
Permissible (max. for 5 minutes)	1 A
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	
≤ VN 01-02	300 µs
≥ VN 02-00	150 µs
From high to low level	
≤ VN 01-02	300 µs
≥ VN 02-00	190 µs
Total current for all outputs	Max. 4 A
Simultaneity factor	50 %
Resistive, inductive and lamp loads can be connected	
UL conditions	DC general use, resistive load, Pilot Duty can be connected
Load impedance, resistive R_{LO}	Max. 48 Ω
Load impedance, inductive R_{LI}	Category DC 13 according to EN 60 947-5-1
Lamp load R_{LL}	< 6 W
Switching frequency	
Resistive load	
≤ VN 01-02	< 100 Hz
≥ VN 02-00	< 500 Hz
Inductive load	Category DC 13 according to EN 60 947-5-1
Lamp load	< 10 Hz
Isolation voltage	
Module bus/ channels	500 V_{eff}
Short-circuit proof	According to EN 61131-2
Reset after eliminating a short circuit	Automatic
Weight	65 g

9.7.2 Wiring diagram

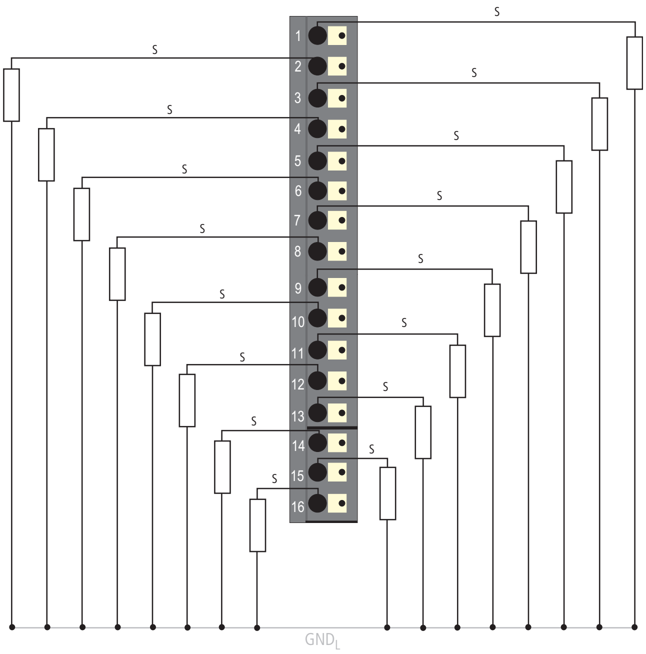


Fig. 194: Wiring diagram

9.7.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
	m + 1	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO9

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.7.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
8	Green	Status channel 8 = 1	
	Off	channel 8 = 0	

9.8 Digital output module, BL20 Economy, 16 DO, 0.5 A, negative switching (sinking)

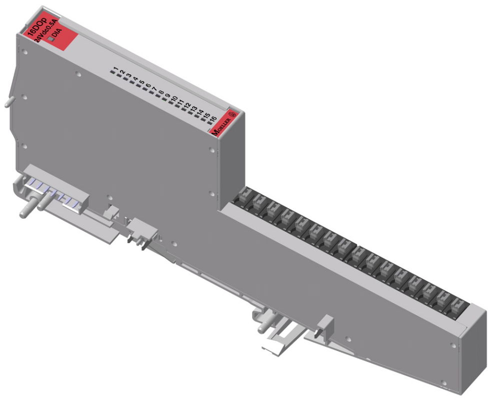


Fig. 195: BL20-E-16DO-24VDC-0.5A-N

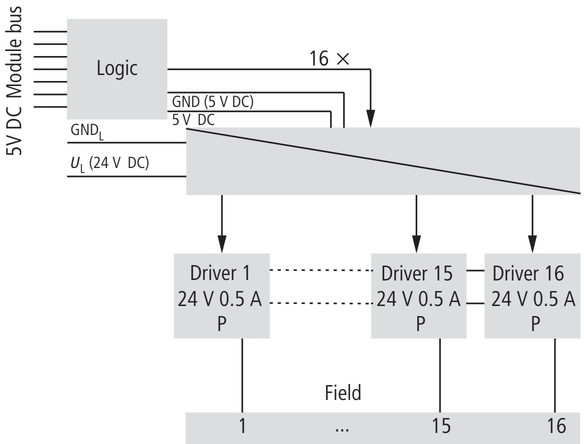


Fig. 196: Block Diagram

9.8.1 Technical data

Technical data	
Designation	BL20-E-16DO-24VDC-0.5A-N
Number of channels	16
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 0,1 mA (outputs inactive) < 30 mA (outputs active)
Nominal current from module bus I_{MB}	< 11 mA (outputs inactive) < 26 mA (outputs active
Output voltage (loaded)	
High level U_{HIGH}	Min. L+ (-1 V)

Technical data	
Output current	
High level (nominal)	0.5 A
Permissible (max. for 5 minutes)	1 A
Delay at signal change and resistive load (R_{LO} < 1 kΩ)	
From low to high level	50 µs
From high to low level	350 µs
Total current for all outputs	Max. 4 A
Simultaneity factor	50 %
Resistive, inductive and lamp loads can be connected	
UL conditions	Resistive load, DC general use, Pilot Duty can be connected
Load impedance, resistive R_{LO}	Max. 48 Ω
Load impedance, inductive R_{LI}	Category DC 13 according to EN 60 947-5-1
Lamp load R_{LL}	< 6 W
Switching frequency	
Resistive load	< 100 Hz
Inductive load	Category DC 13 according to EN 60 947-5-1
Lamp load	< 10 Hz
Isolation voltage	
Module bus/ channels	500 V_{eff}
Short-circuit proof	According to EN 61131-2
Reset after eliminating a short circuit	Automatic
Weight	65 g

9.8.2 Wiring diagram

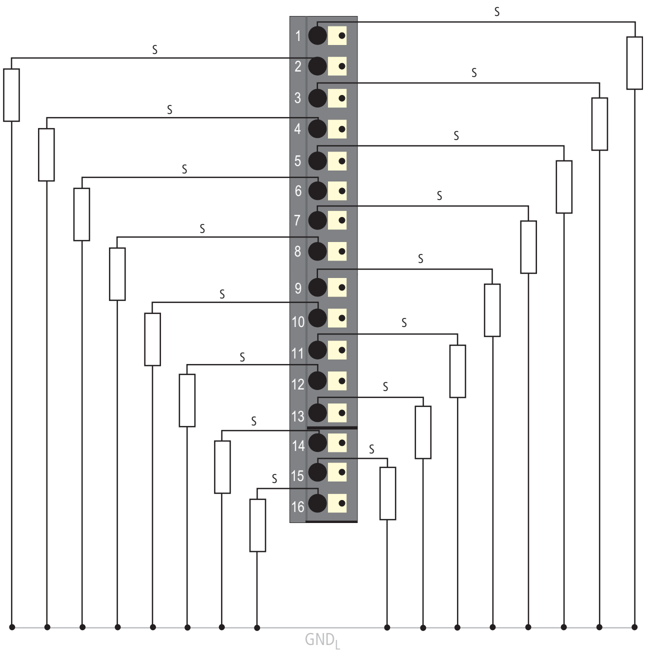


Fig. 197: Wiring diagram

9.8.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
	m + 1	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO9

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.

For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.8.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
1	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
…	…	…	
8	Green	Status channel 8 = 1	
	Off	channel 8 = 0	

9.9 Digital output module, 32DO, 0.5 A, positive switching (sourcing)

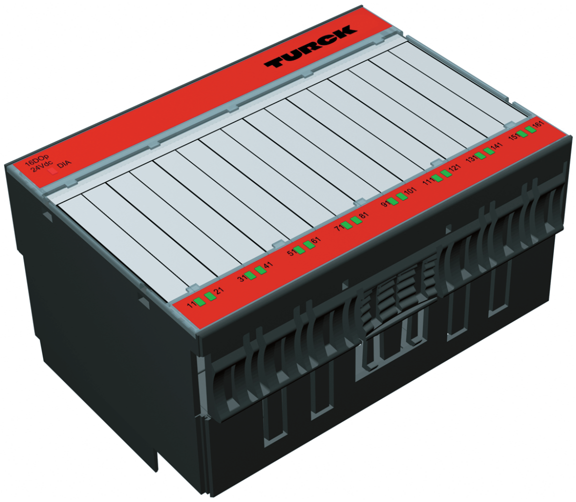


Fig. 198: BL20-32DO-24VDC-0.5A-P

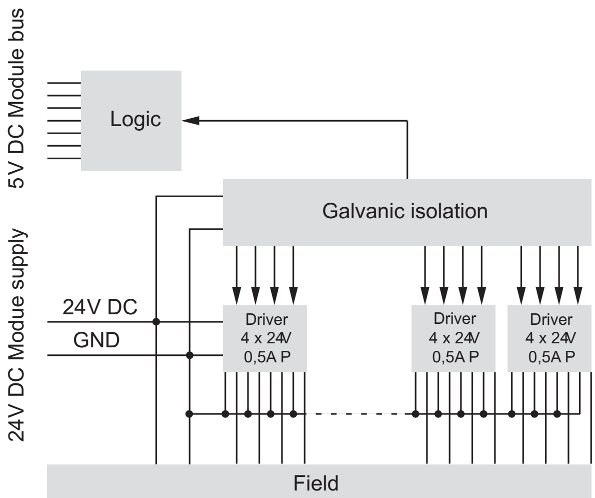


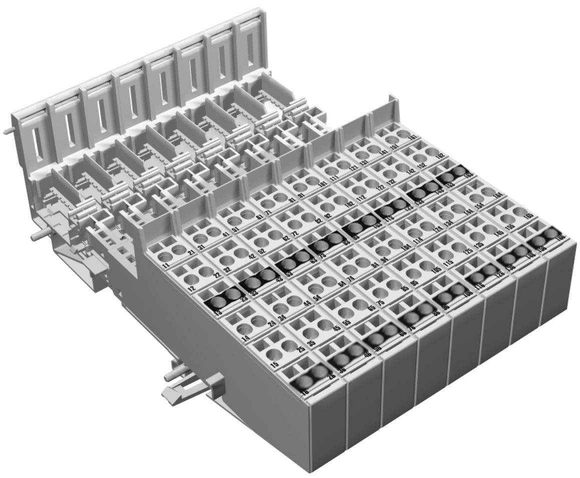
Fig. 199: Block Diagram

9.9.1 Technical data

Technical data	
Designation	BL20-32DO-24VDC-0.5A-P
Number of channels	32
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 50 mA
Nominal current from module bus I_{MB}	30 mA
Power loss of the module, typical	< 4 W
Output voltage (loaded)	

Technical data	
High level U_{HIGH}	Min. L+ (-1 V)
Output current (for supply of actuators/the output is switched on) In order to increase the maximum output current up to 1 A, the parallel switching of outputs is possible. Even in this case, the outputs are short circuit proof according to EN 61131-2.	
High level (nominal)	0.5 A
Permissible	< 1A
Permissible total current over all outputs	10 A A maximum of 10 A can be transmitted via the base modules. The supply modules BL20-BR-24VDC-D and BL20-PF-24VDC-D supply a maximum of 10 A. The number of outputs that can be switched simultaneously, may therefore be smaller than 32.
Delay at signal change and resistive load	
From low to high level	typ. 300 µs
From high to low level	typ. 300 µs
Synchronization factor	100 %
Resistive, inductive and lamp loads can be connected	
Load impedance, resistive R_{LO}	≥ 48 Ω
Load impedance, inductive R_{LI}	< 1,2 H
Lamp load R_{LL}	< 6 W
Switching frequency	
Resistive load	< 100 Hz
Short-circuit proof	According to EN 61131-2
Reset after eliminating a short circuit	Automatic

9.9.2 Base modules



Base module BL20-B6T-SBCSBC

- with tension clamp connection
  BL20-B6T-SBCSBC
- with screw connection
  BL20-B6S-SBCSBC

9.9.3 Wiring diagram

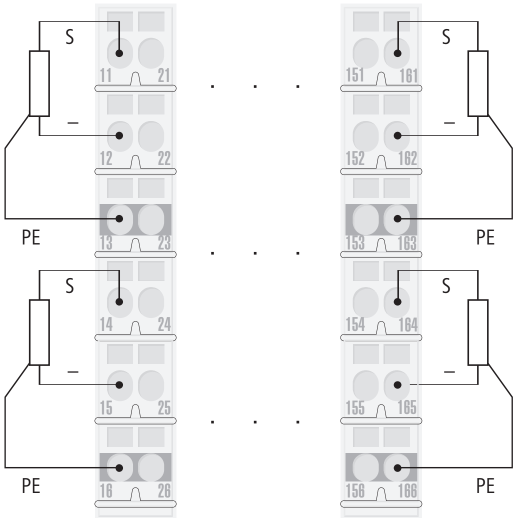


Fig. 200: Wiring diagram BL20-B6x-SBCSBC

9.9.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1
	m + 1	DO16	DO15	DO14	DO13	DO12	DO11	DO10	DO9
	m + 2	DO24	DO23	DO22	DO21	DO20	DO19	DO18	DO17
	m + 3	DO32	DO31	DO30	DO29	DO28	DO27	DO26	DO25

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.9.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	red, flashing,	Short-circuit at at least one of the 32 channels. A diagnostic message is generated.	Eliminate the cause for the short-circuit
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	
…			
164	Green	Status channel 32 = 1	
	Off	Status channel 32 = 0	

> **NOTE**
> The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

Diagnostics

This module has the following diagnostic data per channel (**group** short-circuit recognition):

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
overcurrent channel 29-32	overcurrent channel 25-28	overcurrent channel 21-24	overcurrent channel 17-20	overcurrent channel 13-16	overcurrent channel 9-12	overcurrent channel 5-8	overcurrent channel 1-4

9.10 Digital output module, 2 DO, 0.5 A, 120/230 VAC

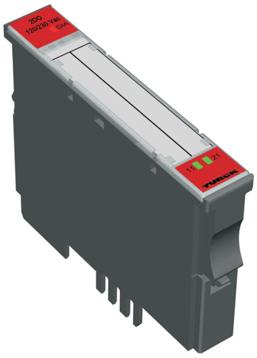


Fig. 201: BL20-2DO-120/230VAC-0.5A

WARNING

Leakage currents in inactive state

Danger due to electrical current

- Do not touch the output contacts
- Connect a load

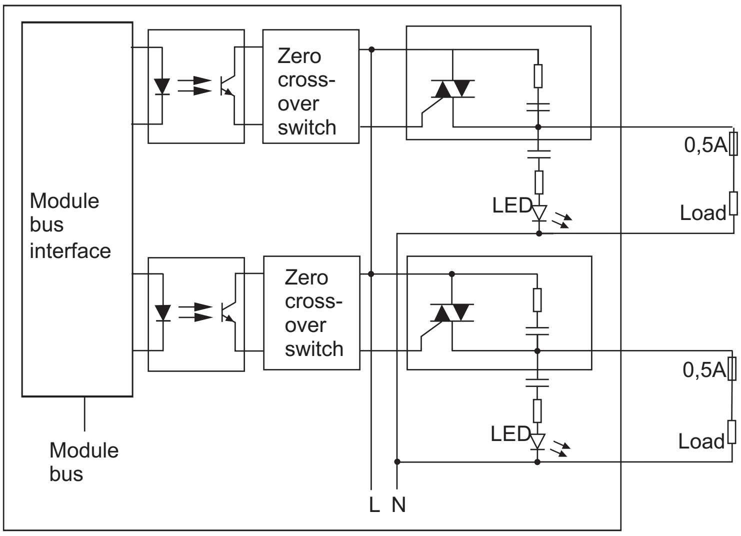


Fig. 202: Block Diagram

The switching element is a non short-circuit proof voltage zero switching Triac.

ATTENTION

Voltage peaks when pulling and plugging under load

Destruction of output driver possible

- Do not pull or plug the electronic module under load.

9.10.1 Technical data

Technical data	
Designation	BL20-2DO-120/230VAC-0.5A
Number of channels	2
Channel design	Voltage zero switching Triac
Nominal voltage from supply terminal U_L	120…230 VAC
Nominal current from supply terminal I_L	< 20 mA (if load current = 0)
Nominal current from module bus I_{MB}	≤ 35 mA
Voltage drop at High level U_V	< 2 V
Max. leakage current at High level I_{Leak}	1.5 mA
Max. leakage current at Low level (residual current)	1.5 mA
Frequency range f_N	45…65 Hz
Power loss of the module	< 1 W
Surge current I_S	8 A (one period at 60 Hz)
Back-up fuse	≤ 500 mA (very quick acting)
Turn-on time t_{ON}	T/2 + 1 ms
Turn-off time t_{OFF}	T/2 + 1 ms
Derating	
at 40 °C	1 A (per channel 0.5 A)
at 50°C	0.75 A (per channel 0.375 A)
at 55°C	0.5 A (per channel 0.25 A)
Output current	
High level (nominal)	0.5 A
High level I_{HIGH} (permissible range)	< 0.6 A
Isolation voltage (fieldbus to channels)	2500 V

9.10.2 Base modules

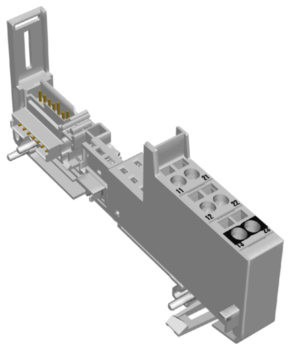


Fig. 203: Base module BL20-S3T-SBC

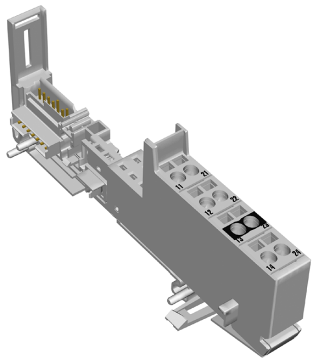


Fig. 204: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S3T-SBC
  BL20-S4T-SBCS
- with screw connection
  BL20-S3S-SBC
  BL20-S4S-SBCS

9.10.3 Wiring diagram

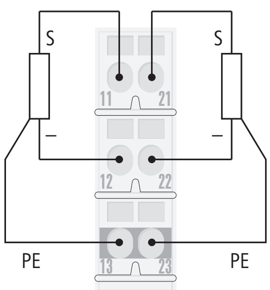


Fig. 205: Wiring diagram BL20-S3x-SBC

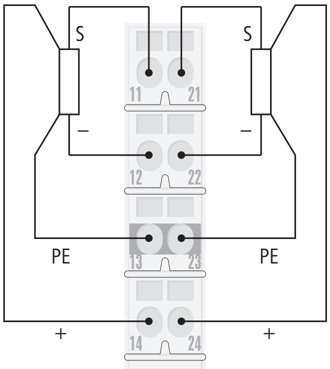


Fig. 206: Wiring diagram BL20-S4x-SBCS

9.10.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

9.10.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	

NOTE

The numbering of the channel LEDs corresponds to the numbering of the connectors at the base module.

NOTE

The indication elements are supplied by the field voltage (and not by the module bus voltage). They only indicate switch status correctly when this voltage is fully present on the Power Feeding module.

10 Analog Output Modules

Analog output modules (AO) receive output values from the gateway via the internal module bus. The modules convert these values and transmit the corresponding signals for each channel to the field level via the base modules.

The module bus electronics of the analog input modules are galvanically isolated from the field level via an optocoupler, and provide reverse polarity protection.

The modules are short-circuit proof.

Supported signal ranges

- 0…20 mA
- 4…20 mA
- 0…10 VDC
- -10…+10 VDC
- HART

10.0.1 Resolution of analog value representations

In the bipolar mode the digitalized analog values are represented as a two's complement. The 16 bit or the 12-bit-representation (left justified) can be chosen by setting the respective module parameter.

NOTE
A detailed description of the measurement value representation for the analog output modules in 16 or 12 bit can be found in the Anhang, s. p. 16.

10.0.2 LED displays

Error signals from the I/O level are indicated by each module via the "DIA" LED. The corresponding diagnostic information is transmitted to the gateway via diagnostic bits.

A continuously lit up red "DIA" LED indicates the failure of the module bus communication at the analog input module.

10.0.3 Shielding

When using shielded signal cables, the connection between the shield and the base module is made via a two-pole shield connection, which is available as an accessory.

10.0.4 Module overview

Module	Number of channels	Short-circuit proof
BL20-1AO-I(0/4…20MA)	1	✓
BL20-2AO-I(0/4…20MA)	2	✓
BL20-2AO-U(-10/0…+10VDC)	2	✓
BL20-E-4AO-U/I	4	✓
BL20-2AOH-I	2	✓

10.1 Analog output module, 1AO, 0/4...20 mA

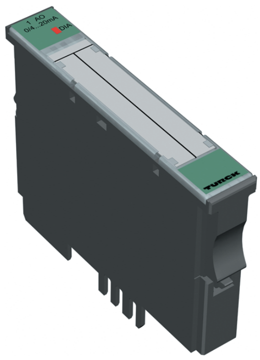


Fig. 207: BL20-1AO-I(0/4…20MA)

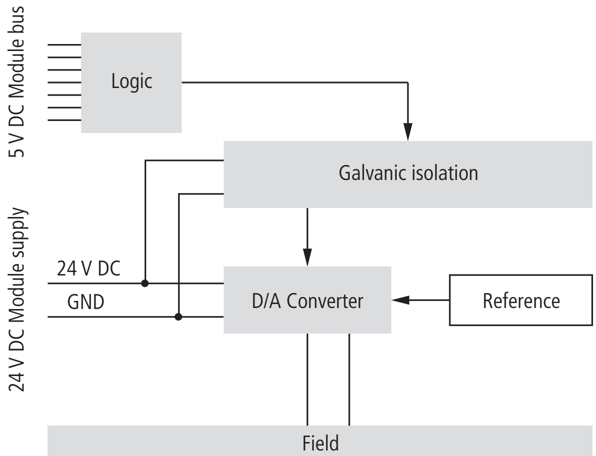


Fig. 208: Block Diagram

10.1.1 Technical data

Technical data	
Designation	BL20-1AO-I(0/4…20MA)
Number of channels	1
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	≤ 50 mA
Nominal current from module bus I_{MB}	≤ 39 mA
Power loss of the module, typical	< 1 W
Output current	0/4...20 mA
Burden resistance	
Resistive load R_{LO}	< 550 Ω
Inductive load R_{LI}	< 1 mH
Transmission frequency	< 200 Hz
Basic error at 23 °C / 73.4 °F	0.2 %
Temperature coefficient	≤300 ppm/°C from end value
Settling time (maximum)	
Resistive load	0.1 ms
Inductive load	0.5 ms
capacitive load	0.5 ms
Measurement value representation	16 bit signed integer/ 12 bit full range, left-justified

NOTE

Negative values are automatically displayed as 0 mA or 4 mA, depending on the configured measurement range.

10.1.2 Base modules

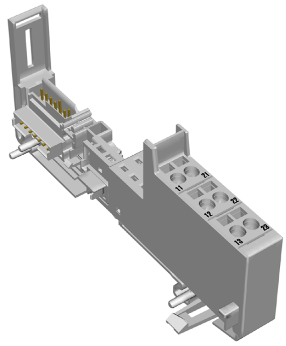


Fig. 209: Base module BL20-S3T-SBB

- with tension clamp connection
  BL20-S3T-SBB
- with screw connection
  BL20-S3S-SBB

10.1.3 Wiring diagram

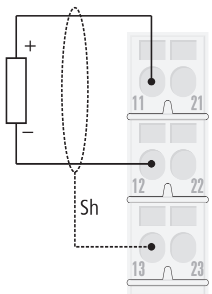


Fig. 210: Wiring diagram BL20-S3x-SBB

10.1.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	AO1 LSB							
	m + 1	AO1 LSB							

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AOx LSB	low byte of the analog value
AOx LSB	high byte of the analog value

10.1.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

10.1.6 Module parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross Reference-Liste Parameter (Seite 33)**).

	Standard				PROFIBUS PROFINET		Parameters
	byte-oriented		word-oriented				
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Output range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	
	Byte 2	Bit 0	Word 1	Bit 0	Byte 1	Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	-			Bit 8	-		reserved
				Bit 9			
				Bit 10			
				Bit 11			
				Bit 12			
				Bit 13			
				Bit 14			
				Bit 15			

The default values are written in **bold**.

Parameters	Value
Output range	**0 = 0…20 mA**
	1 = 4…20 mA
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Substitute value	Substitute value **0** 1. The substitute value defined here will be sent in consequence of certain events parameterized in the gateway. or 2. In case of a module bus error: The substitute value defined here will be sent if the parameter ”Behavior module bus error Ax” is set to ”output substitute value”.

10.1.7 Measurement value representation

NOTE

A detailed description of the measurement value representation for the analog output modules in 16 or 12 bit can be found in the **Anhang**, s. **p. 16**.

10.2 Analog output module, 2AO, 0/4...20 mA

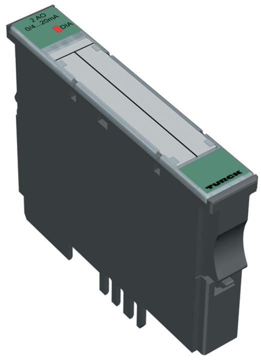


Fig. 211: BL20-2AO-I(0/4…20MA)

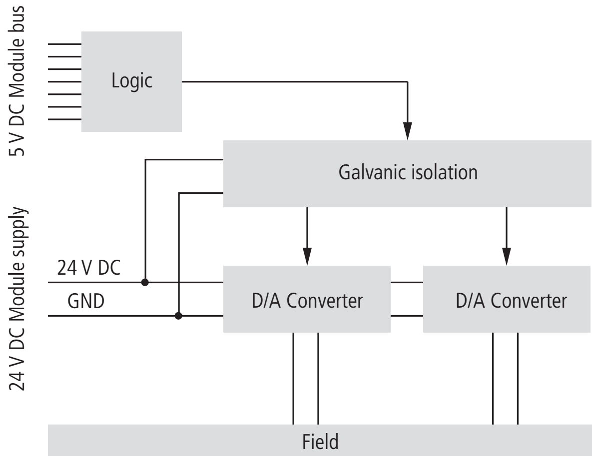


Fig. 212: Block Diagram

10.2.1 Technical data

Technical data	
Designation	BL20-2AO-I(0/4…20MA)
Number of channels	2
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 50 mA
Nominal current from module bus I_{MB}	< 40 mA
Power loss of the module, typical	< 1 W
Output current	0/4...20 mA
Burden resistance	
Resistive load R_{LO}	< 450 Ω
Inductive load R_{LI}	< 1 mH
Transmission frequency	< 200 Hz

Technical data	
Basic error at 23 °C / 73.4 °F	0.2 %
Temperature coefficient	≤ 150 ppm/°C from end value
Settling time (maximum)	2 ms (at 450 Ω
Measurement value representation	16 bit signed integer/ 12 bit full range, left-justified

NOTE

Negative values are automatically displayed as 0 mA or 4 mA, depending on the configured measurement range.

10.2.2 Base modules

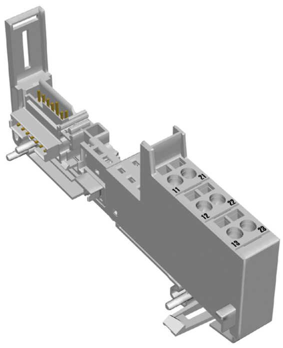


Fig. 213: Base module BL20-S3T-SBB

- with tension clamp connection
  BL20-S3T-SBB
- with screw connection
  BL20-S3S-SBB

10.2.3 Wiring diagram

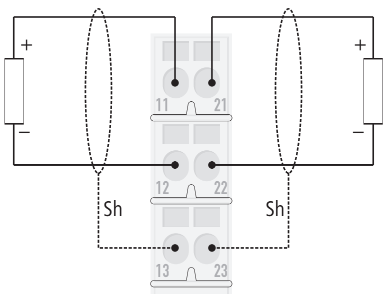


Fig. 214: Wiring diagram BL20-S3x-SBB

10.2.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	AO1 LSB							
	m + 1	AO1 LSB							
	m + 2	AO2 LSB							
	m + 3	AO2 MSB							

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE

With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AOx LSB	low byte of the analog value
AOx LSB	high byte of the analog value

10.2.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

10.2.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross Reference-Liste Parameter (Seite 33)**).

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Output range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Output on module bus error
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Data representation
		Bit 7		Bit 7		Bit 7	
	Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 2	Bit 0	Word 1	Bit 0	Byte 1	Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
Channel 2	Byte 3	Bit 0		Bit 0	Byte 3	Bit 0	Output range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	Deactivate channel
		Bit 4		Bit 4		Bit 4	Output on module bus error
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Data representation
		Bit 7		Bit 7		Bit 7	
	Byte 4	Bit 0	Word 2	Bit 8	Byte 5	Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	
	Byte 5	Bit 0		Bit 0	Byte 4	Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	

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The default values are written in **bold**.

Parameters	Value
Output range	**0 = 0…20 mA**
	1 = 4…20 mA
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)
Deactivate channel	**0 = no**
	1 = yes
Output on module bus error	**00 = substitute value**
	01 = keep current value
Data representation	**00 = standard**
	01 = NE 43
	10 = extended range
Substitute value	Substitute value **0** 1. The substitute value defined here will be sent in consequence of certain events parameterized in the gateway. or 2. In case of a module bus error: The substitute value defined here will be sent if the parameter "Behavior module bus error Ax" is set to "output substitute value".

Measurement value representation

NOTE

The measurement value tables for the parameter settings "standard", "extended range" and "NE 43" can be found on s. p. 296 ff.

10.3 Analog output module, 2AO, -10/0…+10 VDC

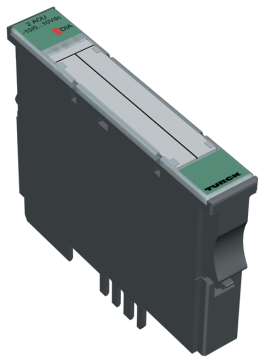

Fig. 215: BL20-2AO-U(-10/0…+10VDC)

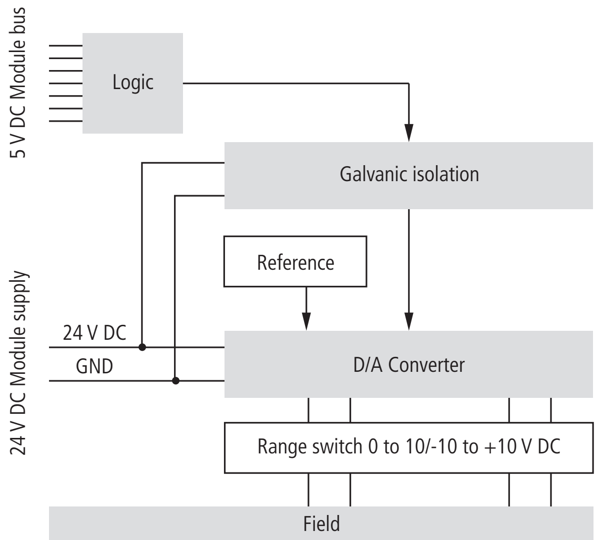

Fig. 216: Block Diagram

10.3.1 Technical data

Technical data	
Designation	BL20-2AO-U(-10/0…+10VDC)
Number of channels	2
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 50 mA
Nominal current from module bus I_{MB}	< 43 mA
Power loss of the module, typical	< 1 W
Output current	-10/0…+10 V
Burden resistance	
Resistive load R_{LO}	> 1 kΩ

Technical data	
Inductive load R_{LI}	< 1 mH
Short-circuit current	≤ 40 mA
Transmission frequency	< 100 Hz
Basic error at 23 °C / 73.4 °F	< 0,2 %
Temperature coefficient	≤300 ppm/°C from end value
Settling time (maximum)	
Resistive load	0.1 ms
Inductive load	0.5 ms
capacitive load	0.5 ms
Interference voltage suppression	
Common-mode	> 90 dB
Normal mode	> 70 dB
Interference between channels	> - 50 dB
Measurement value representation	16 bit signed integer/ 12 bit full range, left-justified

NOTE
Negative values are automatically displayed as 0 V in a configured measurement range of 0…10 V.

10.3.2 Base modules

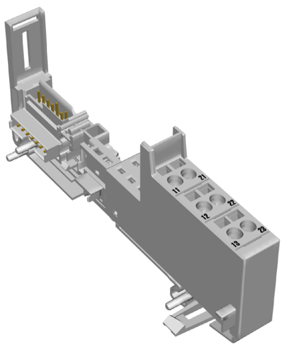

Fig. 217: Base module BL20-S3T-SBB

- with tension clamp connection
  BL20-S3T-SBB
- with screw connection
  BL20-S3S-SBB

10.3.3 Wiring diagram

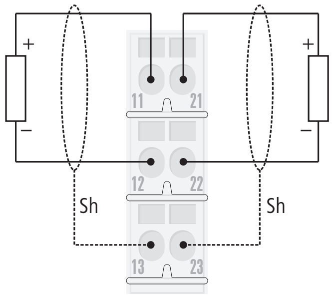

Fig. 218: Wiring diagram BL20-S3x-SBB

10.3.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	AO1 LSB							
	m + 1	AO1 LSB							
	m + 2	AO2 LSB							
	m + 3	AO2 MSB							

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AOx LSB	low byte of the analog value
AOx LSB	high byte of the analog value

10.3.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–

10.3.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see **Cross Reference-Liste Parameter (Seite 33)**).

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Output range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 2	Bit 0	Word 1	Bit 0	Byte 1	Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	

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	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 2	Byte 3	Bit 0	Word1	Bit 0	Byte 3	Bit 0	Output range
		Bit 1		Bit 1		Bit 1	Data format
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 4	Bit 0	Word 2	Bit 8	Byte 5	Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	
	Byte 5	Bit 0		Bit 0	Byte 4	Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	

The default values are written in **bold**.

Parameters	Value
Output range	**0 = 0…10 V**
	0 = -10…10 V
Data format	**0 = 15 bit + sign**
	1 = 12 bit (left-justified)

Parameters	Value
Substitute value	Substitute value **0** 1. The substitute value defined here will be sent in consequence of certain events parameterized in the gateway. or 2. In case of a module bus error: The substitute value defined here will be sent if the parameter "Behavior module bus error Ax" is set to "output substitute value".

10.3.7 Measurement value representation

NOTE

A detailed description of the measurement value representation for the analog outoput modules in 16 or 12 bit can be found in the Appendix, s. p. 16.

10.4 Analog output module, 4AO, voltage/ current, Economy

This 4-channel analog output module provides 4 analog outputs for voltage or current.

The function-setting is carried out via channel-oriented parameters. The module provides galvanic isolation between the field and the module bus connection.

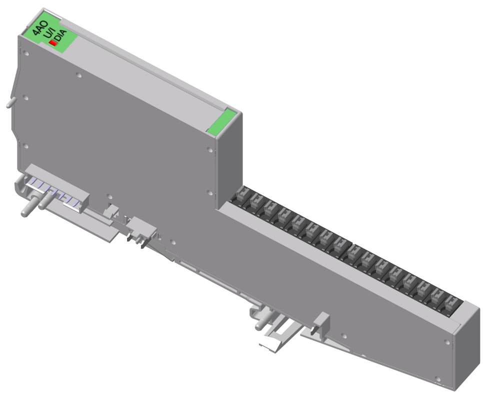
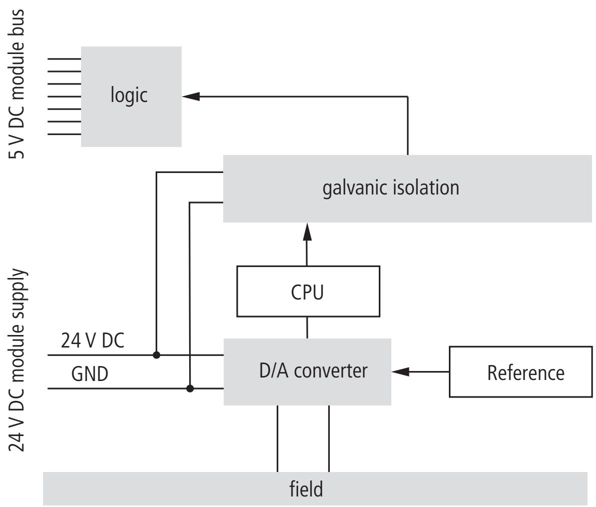


Fig. 219: BL20-E-4AO-U/I



Block Diagram

10.4.1 Technical data

Technical data	
Designation	BL20-E-4AO-U/I
Number of channels	4 (U/I)
Nominal voltage from supply terminal U_L (range)	24 VDC (18…30 VDC)
Nominal current from supply terminal I_L	
without signal output	< 40 mA
with signal output	< 150 mA

Technical data	
Nominal current from module bus I_{MB}	< 40 mA
Power loss of the module, typical	< 3 W
Special Technical data	
Parameterizable measured variables	voltage, current
– Output value, voltage	-10…10 VDC/ 0…10 VDC
Burden resistance	
– Resistive load	> 1 kΩ
– Capacitive load	< 1 µF
– Transmission frequency	< 20 Hz
Settling time (maximum)	
– Resistive load	< 1 ms
– Inductive load	< 2 ms
– Capacitive load	< 2 ms
Short-circuit current	< 40 mA
Basic error (nominal range at 23 °C)	0.2 %
Temperature coefficient	200 ppm/ °C
– Output value, current	0…20 mA /4…20 mA
Burden resistance	
– Resistive load	< 450 Ω
– Inductive load	< 1 mH
– Transmission frequency	< 20 Hz
Settling time (maximum)	
– Resistive load	< 1 ms
– Inductive load	< 2 ms
– Capacitive load	< 2 ms
Basic error (nominal range at 23 °C)	0.2 %
Temperature coefficient	200 ppm/ °C

10.4.2 Wiring diagram

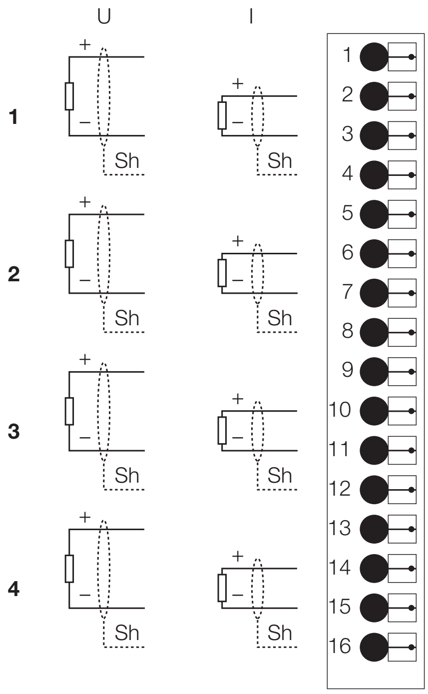


Fig. 220: Connectors

NOTE
Each channel can be parameterized for voltage or current output. Non used output terminals have to remain free!

10.4.3 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	AO1 LSB							
	m + 1	AO1 LSB							
	m + 2	AO2 LSB							
	m + 3	AO2 MSB							
	m + 4	AO3 LSB							
	m + 5	AO3 MSB							
	m + 6	AO4 LSB							
	m + 7	AO4 MSB							

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Meaning
AOx LSB	low byte of the analog value
AOx LSB	high byte of the analog value

10.4.4 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communi-cation failure or field voltage U_L not con-nected.	Check if more than two ad-joining electronics mod-ules have been pulled. Check the field voltage $_U$L.
	Off	No error messages or diagnostics	–

This module has the following diagnostic data **per channel**:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
HW Hardware-Error	-	-	-	Overflow/ Underflow	-	-	Output value out of range

Diagnostics	Meaning
Output value out of range	The permissible output value limits are exceeded. Indicates an exceeding or undercut of the value ranges. → Limit values according to parameterization, from s. p. 292.
Overflow/underflow, OUFL	The output value exceeds the output range and the module can not transmit this value. Limit values according to parameterization, s. p. 292 ff.
Hardware error	Shows common errors of the module hardware. The return analog value in case of an error is "0".

10.4.5 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see Cross Reference-Liste Parameter (Seite 33)).

	Standard						
	byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	Data format
		Bit 5		Bit 5		Bit 5	Deactivate all diagnostics
		Bit 6		Bit 6		Bit 6	Output on module bus error
		Bit 7		Bit 7		Bit 7	

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1		Bit 0		Bit 8		Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 1	Bit 7	Word 0	Bit 15	Byte 2	Bit 7	
		Bit 0		Bit 0		Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 2	Bit 7		Bit 7	Byte 1	Bit 7	
Channel 2		Bit 0		Bit 0		Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	Data format
		Bit 5		Bit 5		Bit 5	Deactivate all diagnostics
		Bit 6		Bit 6		Bit 6	Output on module bus error
	Byte 3	Bit 7	Word 1	Bit 7	Byte 3	Bit 7	

	Standard						
	byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Channel 2		Bit 0		Bit 8		Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 4	Bit 7		Bit 15	Byte 5	Bit 7	
		Bit 0		Bit 0		Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 5	Bit 7	Word 2	Bit 7	Byte 4	Bit 7	
Channel 3		Bit 0		Bit 0		Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	Data format
		Bit 5		Bit 5		Bit 5	Deactivate all diagnostics
		Bit 6		Bit 6		Bit 6	Output on module bus error
	Byte 6	Bit 7		Bit 7	Byte 6	Bit 7	
		Bit 0		Bit 8		Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 7	Bit 7	Word 3	Bit 15	Byte 8	Bit 7	

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 3		Bit 0		Bit 0		Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 8	Bit 7		Bit 7	Byte 7	Bit 7	
Channel 4		Bit 0		Bit 0		Bit 0	Mode
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	Data format
		Bit 5		Bit 5		Bit 5	Deactivate all diagnostics
		Bit 6		Bit 6		Bit 6	Output on module bus error
	Byte 9	Bit 7	Word 4	Bit 7	Byte 9	Bit 7	
		Bit 0		Bit 8		Bit 0	Substitute value (low byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
	Byte 10	Bit 7		Bit 15	Byte 11	Bit 7	
		Bit 0		Bit 0		Bit 0	Substitute value (high byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
	Byte 11	Bit 7	Word 5	Bit 7	Byte 10	Bit 7	

The default values are written in **bold**.

Parameters	settings
Mode	**0000 = voltage -10…10 V DC standard** 0001 = voltage 0…10 V DC standard 0010 = voltage -10…10 VDC PA (NE 43) 0011 = voltage 0…10 VDC PA (NE 43) 0100 = voltage -10…10 VDC extended range 0101 = voltage 0…10 VDC extended range 1000 = current 0…20 mA standard 1001 = current 4…20 mA standard 1010 = current 0…20 mA PA (NE 43) 1011 = current 4…20 mA PA (NE 43) 1100 = current 0…20 mA extended range 1101 = current 4…20 mA extended range 1111 = deactivate
Data format	**0 = 15 bit + sign** 1 = 12 bit (left-justified)
Deactivate all diagnostics	**0 = no** 1 = yes
Output on module bus error	**00 = substitute value** 01 = keep current value
Substitute value	Substitute value **0** 1. The substitute value defined here will be sent in consequence of certain events parameterized in the gateway. or 2. In case of a module bus error: The substitute value defined here will be sent if the parameter "Behavior module bus error Ax" is set to "output substitute value".

NOTE

The measurement value tables for the parameter settings "standard", extended range" and "NE 43" can be found on s. p. 300 ff.

Value representation/ resolution	range	Min. value	Max. value
Standard 16 bit/ 12 bit	-10…10 VDC	-10 VDC	10 VDC
	0…10 VDC	0 VDC	10 VDC
	0…20 mA	0 mA	20 mA
	4…20 mA	4 mA	20 mA
Extended range/ 16 bit/ 12 bit	-10…10 VDC	-11.76 VDC	11.76 VDC
	0…10 VDC	0 VDC	11.76 VDC
	0…20 mA	0 mA	23.52 mA
	4…20 mA	0 mA	22.81 mA

Value representation/ resolution	range	Min. value	Max. value
PA (NE43) 16 bit/ 12 bit	-10…10 VDC	-10.5 VDC	10.5 VDC
	0…10 VDC	0 VDC	10.5 VDC
	0…20 mA	0 mA	21 mA
	4…20 mA	3.6 mA	21 mA

10.4.6 Standard value representation

16-bit representation

	dec.	hex.	bipolar	-10…10 V
dec. value = 3276,7 [1/V] × voltage value [V]				
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF		-0.000305 V
	…	…		…
-50.00000 %	-16384	C000		-5.0000 V
	…	…		…
-99.99695 %	-32767	8001		-9.9997 V
-100.00 %	-32768	8000		- 10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value = 3276,7 [1/V] × voltage value [V]				
100.00 %	32767	7FFF	nominal range	10.0000 V
99.99695 %	32766	7FFE		9.9997 V
	…	…		…
50.00153 %	16384	4000		5.0002 V
	…	…		…
0.00305 %	1	0001		0.000305 V
0.00000 %	0	0000		0.000000 V
-0.00305 %	-1	FFFF	DIA Output value out of range ON at FFFF…8000	0.000000 V
	…	…		…
-50.00000 %	-16384	C000		0.000000 V
	…	…		…
-99.99695 %	-32767	8001		0.000000 V
-100.00 %	-32768	8000		0.000000 V

	dec.	hex.	unipolar	0…20 mA
dec. value = 1638,35 [1/mA] × current value [mA]				
100.00 %	32767	7FFF	nominal range	20.0000 mA
99.99695 %	32766	7FFE		19.9994 mA
	…	…		…
50.00153 %	16384	4000		10.0003 mA
	…	…		…
0.00305 %	1	0001		0.0006103 mA
0.00000 %	0	0000		0.000000 mA
-0.00305 %	-1	FFFF	DIA Output value out of range ON at FFFF…8000	0.000000 mA
	…	…		…
-50.00000 %	-16384	C000		0.000000 mA
	…	…		…
-99.99695 %	-32767	8001		0.000000 mA
-100.00 %	-32768	8000		0.000000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 2047,94 × (current value [mA]- 4 mA)				
100.00 %	32767	7FFF	nominal range	20.0000 mA
99.99695 %	32766	7FFE		19.9995 mA
	…	…		…
50.00153 %	16384	4000		12.00024 mA
	…	…		…
0.00305 %	1	0001		4.0004883 mA
0.00000 %	0	0000		4.000000 mA
-0.00305 %	-1	FFFF	DIA Output value out of range ON at FFFF…8000	4.000000 mA
	…	…		…
-50.00000 %	-16384	C000		4.000000 mA
	…	…		…
-99.99695 %	-32767	8001		4.000000 mA
-100.00 %	-32768	8000		4.000000 mA

12 bit representation (left-justified)

	dec.	hex.	bipolar	-10…10 V
dec. value = 204,7 [1/V] × voltage value [V] × 16				
100.000 %	2047 × 16	7FFF	nominal range	10.0000 V
99.951 %	2046 × 16	7FEx		9.9951 V
	…	…		…
0.04885 %	1 × 16	001×		0.004885 V
0.00000 %	0	000×		0.000000 V
-0.04883 %	-1 × 16	FFF×		-0.004883 V
	…	…		…
-99.95 %	-2047 × 16	801×		-9.9951 V
-100.00 %	-2048 × 16	800×		- 10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value = 409,5 [1/V] × voltage value [V] × 16				
100.00 %	4095 × 16	FFF×	nominal range	10.0000 V
99.976 %	4094 × 16	FFEx		9.9976 V
	…	…		…
50.012%	2048 × 16	800×		5.0021 V
	…	…		…
0.0244 %	1 × 16	001×		0.002442 V
0.00000 %	0	000×		0.000000 V

	dec.	hex.	unipolar	0…20 mA
dec. value = 204,75 [1/mA] × current value [mA] × 16				
100.00 %	4095 × 16	FFF×	nominal range	20.0000 mA
99.9756 %	4094 × 16	FFEx		19.995117 mA
	…	…		…
50.0122%	2048 × 16	800×		10.0024 mA
	…	…		…
0.0244 %	1 × 16	001×		0.004883 mA
0.00000 %	0	000×		0.000000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 255.9 [1/mA] × (current value [mA] - 4 mA) × 16				
100.00 %	4095 × 16	FFF×	nominal range	20.0000 mA
99.9756 %	4094 × 16	FFEx		19.99609 mA
	…	…		…
50.0122%	2048 × 16	800×		12.0019mA
	…	…		…
0.0244 %	1 × 16	001×		4.00391 mA
0.00000 %	0	000×		4.000000 mA

10.4.7 Extended Range - value representation

16-bit representation

	dec.	hex.	bipolar	-10…10 V
dec. value = 2764,8 [1/V] × voltage value [V]				
118.515 %	32767	7FFF	DIA Output value out of range ON at F00…7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
117.593 %	32512	7F00		11.7593 V
117.589 %	32511	7EFF	output range overrun	11.7589 V
117.535 %	32496	7EF0		11.7535 V
100.058%	27664	6C10		10.0058 V
≥ 100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0 V
-0.00362 %	-1	FFFF		-361.7 µV
-0.05787 %	-16	FFF0		- 5.787 mV
-25.000 %	-6912	E500		-2.5 V
-100.000 %	-27648	9400		-10 V
≤ 100.004 %	-27649	93FF	output range underrun	-10.0004 V
-100.058 %	-27664	93F0		-10.0058 V
-117.593 %	-32512	8100		-11.7593 V
-117.596 %	-32513	80FF	DIA Output value out of range ON at 08FF…8000	11.7596 V
-118.461 %	-32752	80F0		-11.846 V
-118.519 %	-32768	8000		-11.852 V

	dec.	hex.	unipolar	0…10 V
dec. value = 2764,8 [1/V] × voltage value [V]				
118.515 %	32767	7FFF	DIA Output value out of range ON at 7F00…7FFF	11.851 V
118.461 %	32752	7FF0		11.846 V
117.593 %	32512	7F00		11.7593 V
117.589 %	32511	7EFF	output range overrun	11.7589 V
117.535 %	32496	7EF0		11.7535 V
100.058%	27664	6C10		10.0058 V
≥ 100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10 V
0.05787 %	16	0010		5.787 mV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0.00 V
-0.00362 %	-1	FFFF	DIA Overflow/underflow, OUFL ON at FFFF…8000	0.00 V
-0.05787 %	-16	FFF0		0.00 V
-25.000 %	-6912	E500		0.00 V
-100.000 %	-27648	9400		0.00 V
≤ 100.004 %	-27649	93FF		0.00 V
-100.058 %	-27664	93F0		0.00 V
-117.593 %	-32512	8100		0.00 V
-117.596 %	-32513	80FF		0.00 V
-118.461 %	-32752	80F0		0.00 V
-118.519 %	-32768	8000		0.00 V

	dec.	hex.	unipolar	0…20 mA
			dec. value = 1382,4 [1/mA] × current value [mA]	
118.515 %	32767	7FFF	DIA Output value out of range ON at 7F00…7FFF	23.703 mA
118.461 %	32752	7FF0		23.692 mA
117.593 %	32512	7F00		23.5185 mA
117.589 %	32511	7EFF	output range overrun	23.5178 mA
117.535 %	32496	7EF0		23.507 mA
100.058%	27664	6C10		20.0116 mA
≥ 100.004 %	27649	6C01		20.0007 mA
100.000 %	27648	6C00	nominal range	20 mA
0.05787 %	16	0010		11.574 µA
0.003617 %	1	0001		0.7234 µA
0.000 %	0	0000		0.0000 mA
-0.00362 %	-1	FFFF	DIA Overflow/underflow, OUFL ON at FFFF…8000	0.0000 mA
-0.05787 %	-16	FFF0		0.0000 mA
-25.000 %	-6912	E500		0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
≤ 100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 1728 [1/mA] × (current value [mA] - 4 mA)				
118.515 %	32767	7FFF	DIA Output value out of range ON at F00…7FFF	22.962 mA
118.461 %	32752	7FF0		22.954 mA
117.593 %	32512	7F00		22.8148 mA
117.589 %	32511	7EFF	output range overrun	22.8142 mA
117.535 %	32496	7EF0		22.8056 mA
100.058%	27664	6C10		20.0093 mA
≥ 100.004 %	27649	6C01		20.0006 mA
100.000 %	27648	6C00	nominal range	20 mA
0.05787 %	16	0010		4.009259 mA
0.003617 %	1	0001		4.000578 mA
0.000 %	0	0000		4.0000 mA
-0.00362 %	-1	FFFF	output range underrun	3.99942 mA
-0.05787 %	-16	FFF0		3.99075 mA
-25.000 %	-6912	E500		0.0000 mA
-25.004 %	-6913	E4FF	DIA Overflow/underflow, OUFL ON at E4FF…8000	0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
≤ 100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

12 bit representation (left-justified)

The representation of the 12 bit values corresponds to that of the 16 bit values. Only bits 0 to 3 are set to ”0”.

10.4.8 Value representation process automation (NE 43)

16-bit representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

Example:

Process value:

– dec.	15020
– hex.	3AAC
Output current	15.02 mA

	dec.	hex.	bipolar	-10…10 V
dec. value = 1000 [1/V] × voltage value [V]				
327.67 %	32767	7FFF	DIA Overflow/underflow, OUFL ON at 2AF9…7FFF	11.000 V
110, 01 %	11001	2AF9		11.000 V
110.00 %	11000	2AF8	DIA Output value out of range ON at 2905…7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	output range overrun	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V
-0.01 %	-1	FFFF		-0.001 V
-40.00 %	-4000	F060		-4.000 V
-100.00 %	-10000	D8F0		-10.000 V
≤ -100.01 %	-10001	D8EF	output range underrun	-10.001 V
-105.00 %	-10500	D6FC		-10.500 V
-105.01 %	-10501	D6FB	DIA Output value out of range ON at D6FB…8000	-10.501 V
-110.00 %	-11000	D508		-11.000 V
-110.01 %	-11001	D507	DIA Overflow/underflow, OUFL ON at D507…8000	-11,00 0 V
-327.68 %	-32768	8000		-11.000 V

	dec.	hex.	unipolar	0…10 V
dec. value = 1000 [1/V] × voltage value [V]				
655.35 %	65535	FFFF	DIA Overflow/underflow, OUFL ON at 2AF9…FFFF	11.000 V
110, 01 %	11001	2AF9		11.000 V
110.00 %	11000	2AF8	DIA Output value out of range ON at 2905…FFFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	output range overrun	10.500 V
100.01 %	10001	2711		10.001 V
100.000 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
20.00 %	2000	07D0		2.000 V
0.01 %	1	0001		0.001 V
0.000 %	0	0000		0 V

	dec.	hex.	unipolar	0…20 mA
dec. value = 1000 [1/mA] × current value [mA]				
327.675 %	65535	FFFF	DIA Overflow/underflow, OUFL ON at 55F1…FFFF	22.000 mA
110, 05 %	22001	55F1		22.000 mA
110.000 %	22000	55F0	DIA Output value out of range ON at 5209…7FFF	22.000 mA
105.005 %	21001	5209		21.001 mA
105.00 %	21000	5208	output range overrun	21.000 mA
100.005 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
40.00 %	8000	1F40		8.000 mA
20.00 %	4000	0FA0		4.000 mA
0.01 %	2	0002		0.002 mA
0.005 %	1	0001		0.001 mA
0.000 %	0	0000		0.000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 1000 [1/mA] × current value [mA]				
384.594 %	65535	FFFF	DIA Overflow/underflow, OUFL ON at 55F1…FFFF	22.000 mA
112, 506 %	22001	55F1		22.001 mA
112.500 %	22000	55F0	DIA Output value out of range ON at 5209…FFFF	22.000 mA
106.256 %	21001	5209		21.001 mA
106.250 %	21000	5208	output range overrun	21.000 mA
100.006 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
25.000 %	8000	1F40		8.000 mA
0.000 %	4000	0FA0		4.000 mA
≤ -0.006 %	≤ 3999	0F9F	output range underrun	3.999 mA
-1.250 %	3800	0ED8		3.800 mA
-2.500 %	3600	0E10		3.600 mA
-2.506 %	3599	0E0F	DIA Output value out of range ON at 0E0F…0000	3.599 mA
-12.506 %	2000	07D0		2.000 mA
-12.505 %	< 1999	07CF		1.999 mA
-24.994 %	1	0001		0.001 mA
-25.000 %	0	0000		0.000 mA

12 bit representation (left-justified)

The representation of the 12 bit values corresponds to that of the 16 bit values. Only bits 0 to 3 are set to ”0”.

10.5 Analog output module, 2 AO, current, HART

This analog input module provides 2 current HART-outputs.

The two channels of the module are galvanically isolated. Additionally, the modules provides galvanic isolation between field level and module bus connection.

> **NOTE**
> For PROFIBUS:
> The BL20-2AOH-I can only be used with the BL20-DPV1-gateways (BL20-GW-DPV1, BL20-E-GW-DP)!

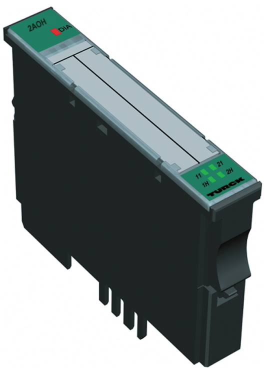


Fig. 221: BL20-2AOH-I

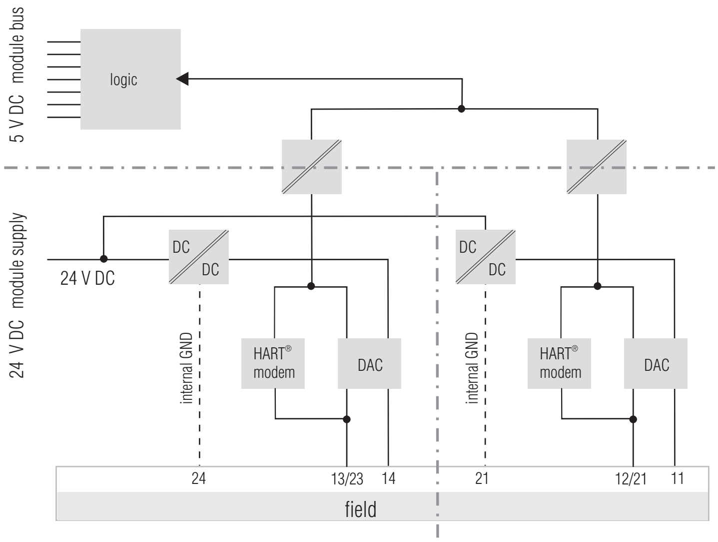


Fig. 222: Block Diagram

10.5.1 Technical data

Technical data	
Designation	BL20-2AOH-I
Number of channels	2
Nominal voltage from supply terminal U_L (range)	24 VDC (18…30 VDC)
Nominal current from supply terminal I_L	
without signal output	< 20 mA
with signal output	< 80 mA
Nominal current from module bus I_{MB}	< 30 mA
Power loss of the module, typical	< 1 W
Output current	0/4...20 mA
Burden resistance	
Resistive load R_{LO}	< 600 Ω
Inductive load R_{LI}	< 1 mH
Transmission frequency	< 200 Hz
Repeatability	0,1 %
Basic error at 23 °C / 73.4 °F	0.2 %
Temperature coefficient	≤ 200 ppm/°C from end value
Settling time (maximum)	
Resistive load	0.1 ms
Inductive load	0.5 ms
Measurement value representation	16 bit signed integer, NE 43 (PA), extended range

10.5.2 Base modules

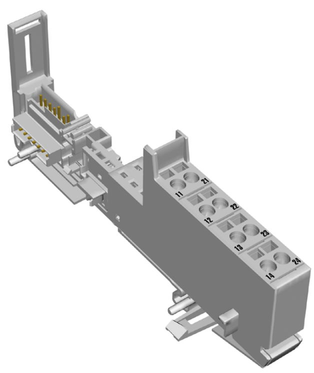


Fig. 223: Base module BL20-S4T-SBBS

10.5.3 Wiring diagram

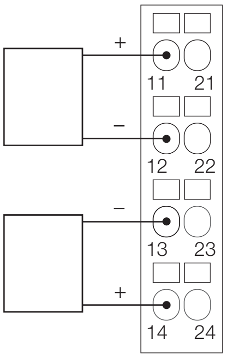


Fig. 224: Connection options with base module BL20-S4x-SBBS

10.5.4 Process data mapping

Process input data

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	n + 3	Parameterizable HART-variable A without unit							
	n + 1	n + 2								
	n + 2	n + 1								
	n + 3	n								
	n + 4	n + 7	Parameterizable HART-variable B without unit							
	n + 5	n + 6								
	n + 6	n + 5								
	n + 7	n + 4								
	n + 8	n + 11	Parameterizable HART-variable C without unit							
	n + 9	n + 10								
	n + 10	n + 9								
	n + 11	n + 8								
	n + 12	n + 15	Parameterizable HART-variable D without unit							
	n + 13	n + 14								
	n + 14	n + 13								
	n + 15	n + 12								

Representation of HART-variables without unit according to ANSI/IEEE 754-1985 ”Standard for Binary Floating-Point Arithmetic for microprocessor systems”.

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Process output data

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	m + 3	AO1 LSB							
	m + 1	m + 2	AO1 LSB							
	m + 2	m + 1	AO2 LSB							
	m + 3	m	AO2 MSB							

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

Process data	Meaning
AOx LSB	low byte of the analog value
AOx LSB	high byte of the analog value

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

10.5.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure or field voltage UL not connected.	Check if more than two ad-joining electronics modules have been pulled. Check the field voltage $_{U}$L.
	Off	No error messages or diagnostics	–
11/21	Red flashing 0.5 Hz	Wire break (if parameterized as diagnostics)	
	Red	Invalid value	see also diagnostics Invalid value
	Red, 4 Hz both LEDs alternating	Hardware error	Exchange the module.
	Off	Channel OK	
1H/ 2H	Green	HART-communication OK	The HART-status is only shown in active HART-communication. The status-display is either realized acyclically or via polling operation (depending on the parameterization). With acyclical monitoring the information (LED) is turned off after 1.5 seconds. Further HART-communication retriggers the LED.
	Red flashing 0.5 Hz	HART communication error: – no communication <u>or</u> – high number of CRC-errors	
	Red	HART-status-flag (if HART-status polling has been parameterized, see parameter Mode)	
	Off	No HART-communication	

NOTE
The LEDs 11 and 1H are assigned to channel 1 and the LEDs 21 and 2H to channel 2 of the module.

Diagnostics

This module has the following diagnostic data **per channel**:

Byte	B7	B6	B5	B4	B3	B2	B1	B0
	Channel 1							
0	hard-ware error	Invalid parame-ter	HART comm. error	HART status error	Value below lower limit	Invalid value	Wire break	Value above upper limit
1	-							
	Channel 2							
2	hard-ware error	Invalid parame-ter	HART comm. error	HART status error	Value below lower limit	Invalid value	Wire break	Value above upper limit
3	-							

Diagnostics	Meaning
Value above upper limit	The allowed output range limits are exceeded. → Limit values according to parameterization, from s. p. 314.
Wire break	Displays an open circuit in the signal line. The permissible output value limits are exceeded.
Invalid value	The output value exceeds the values which the module is able to interpret.
Value below Lower limit	The allowed output range limits are exceeded. → Limit values according to parameterization, from s. p. 314. The permissible output value limits are exceeded.
HART status error	The connected HART-device set a bit in the HART status-information ("status - polling").
HART communication error	The channel does not allow communication with the HART-device.
Invalid parameter	Possible causes: Setting of a reserved parameter bit The substitute value which is set is not within the measurement value range. Module behavior: Output value/substitute value = 0 mA The return value of the HART-variable in the process data is 0×0000 0000.
Hardware error	Shows common errors of the module hardware. The return analog value in case of an error is "0".

NOTE
If an error message from the sensor occurs, the HART-status is set to "1".

10.5.6 Module parameters

NOTE

Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
If you use older configuration files with old parameter texts (issue date before April 2014), then you can find a cross reference list in the manual's appendix (see Cross Reference-Liste Parameter (Seite 33)).

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 1	Byte 0	Bit 0	Word 0	Bit 0	Byte 0	Bit 0	Deactivate channel
		Bit 1		Bit 1		Bit 1	Deactivate all diagnostics
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	Mode
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	reserved
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	Activate HART diagnostics
	Byte 1	Bit 0		Bit 8	Byte 1	Bit 0	Data representation
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	reserved
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Output on module bus error
		Bit 7		Bit 15		Bit 7	

	Standard					PROFIBUS PROFINET		Parameters
	byte-oriented		word-oriented					
Channel 1	Byte 2	Bit 0	Word 1	Bit 0	Byte 3	Bit 0		Substitute value (low byte)
		Bit 1		Bit 1		Bit 1		
		Bit 2		Bit 2		Bit 2		
		Bit 3		Bit 3		Bit 3		
		Bit 4		Bit 4		Bit 4		
		Bit 5		Bit 5		Bit 5		
		Bit 6		Bit 6		Bit 6		
		Bit 7		Bit 7		Bit 7		
	Byte 3	Bit 0		Bit 0	Byte 2	Bit 0		Substitute value (high byte)
		Bit 1		Bit 1		Bit 1		
		Bit 2		Bit 2		Bit 2		
		Bit 3		Bit 3		Bit 3		
		Bit 4		Bit 4		Bit 4		
		Bit 5		Bit 5		Bit 5		
		Bit 6		Bit 6		Bit 6		
		Bit 7		Bit 7		Bit 7		

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Channel 2	Byte 4	Bit 0	Word 2	Bit 8	Byte 4	Bit 0	Deactivate channel
		Bit 1		Bit 9		Bit 1	Deactivate all diagnostics
		Bit 2		Bit 10		Bit 2	reserved
		Bit 3		Bit 11		Bit 3	Mode
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	reserved
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	Activate HART diagnostics
	Byte 5	Bit 0		Bit 0	Byte 5	Bit 0	Data representation
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	reserved
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Output on module bus error
		Bit 7		Bit 7		Bit 7	
	Byte 6	Bit 0	Word 3	Bit 0	Byte 7	Bit 0	Substitute value (low byte)
		Bit 1		Bit 1		Bit 1	
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	
		Bit 7		Bit 7		Bit 7	
	Byte 7	Bit 0		Bit 8	Byte 6	Bit 0	Substitute value (high byte)
		Bit 1		Bit 9		Bit 1	
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	
		Bit 7		Bit 15		Bit 7	

	Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
HART-Var. A	Byte 8	Bit 0	Word 4	Bit 0	Byte 8	Bit 0	Mapped channel VA
		Bit 1		Bit 1		Bit 1	reserved
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Mapped variable VA
		Bit 7		Bit 7		Bit 7	
HART-Var. B	Byte 9	Bit 0		Bit 8	Byte 9	Bit 0	Mapped channel VB
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Mapped variable VB
		Bit 7		Bit 15		Bit 7	
HART-Var. C	Byte 10	Bit 0	Word 5	Bit 0	Byte 10	Bit 0	Mapped channel VC
		Bit 1		Bit 1		Bit 1	reserved
		Bit 2		Bit 2		Bit 2	
		Bit 3		Bit 3		Bit 3	
		Bit 4		Bit 4		Bit 4	
		Bit 5		Bit 5		Bit 5	
		Bit 6		Bit 6		Bit 6	Mapped variable VC
		Bit 7		Bit 7		Bit 7	
HART-Var. D	Byte 11	Bit 0		Bit 8	Byte 11	Bit 0	Mapped channel VD
		Bit 1		Bit 9		Bit 1	reserved
		Bit 2		Bit 10		Bit 2	
		Bit 3		Bit 11		Bit 3	
		Bit 4		Bit 12		Bit 4	
		Bit 5		Bit 13		Bit 5	
		Bit 6		Bit 14		Bit 6	Mapped variable VD
		Bit 7		Bit 15		Bit 7	

The default values are written in **bold**.

Parameters	settings
Deactivate channel	**0 = no** 1 = yes
Deactivate all diagnostics	0 = no **1 = yes**
Mode	0 = 0… 20 mA (HART-status polling not possible) 1 = 4… 20 mA (HART-status polling not possible) **2 = 4…20 mA HART active** Cyclic polling of HART-status activated.
Activate HART diagnostics	**0 = yes** 1 = no
Data representation	**0 = 15 bit + sign** 1 = NE 43 2 = Extended Range
Output on module bus error	**0 = substitute value** 1 = current value
Substitute value	Substitute value **4** 1. The substitute value defined here will be sent in consequence of certain events parameterized in the gateway. or 2. In case of a module bus error: The substitute value defined here will be sent if the parameter "Behavior module bus error Ax" is set to"output substitute value".
Mapped channel Vx	Defines the channel of which the HART-variable is read. **0 = channel 1** 1 = channel 2
Mapped variable Vx	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)

NOTE
The measurement value tables for the parameter settings "standard", extended range" and "NE 43" can be found on s. p. 314 ff.

10.5.7 Standard value representation, 16 bit integer

	dec.	hex.	unipolar	0…20 mA
dec. value = 1638,35 [1/mA] × current value [mA]				
100.00 %	32767	7FFF	nominal range	20.0000 mA
99.99695 %	32766	7FFE		19.9994 mA
	…	…		…
50.00153 %	16384	4000		10.0003 mA
	…	…		…
0.00305 %	1	0001		0.0006103 mA
0.00000 %	0	0000		0.000000 mA
-0.00305 %	-1	FFFF	DIA Invalid value ON at FFFF…8000	0.000000 mA
	…	…		…
-50.00000 %	-16384	C000		0.000000 mA
	…	…		…
-99.99695 %	-32767	8001		0.000000 mA
-100.00 %	-32768	8000		0.000000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 2047,94 × (current value [mA]- 4 mA)				
100.00 %	32767	7FFF	nominal range	20.0000 mA
99.99695 %	32766	7FFE		19.9995 mA
	…	…		…
50.00153 %	16384	4000		12.00024 mA
	…	…		…
0.00305 %	1	0001		4.0004883 mA
0.00000 %	0	0000		4.000000 mA
-0.00305 %	-1	FFFF	DIA Invalid value ON at FFFF…8000	4.000000 mA
	…	…		…
-50.00000 %	-16384	C000		4.000000 mA
	…	…		…
-99.99695 %	-32767	8001		4.000000 mA
-100.00 %	-32768	8000		4.000000 mA

10.5.8 Extended Range value representation, 16-bit-representation

	dec.	hex.	unipolar	0…20 mA
dec. value = 1382,4 [1/mA] × current value [mA]				
118.515 %	32767	7FFF	DIA Value above upper limitON at 7F00…7FFF	23.703 mA
118.461 %	32752	7FF0		23.692 mA
117.593 %	32512	7F00		23.5185 mA
117.589 %	32511	7EFF	output range overrun	23.5178 mA
117.535 %	32496	7EF0		23.507 mA
100.058%	27664	6C10		20.0116 mA
≥ 100.004 %	27649	6C01		20.0007 mA
100.000 %	27648	6C00	nominal range	20 mA
0.05787 %	16	0010		11.574 µA
0.003617 %	1	0001		0.7234 µA
0.000 %	0	0000		0.0000 mA
-0.00362 %	-1	FFFF	DIA Invalid value ON at FFFF…8000	0.0000 mA
-0.05787 %	-16	FFF0		0.0000 mA
-25.000 %	-6912	E500		0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
≤ 100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 1728 [1/mA] × (current value [mA] - 4 mA)				
118.515 %	32767	7FFF	Value above upper lim-itON at 7F00…7FFF	22.962 mA
118.461 %	32752	7FF0		22.954 mA
117.593 %	32512	7F00		22.8148 mA
117.589 %	32511	7EFF	output range overrun	22.8142 mA
117.535 %	32496	7EF0		22.8056 mA
100.058%	27664	6C10		20.0093 mA
≥ 100.004 %	27649	6C01		20.0006 mA
100.000 %	27648	6C00	nominal range	20 mA
0.05787 %	16	0010		4.009259 mA
0.003617 %	1	0001		4.000578 mA
0.000 %	0	0000		4.0000 mA
-0.00362 %	-1	FFFF	output range underrun	3.99942 mA
-0.05787 %	-16	FFF0		3.99075 mA
-25.000 %	-6912	E500		0.0000 mA
-25.004 %	-6913	E4FF	DIA Invalid value ON at E4FF…8000	0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
≤ 100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

10.5.9 Value representation process automation (NE 43), 16 bit representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

Example:

Process value:	
– dec.	15020
– hex.	3AAC
Output current	15.02 mA

	dec.	hex.	unipolar	0…20 mA
dec. value = 1000 [1/mA] × current value [mA]				
327.675 %	65535	FFFF	DIA Invalid value ON at 55F1…FFFF	22.000 mA
110, 05 %	22001	55F1		22.000 mA
110.000 %	22000	55F0	DIA Value above upper limit ON at 5209…7FFF	22.000 mA
105.005 %	21001	5209		21.001 mA
105.00 %	21000	5208	output range overrun	21.000 mA
100.005 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
40.00 %	8000	1F40		8.000 mA
20.00 %	4000	0FA0		4.000 mA
0.01 %	2	0002		0.002 mA
0.005 %	1	0001		0.001 mA
0.000 %	0	0000		0.000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value = 1000 [1/mA] × current value [mA]				
384.594 %	65535	FFFF	DIA Invalid value ON at 55F1…FFFF	22.000 mA
112, 506 %	22001	55F1		22.001 mA
112.500 %	22000	55F0	DIA Value above upper limit ON at 5209 to FFFF	22.000 mA
106.256 %	21001	5209		21.001 mA
106.250 %	21000	5208	output range overrun	21.000 mA
100.006 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
25.000 %	8000	1F40		8.000 mA
0.000 %	4000	0FA0		4.000 mA
≤ -0.006 %	≤ 3999	0F9F	output range underrun	3.999 mA
-1.250 %	3800	0ED8		3.800 mA
-2.500 %	3600	0E10		3.600 mA
-2.506 %	3599	0E0F	DIA Value below Lower limit ON at 0E0F…0000	3.599 mA
-12.506 %	2000	07D0		2.000 mA
-12.505 %	< 1999	07CF		1.999 mA
-24.994 %	1	0001		0.001 mA
-25.000 %	0	0000		0.000 mA

11 Relay Modules

11.1 Load limit curve with resistive load

At 1 000 switching cycles, no sustained arcs with a burning life > 10 ms may occur.

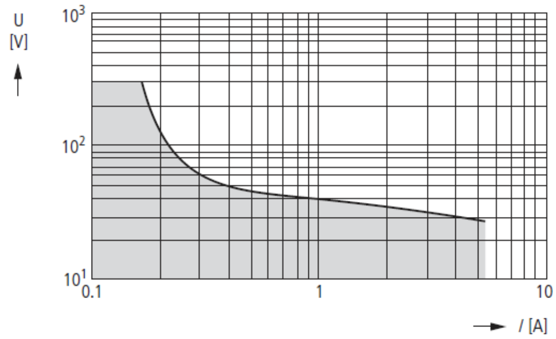


Fig. 225: Definition of load limit curve

ATTENTION

Switching of too high loads/power

Destruction of contacts

➤ Observe the devices' load limit curve.

11.2 Module overview

Module	Function
BL20-2DO-R-NC	normally closed contact
BL20-2DO-R-NO	normally open contact
BL20-2DO-R-CO	change over contact

11.3 Relay module, 2 normally closed contacts

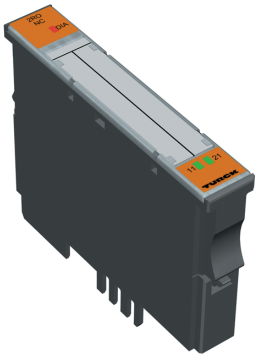


Fig. 226: BL20-2DO-R-NC

o

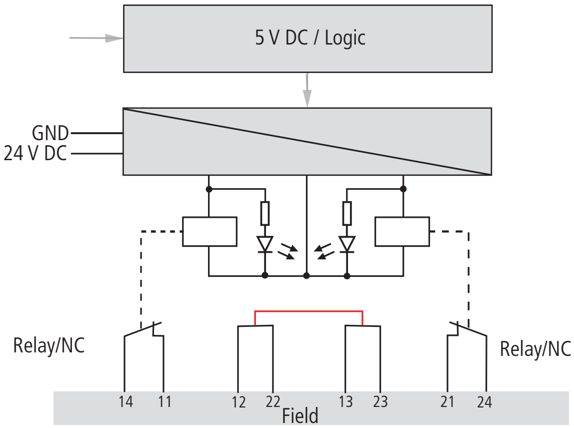


Fig. 227: Block diagram with base module BL20-S4x-SBBS

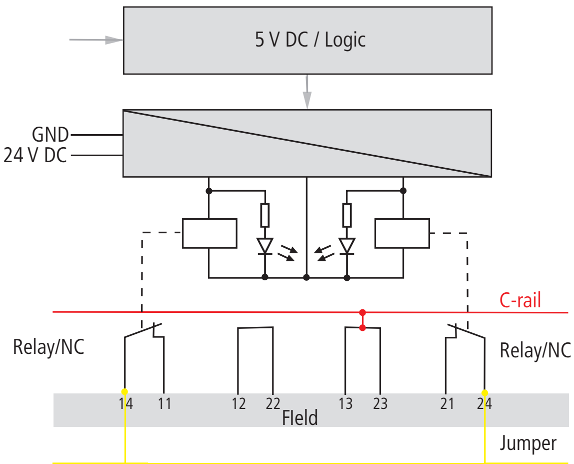


Fig. 228: Block diagram with base module BL20-S4x-SBCS

11.3.1 Technical data

Technical data	
Designation	BL20-2DO-R-NC
Number of channels	2 normally closed contacts
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 20 mA
Nominal current from module bus I_{MB}	≤ 28mA
Power loss of the module, typical	< 1 W
Resistive, inductive and lamp loads can be connected	
Application category as per AC15 / DC13	
Switching voltage (to supply the actuators)	
Nominal load voltage	230 VAC/30 VDC
Switching current (to supply the actuators)	
Current for DC (purely resistive)	Load limit curve, s. S. 319
Nominal current (DC13) 24 VDC	1 A
Nominal current (AC15) 250 VDC	3 A
Minimum load current (≥ 12 VDC)	100 mA
Synchronization factor	100 %
Current and number of switching operations (operational life): AC15 - 250 VAC	1×10^5 at 2 A
	2×10^5 at 1 A
	4×10^5 at 0.5 A
Current and number of switching operations (operational life): DC13 - 24 VDC	2×10^5 at 1 A
	$> 5 \times 10^5$ at 0,5 A
Switching frequency	
Resistive load	< 0.1 Hz
Inductive load	< 0.1 Hz
Lamp load	< 0.1 Hz
Isolation voltage	
Relay output to relay output	no
Relay output to module bus	1.5 kV_{eff}
Relay output to field voltage cable	1.5 kV_{eff}
Module bus to field voltage cable	500 V_{eff}

11.3.2 Base modules

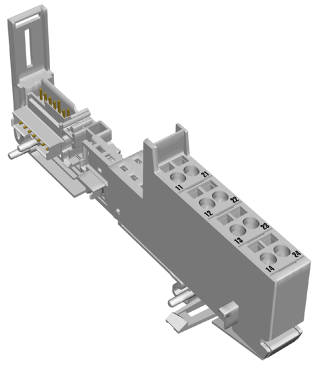


Fig. 229: Base module BL20-S4T-SBBS

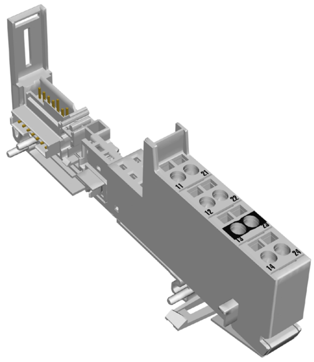


Fig. 230: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S4T-SBBS
  BL20-S4T-SBCS
- with screw connection
  BL20-S4S-SBBS
  BL20-S4S-SBCS

11.3.3 Wiring diagram

1. The potential free contacts 11 and 14 or 21 and 24 can be used directly.
2. In addition to that, the following wiring diagrams show different possibilities for a common power supply of the connected loads.

With externally connected supply and cross-connected root:

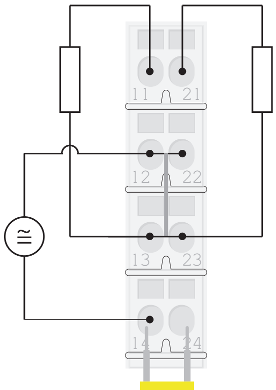
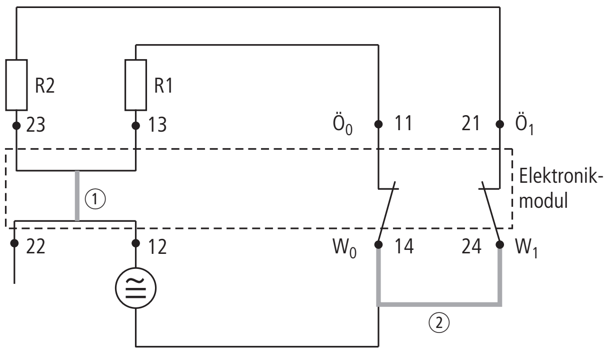


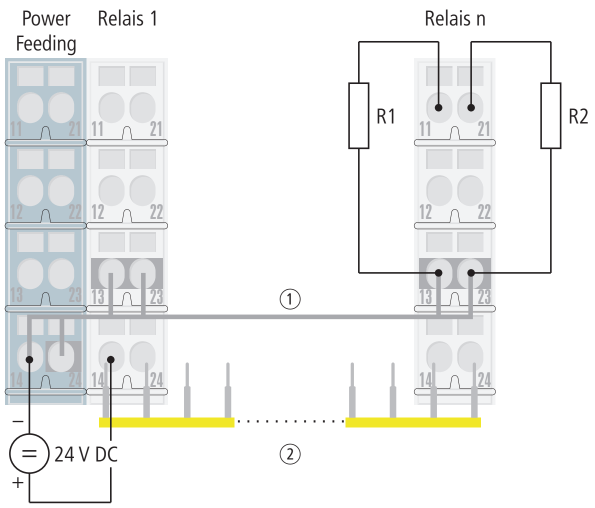
Fig. 231: Wiring diagram BL20-S4x-SBBS



① bridged in the electronics
②cross-connection via jumper in the base module

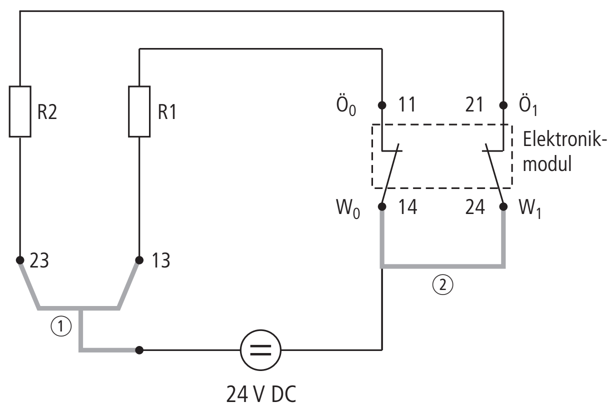
Fig. 232: Block diagram BL20-S4x-SBBS

With supply via C-rail and cross-connected root:



① Supply via C-rail (-)
② Max.. 8 relay modules (+)

Fig. 233: Wiring diagram BL20-S4x-SBCS



① C-rail
② cross-connection via jumper in the base module

Fig. 234: Block diagram BL20-S4x-SBCS

WARNING

Dangerous electrical voltage

Acute danger to life due to electric shock!

➤ It is only permitted to load the C-rail with a maximum of 24 V, not with 230 V!

NOTE

Contact designations used for base modules are not designations of relay contacts according to DIN.

11.3.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

11.3.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

11.4 Relay module, 2 normally open contacts

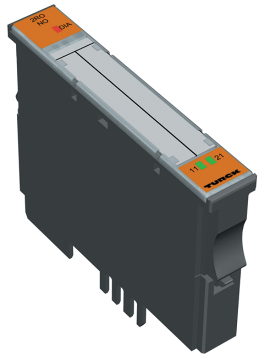


Fig. 235: BL20-2DO-R-NO

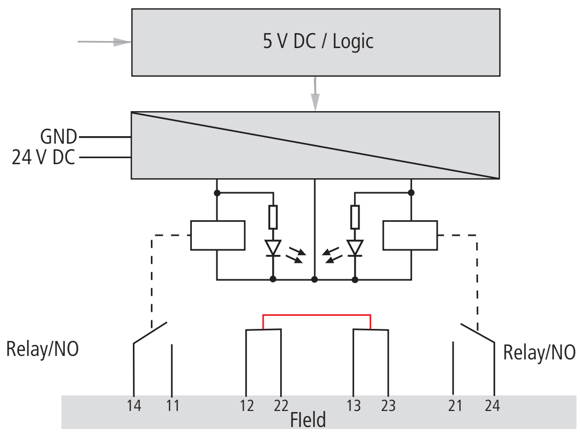


Fig. 236: Block diagram with base module BL20-S4x-SBBS

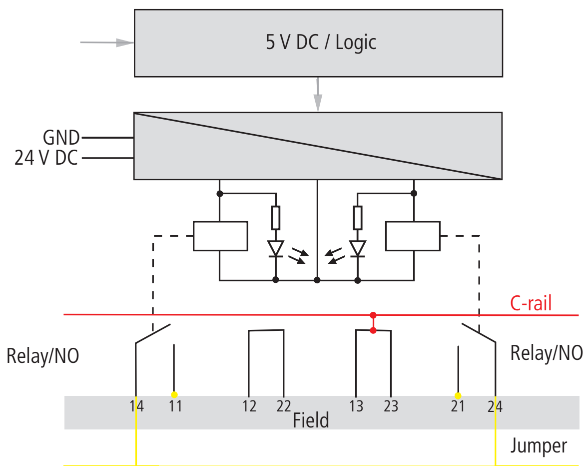


Fig. 237: Block diagram with base module BL20-S4x-SBCS

11.4.1 Technical data

Technical data	
Designation	BL20-2DO-R-NO
Number of channels	2 normally open contacts
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 20 mA
Nominal current from module bus I_{MB}	≤ 28mA
Power loss of the module, typical	< 1 W
Resistive, inductive and lamp loads can be connected	
Application category as per AC15 / DC13	
Switching voltage (to supply the actuators)	
Nominal load voltage	230 VAC/30 VDC
Switching current (to supply the actuators)	
Current for DC (purely resistive)	Load limit curve, s. S. 319
Nominal current (DC13) 24 VDC	1 A
Nominal current (AC15) 250 VDC	3 A
Minimum load current (≥ 12 VDC)	100 mA
Synchronization factor	100 %
Current and number of switching operations (operational life): AC15 - 250 VAC	1×10^5 at 2 A
	2×10^5 at 1 A
	4×10^5 at 0.5 A
Current and number of switching operations (operational life): DC13 - 24 VDC	2×10^5 at 1 A
	$> 5 \times 10^5$ at 0,5 A
Switching frequency	
Resistive load	< 0.1 Hz
Inductive load	< 0.1 Hz
Lamp load	< 0.1 Hz
Isolation voltage	
Relay output to relay output	no
Relay output to module bus	1.5 kV_{eff}
Relay output to field voltage cable	1.5 kV_{eff}
Module bus to field voltage cable	500 V_{eff}

11.4.2 Base modules

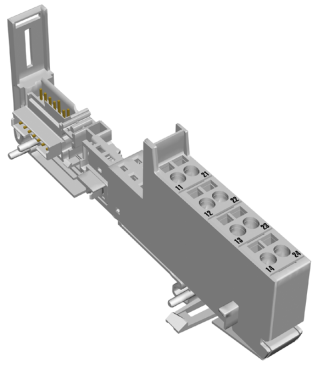


Fig. 238: Base module BL20-S4T-SBBS

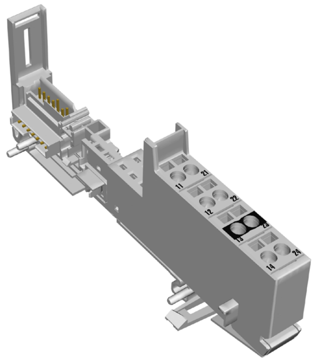


Fig. 239: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S4T-SBBS
  BL20-S4T-SBCS
- with screw connection
  BL20-S4S-SBBS
  BL20-S4S-SBCS

11.4.3 Wiring diagram

The potential free contacts 11 and 14 or 21 and 24 can be used directly.

In addition to that, the following wiring diagrams show different possibilities for a common power supply of the connected loads.

With supply via C-rail and cross-connected root:

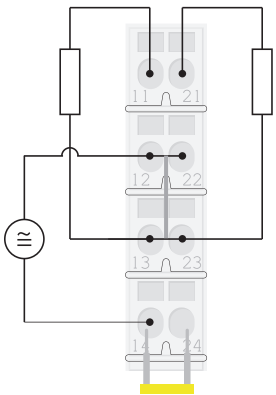
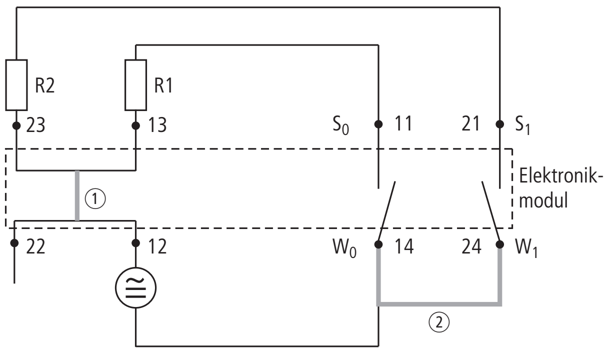


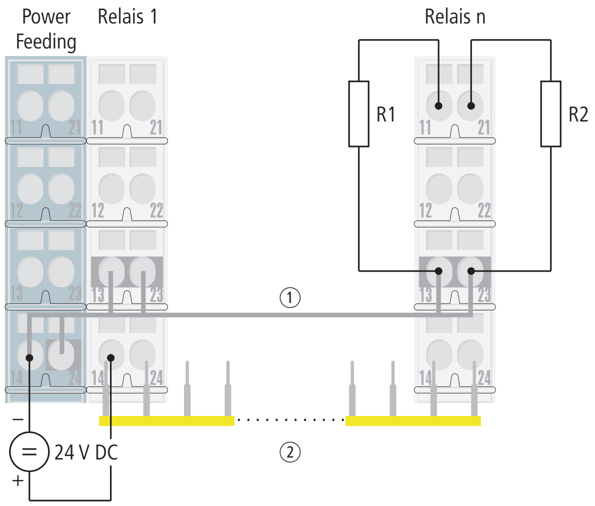
Fig. 240: Wiring diagram BL20-S4x-SBBS



① bridged in the electronics
② cross-connection via jumper in the base module

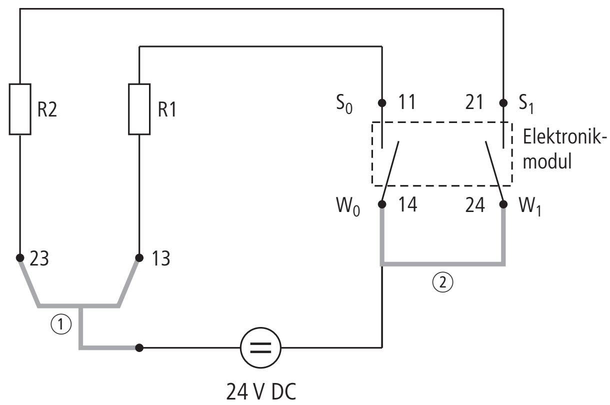
Fig. 241: Block diagram BL20-S4x-SBBS

With supply via C-rail and cross-connected root:



① Supply via C-rail
② Max. 8 relay modules

Fig. 242: Wiring diagram BL20-S4x-SBCS



① C-rail
② cross-connection via jumper in the base module

Fig. 243: Block diagram BL20-S4x-SBCS

WARNING

Dangerous electrical voltage

Acute danger to life due to electric shock!

➤ It is only permitted to load the C-rail with a maximum of 24 V, not with 230 V!

NOTE

Contact designations used for base modules are not designations of relay contacts according to DIN.

11.4.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

11.4.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

11.5 Relay module, 2 change over contacts

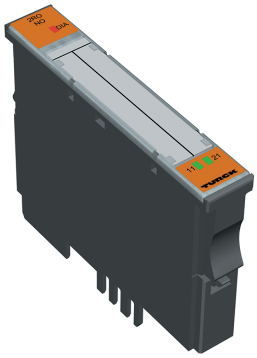


Fig. 244: BL20-2DO-R-CO

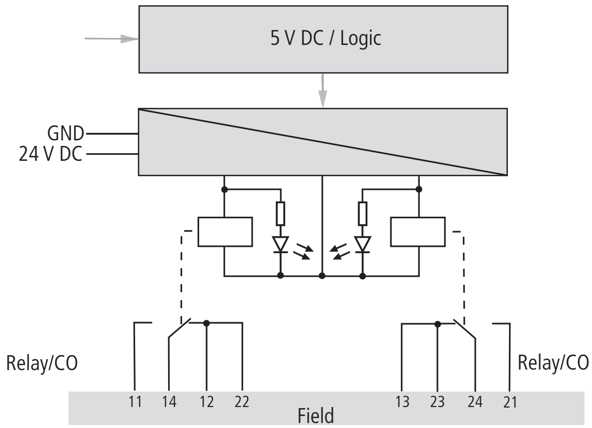


Fig. 245: Block diagram with base module BL20-S4x-SBBS

11.5.1 Technical data

Technical data	
Designation	BL20-2DO-R-CO
Number of channels	2 change over contacts
Nominal voltage from supply terminal	24 VDC
Nominal current from supply terminal I_L	< 20 mA
Nominal current from module bus I_{MB}	≤ 28mA
Power loss of the module, typical	< 1 W
Resistive, inductive and lamp loads can be connected	
Application category as per AC15 / DC13	
Switching voltage (to supply the actuators)	
Nominal load voltage	230 VAC/30 VDC
Switching current (to supply the actuators)	
Current for DC (purely resistive)	Load limit curve, s. S. 319
Nominal current (DC13) 24 VDC	1 A
Nominal current (AC15) 250 VDC	3 A
Minimum load current (≥ 12 VDC)	100 mA
Synchronization factor	100 %
Current and number of switching operations (operational life): AC15 - 250 VAC	1×10^5 at 2 A
	2×10^5 at 1 A
	4×10^5 at 0.5 A
Current and number of switching operations (operational life): DC13 - 24 VDC	2×10^5 at 1 A
	$> 5 \times 10^5$ at 0,5 A
Switching frequency	
Resistive load	< 0.1 Hz
Inductive load	< 0.1 Hz
Lamp load	< 0.1 Hz
Isolation voltage	
Relay output to relay output	no
Relay output to module bus	1.5 kV_{eff}
Relay output to field voltage cable	1.5 kV_{eff}
Module bus to field voltage cable	500 V_{eff}

11.5.2 Base modules

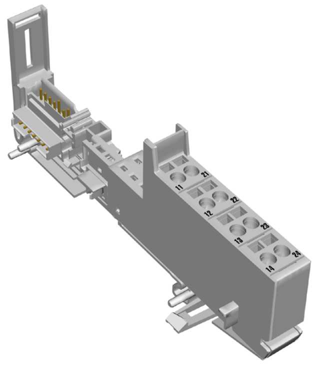


Fig. 246: Base module BL20-S4T-SBBS

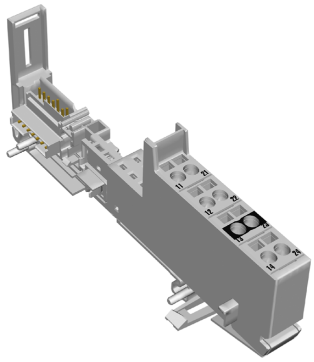


Fig. 247: Base module BL20-S4T-SBCS

- with tension clamp connection
  BL20-S4T-SBBS
- with screw connection
  BL20-S4S-SBBS

11.5.3 Wiring diagram

The potential free contacts 11/12 and 14 or 21/23 and 24 can be used directly.

In addition to that, the following wiring diagrams show different possibilities for a common power supply of the connected loads.

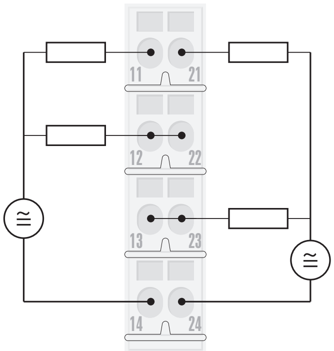


Fig. 248: Wiring diagram BL20-S4x-SBBS

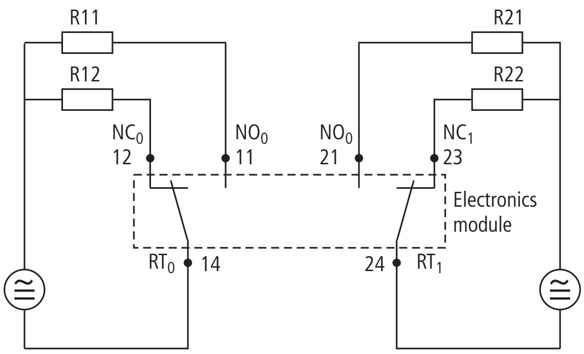


Fig. 249: Block diagram BL20-S4x-SBBS

NOTE
Contact designations used for base modules are not designations of relay contacts according to DIN.

11.5.4 Process data mapping

Data	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	-	-	-	-	-	-	DO2	DO1

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Process data	Value	Meaning
DOx	0	Digital output inactive
	1	Digital output active

11.5.5 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
11	Green	Status channel 1 = 1	
	Off	Status channel 1 = 0	
21	Green	Status channel 2 = 1	
	Off	Status channel 2 = 0	

12 Technology Modules

12.1 Counter module – BL20-1CNT-24VDC

12.1.1 Technical features

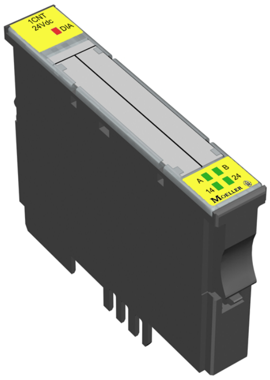


Fig. 250: BL20-1CNT-24VDC

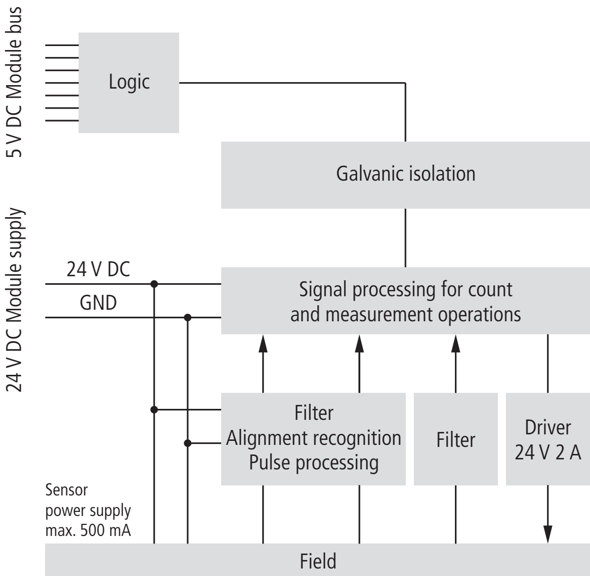


Fig. 251: Block Diagram

Technical data

Technical data	
Designation	BL20-1CNT-24VDC
Number of channels	1
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal I_L	< 50 mA (if load current = 0)
Nominal current from module bus I_{MB}	< 40 mA
Power loss of the module, typical	< 1,3 W
Sensor supply	
Output voltage	L+ (-0,8 V)
Output current	≤0.5 A, short-circuit-proof
Counter signals and digital input	
Input voltage at nominal value 24 VDC	
Low level U_{LOW}	-30…5 VDC
High level U_{LOW}	11…30 VDC
Input current	
Low level I_{LOW}	-8…1.5 mA
High level I_{HIGH}	2…10 mA
Input delay	≤ 200 ms
Minimum pulse width (maximum counter frequency)	
Filter on	≥ 25 ms (20 kHz)
Filter off	≥ 2.5 ms (200 kHz)
Digital output	
Input voltage at nominal value 24 VDC	
Low level U_{LOW}	≤ 3 VDC
High level U_{HIGH}	≥ L+ (-1 VDC)
Output current	
High level I_{HIGH} (permissible range)	5…2 A
High level I_{HIGH} (nominal value)	0,5 A (55 °C)
Switching frequency	
with resistive load	100 Hz
with inductive load	2 Hz
with lamp load	10 Hz
Lamp load R_{LL}	≤ 10 W

Technical data	
Output delay (resistive load)	100 µs
Short-circuit proof	Yes
Response threshold	2.6…4 mA
Inductive suppression	L+ -(50…60 V)
Measurement ranges	
Frequency measurement	0.1…200 kHz
Revolutions speed measurement	1 U/min.…25 000 U/min.
Period duration measurement	5…120 s
Count modes	
Signal evaluation (A,B)	pulse and direction rotary sensor, single rotary sensor, double rotary sensor, fourfold
Counter mode	Continuous count Single count Periodical count
Hysteresis	0…255
Pulse duration	0…255
synchronization	single-action periodical
Count limits	
Upper count limit	0…7FFF FFFF
Lower count limit	8000 0000…0
Measurement ranges	
Signal evaluation (A,B)	pulse and direction rotary sensor: single

12.1.2 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red, flashing 0.5 Hz	Parameter error	Check parameterization of the module.
	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. Check the supply of the module bus.
	Off	No error messages or diagnostics	–
A	Green	Counter input or measuring input active	-
	Off	Counter input or measuring input inactive	-
B	Green	Counter input inactive or direction input set for counting down	-
	Off	Counter input active or direction input set for counting up	-
14	Green	Status of digital input = 1	-
	Off	Status of digital input = 0	-
24	Red	Error on digital output	Check the wiring of the digital output.
	Green	Status of digital output = 1	-
	Off	Status of digital output = 0	-

Diagnostics

Count mode	Measurement mode	Assignment (byte, bit)
short-/open circuit ERR_DO		0.0
Short-circuit sensor supply ERR-24 VDC		0.1
End of counter range wrong	Sensor pulse wrong	0.2
Start of counter range wrong	Integration time wrong	0.3
Invert-DI at L-retr. error It is not permitted to invert the level of the digital input when using the latch-retrigger-function	Upper limit wrong	0.4
Main count direction wrong	Lower limit wrong	0.5

Count mode	Measurement mode	Assignment (byte, bit)
Operating mode wrong		0.6
Operation mode = 0	Operation mode = 1 Bit 7 = 1 (measuring mode) is only displayed if one other diagnostic bit is set	0.7

12.1.3 Base modules

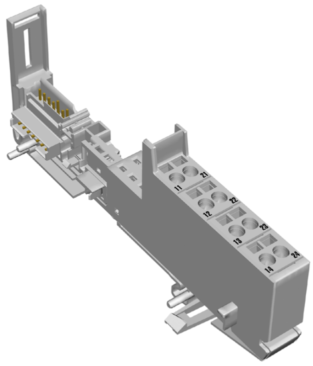


Fig. 252: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S4T-SBBS
- with screw connection
  BL20-S4S-SBBS

12.1.4 Wiring diagram

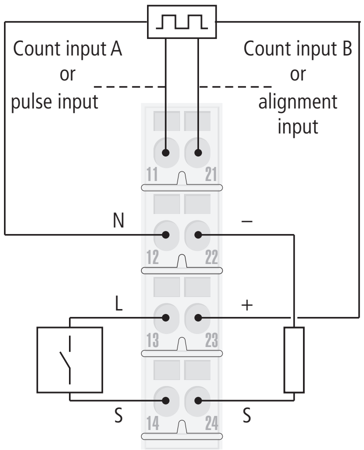


Fig. 253: Wiring diagram BL20-S4x-SBBS

Connection options for pulse generators

	Connector	Count direction
Pulse generator without direction indicator	24 VDC count pulses at terminal 11	Up
Pulse generator with direction signal	24 VDC count pulses at terminal 11 and 24 V DC direction at terminal 21	Up, down
Pulse generator with 2 90° offset spur lines	Channel A at terminal 11 and channel B at terminal 21	Up, down

12.1.5 Operation modes

The BL20 counter module offers the connection of a pulse generator for measuring 24 VDC signals (11…30 VDC), up to a frequency of 200 kHz.

Moreover, the module provides the sensor with 24 VDC.

The electronics module supports the following operating modes:

Count modes:

- Continuous count
- Single count
- Periodical count

Measurement modes:

- Frequency measurement
- Revolutions speed measurement
- Period duration measurement

Each of the operating modes have individual parameters assigned to them. The relevant parameter lists are specified in more detail in the descriptions of the integration in the fieldbus systems.

The counter module is provided with a digital output that is used for direct control of the process or for indicating comparison results.

The digital input of the counter module is used for initiating the hardware release signal, the synchronization or latch and retrigger function.

The BL20 counter module can process signals generated from the following sensors:

- 24 VDC pulse generator with direction signal
- 24 VDC pulse generator without direction signal
- 24 VDC pulse generator with two 90° offset channels (rotary sensor)

12.1.6 Selecting counter or measurement mode

Profibus-DP:

The GSD file provides 2 module codes the BL20-1CNT-24VDC modules.

For count mode select modules with code C

For measurement mode select modules with code M.

DeviceNet:

The attribute no. 113 must be written first and determines the operating mode.

The write operation to attribute no. 113 resets all other attributes to the default values!

CANopen:

Object 5800hex controls the operating mode parameters of the BL20 counter module. Its use includes the setting of count mode or measurement mode.

12.1.7 Count mode

Count mode - process data mapping

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Count mode - process input data

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	n + 7	counter value							
	n + 1	n + 6								
	n + 2	n + 5								
	n + 3	n + 4								
Diag-nostics	n + 4	n + 3	ERR_ 24Vdc	ERR_ DO	ERR_ PARA	res.	res.	RES_ STS_A	ERR_ LOAD	STS_ LOAD
Status	n + 5	n + 2	STS_ DN	STS_ UP	res.	STS_ DO2	STS_ DO1	res.	STS_ DI	STS_ GATE
	n + 6	n + 1	STS_ ND	STS_ UFLW	STS_ OFLW	STS_ CMP2	STS_ CMP1	reserved		STS_ SYN
	n + 7	n	reserved							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Bit	Description
ERR_24Vdc	Short-circuit sensor supply: This diagnostics information must be acknowledged with the EXTF_ACK (process output) control bit.
ERR_DO	Short-/open circuit/excess temperature at the output DO1 This diagnostics information must be acknowledged with the EXTF_ACK (process output) control bit.
ERR_PARA	– 1: There is a parameter error. ERR_PARA is a group diagnostics bit. With the separate diagnostics message bits 3…6 describe the parameter errors in more detail. – 0: The parameter definition is correct as per specification.
RES_STS_A	– 1 Resetting of status bits running. The last process output telegram contained: RES_STS = 1. – 0: The last process output telegram contained: RES_STS = 0.
ERR_LOAD	– 1: Error with load function Control bits LOAD_DO_PARAM, LOAD_CMP_VAL2, LOAD_CMP_VAL1, LOAD_PREPARE and LOAD_VAL must not be set at the same time during the transfer. An incorrect value was transferred with the control bits. Example: Values above the upper count limit or below the lower count limit were selected for "Load value direct" or "Load value in preparation".
STS_LOAD	Status of load function is set, if the Load function is running.
STS_DN	1: Status direction down.

Bit	Description
STS_UP	1: Status direction up.
STS_DO2	The DO2 status bit indicates the status of digital output DO2.
STS_DO1	The DO1 status bit indicates the status of digital output DO1.
STS_DI	The DI status bit indicates the status of digital input DI.
STS_GATE	1: Counting operation running.
STS_ND	Status zero crossing Set on crossing zero in counter range when counting without main direction. This bit must be reset by the RES_STS control bit.
STS_UFLW	Status lower count limit Set if the count value goes below the lower count limit. This bit must be reset by the RES_STS control bit.
STS_OFLW	Status upper count limit Set if the counter goes above the upper count limit. This bit must be reset by the RES_STS control bit.
STS_CMP2	Status comparator 2 This status bit indicates a comparison result for comparator 2 if: the output DO2 is released with CTRL_DO2 = 1 and a comparison is run via MODE_DO2 = 01, 10 or 11: Otherwise STS_CMP2 simply indicates that the output is or was set. STS_CMP2 is also set if DO1 SET_DO2 = 1 when the output is not released. This bit must be reset by the RES_STS control bit.
STS_CMP1	Status comparator 1 This status bit indicates a comparison result for comparator 2 if: the output DO1 is released with CTRL_DO1 = 1 and a comparison is run via MODE_DO1 = 01, 10 or 11. Otherwise STS_CMP2 simply indicates that the output is or was set. STS_CMP2 is also set if DO1 SET_DO2 = 1 when the output is not released. This bit must be reset by the RES_STS control bit.
STS_SYN	Status synchronization After synchronization is successfully completed the STS_SYN status bit is set. This bit must be reset by the RES_STS control bit. This bit must be reset by the RES_STS control bit.

Count mode - process output data

The structure of the process output data depends on the module's parameterization.

1 Process output data with parameter values for:
Load value direct or
Load value in preparation or
Reference value 1 or
Reference value 2

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	m + 7	Load value direct Load value in preparation, Reference value 1 Reference value 2 (depending on the parameterization)							
	m + 1	m + 6								
	m + 2	m + 5								
	m + 3	m + 4								
Con-trol	m + 4	m + 3	EXTF_ ACK	CTRL_ DO2	SET_ DO2	CTRL_ DO1	SET_ DO1	RES_ STS	CTRL_ SYN	SW_ GATE
	m + 5	m + 2	reserved			LOAD_ PRE-PARE	LOAD_ VAL	LOAD_ DO_ PARAM	LOAD_ CMP_ VAL2	LOAD_ CMP_ VAL1
	m + 6	m + 1	reserved							
	m + 7	m								

2 Process output data with parameter values for:
Function and behavior of DO1/DO2

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	m + 7	reserved		MODE_DO2		reserved		MODE_DO1	
	m + 1	m + 6	Hysteresis value							
	m + 2	m + 5	Pulse duration							
	m + 3	m + 4	reserved							
Con-trol	m + 4	m + 3	EXTF_ ACK	CTRL_ DO2	SET_ DO2	CTRL_ DO1	SET_ DO1	RES_ STS	CTRL_ SYN	SW_ GATE
	m + 5	m + 2				LOAD _ DO_ PARA M	LOAD _ CMP_ VAL2	LOAD _ CMP_ VAL1	LOAD _ PRE-PARE	LOAD _ VAL
	m + 6	m + 1	reserved							
	m + 7	m								

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

NOTE

Unlike the physical digital output DO1, output DO2 is only a data value that is indicated with the data bit STS_DO2 of the process input.

Bit	Description
MODE_DO2	MODE_DO2 is only valid, if LOAD_DO_PARAM: 0 A 1. The virtual output DO2 can show the status of the data bit SET_DO2 or comparison results if CTRL_DO2 = 1. MODE_DO2 defines which function DO2 is to accept: – 00: The output DO2 shows the status of the control bit SET_DO2. This must be released with CTRL_DO2 = 1. – 01: Output DO2 indicates: Counter status ≥ reference value 2 – 10: Output DO2 indicates: Counter status ≤ reference value 2 – 11: Output DO2 indicates: Counter status = reference value 2 A pulse is generated for indicating equal values. The pulse duration is defined by byte 2 of this process output.
MODE_DO1	MODE_DO1 is only valid, if LOAD_DO_PARAM: “0” → “1“. The physical output DO1 can show the status of the data bit SET_DO1 or comparison results if CTRL_DO1 = 1. MODE_-DO1 defines which function DO1 is to accept: – 00: The output DO1 shows the status of the control bit SET_DO1. This must be released with CTRL_DO1 = 1. – 01: Output DO1 indicates: Counter status ≥ reference value 1 – 10: Output DO1 indicates: Counter status ≤ reference value 1 – 11: Output DO1 indicates: Counter status = reference value 1 A pulse is generated for indicating equal values. The pulse duration is defined by byte 2 of this process output.
Hysteresis value	0…255) The reference value 1/2 can be assigned a hysteresis value in order to generate a response at DO1/DO2 with hysteresis. This will prevent the excessive on and off switching of DO1/DO2 if the count value fluctuates too quickly around the reference value.
Pulse duration	(0…255) unit: ms The reference value 1/2 can be assigned a hysteresis value in order to generate a response at DO1/DO2 with hysteresis. This will prevent the excessive on and off switching of DO1/DO2 if the count value fluctuates too quickly around the reference value.
EXTF_ ACK	Error acknowledgment The error bits must be acknowledged with the control bit EXTF_ACK after the cause of the fault has been rectified. This control bit must then be reset again. Any new error messages are not set while the EXTF_ACK control bit is set!
CTRL_ DO2	0: The virtual output DO2 is blocked.
	1: The virtual output DO2 is enabled.
SET_ DO2	If CTRL_DO2 = 1 and the virtual output DO2 is set to indicate the value SET_DO2, DO2 can be set and reset directly with SET_DO2. DO2 can be set for this function via the process output (MODE_DO2 = 00 and LOAD_DO_PARAM 0→ 1). The output DO2 can also be set before commissioning via the separate parameter data. The default setting for DO2 is to indicate the status of SET_DO2.The output DOx can also be set before commissioning via the separate parameter data. The default setting for DO2 is to display the value of SET_DO2.
CTRL_DO1	0: The output DO1 is blocked.
	1: The output DO1 is released.

Bit	Description
SET_DO1	If CTRL_DO1 = 1 and the physical output DO1 is set to indicate the value SET_DO1, DO1 can be set and reset directly with SET_DO1. DO1 can be set for this function via the process output (MODE_DO1 = 00 and LOAD_DO_PARAM 0 → "1"). The output DO1 can also be set before commissioning via the separate parameter data. The default setting for DO1 is to indicate the status of SET_DO1.
RES_STS	"0"→ "1" Initiate resetting of status bits. Status bits STS_ND, STS_UFLW, STS_OFLW, STS_CMP2, STS_CMP1, STS_SYN (process input) are reset. Bit RES_STS_A = 1 (process input) acknowledges that the reset command has been received. RES_STS can now be reset to 0.
CTRL_SYN	Release synchronization: 1: "0" → 1" (rising edge) at the physical DI input enables the counter value to be set (synchronized) once/periodically to the load value.
SW_GATE	"0" → "1": Counting is started (release). "1" → "0": Counting is stopped. The starting and stopping of the counting operation with a data bit is implemented with a so-called "SW gate". The HW gate is also provided in addition for stopping and starting the counting operation via the DI hardware input. If this function is configured a positive signal must be present at this input in order to activate the SW gate (AND logic operation).
LOAD_ DO_PARAM	Parameter definition of the DO1 physical output and the virtual output DO2. "0" → "1": DO1 and DO2 can indicate the status of data bit SET_DO1 and SET_DO2 or comparison results. The latest telegram (MODE_DO1 and MODE_DO2) indicates the function required for DO1 and DO2.
LOAD_ CMP_VAL2	Parameter definition of reference value 2 "0" → "1": The value in bytes 0…3 is accepted as a reference value 2.

Count mode - parameters

Standard						
byte-oriented		word-oriented		PROFIBUS PROFINET		Parameter
Byte 0	Bit 0	Word 0	Bit 0	Byte 15	Bit 0	Counter mode
Byte 0	Bit 1	Word 0	Bit 1	Byte 15	Bit 1	Counter mode
Byte 0	Bit 2	Word 0	Bit 2	Byte 15	Bit 2	Counter mode
Byte 0	Bit 3	Word 0	Bit 3	Byte 15	Bit 3	Counter mode
Byte 0	Bit 4	Word 0	Bit 4	Byte 15	Bit 4	Counter mode
Byte 0	Bit 5	Word 0	Bit 5	Byte 15	Bit 5	Counter mode
Byte 0	Bit 6	Word 0	Bit 6	Byte 15	Bit 6	reserved
Byte 0	Bit 7	Word 0	Bit 7	Byte 15	Bit 7	reserved
Byte 1	Bit 0	Word 0	Bit 8	Byte 14	Bit 0	Gate function
Byte 1	Bit 1	Word 0	Bit 9	Byte 14	Bit 1	Digital input DI
Byte 1	Bit 2	Word 0	Bit 10	Byte 14	Bit 2	Function DI
Byte 1	Bit 3	Word 0	Bit 11	Byte 14	Bit 3	Function DI
Byte 1	Bit 4	Word 0	Bit 12	Byte 14	Bit 4	synchronization
Byte 1	Bit 5	Word 0	Bit 13	Byte 14	Bit 5	Main count direction
Byte 1	Bit 6	Word 0	Bit 14	Byte 14	Bit 6	Main count direction
Byte 1	Bit 7	Word 0	Bit 15	Byte 14	Bit 7	

Standard byte-oriented		word-oriented		PROFIBUS PROFINET		Parameter
	Bit 0		Bit 0		Bit 0	Lower count limit (HWORD)
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 2	Bit 7		Bit 7	Byte 13	Bit 7	
	Bit 0		Bit 0		Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 3	Bit 7	Word 1	Bit 7	Byte 12	Bit 7	
	Bit 0		Bit 8		Bit 0	
	Bit 1		Bit 9		Bit 1	Lower count limit (LWORD)
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
Byte 4	Bit 7		Bit 15	Byte 11	Bit 7	
	Bit 0		Bit 0		Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 5	Bit 7	Word 2	Bit 7	Byte 10	Bit 7	

Standard						
byte-oriented		word-oriented		PROFIBUS PROFINET		Parameter
	Bit 0		Bit 0		Bit 0	Upper count limit (HWORD)
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 6	Bit 7		Bit 7	Byte 9	Bit 7	
	Bit 0		Bit 8		Bit 0	
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
Byte 7	Bit 7	Word 3	Bit 15	Byte 8	Bit 7	
	Bit 0		Bit 0		Bit 0	Upper count limit (LWORD)
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 8	Bit 7		Bit 7	Byte 7	Bit 7	
	Bit 0		Bit 0		Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 9	Bit 7	Word 4	Bit 7	Byte 6	Bit 7	

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameter
Byte 10	Bit 0	Word 5	Bit 8	Byte 5	Bit 0	Hysteresis
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	
Byte 11	Bit 0		Bit 0	Byte 4	Bit 0	Pulse duration DO1, DO2 [n*2ms]
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 12	Bit 0	Word 6	Bit 0	Byte 3	Bit 0	Substitute value DO
	Bit 1		Bit 1		Bit 1	Diagnostic DO1
	Bit 2		Bit 2		Bit 2	Function DO1
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	reserved
	Bit 5		Bit 5		Bit 5	Function DO2
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	reserved
Byte 13	Bit 0		Bit 0	Byte 2	Bit 0	Signal evaluation (A, B)
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	Sensor/ input filter (A)
	Bit 3		Bit 3		Bit 3	Sensor/ input filter (B)
	Bit 4		Bit 4		Bit 4	Sensor/ input filter (DI)
	Bit 5		Bit 5		Bit 5	sensor (A)
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	Direction input (B)

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameter
Byte 14	Bit 0	Word 7	Bit 0	Byte 1	Bit 0	Group diagnostics
	Bit 1		Bit 1		Bit 1	reserved
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	behavior CPU/ master stop
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	
Byte 15	Bit 0		Bit 0	Byte 0	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	

The default values are written in **bold**.

Parameters	settings
Counter mode	**100000 = continuous count** 100001 = single-action count 100010 = periodical count
Gate function	**0 = abort count procedure** 1 = interrupt count procedure
Digital input DI	**0 = normal** 1 = inverted
Function DI	**00 = input** 01 = HW gate 10 = Latch-Retrigger when edge pos. 11 = Synchronization when edge pos.
synchronization	**0 = single-action** 1 = periodical
Main count direction	**00 = none** 01 = up 10 = down
Lower count limit	-2 147 483 648 (-2^{31})…0

Parameters	settings
Lower count limit (HWORD)	**-32768**…0 (Signed16)
Lower count limit (LWORD)	-32 768…32 767 (Signed16); **0**
Upper count limit	0…+ 2147483647 (2^{31}-1)
Upper count limit (HWORD)	0…**32767** (Unsigned16)
Upper count limit (LWORD)	0…**65535** (Unsigned16)
Hysteresis	**0**…255 (Unsigned8)
Pulse duration DO1, DO2 [n*2ms]	**0**…255 (Unsigned8)
Substitute value DO	**0** 1
Diagnostic DO1	**0 = 1** 1 = off
Function DO1	**00 = output** 01 = on when cnt value >= ref. value 10 = on when cnt value <= ref. value 11 = pulse when cnt value = ref. value
Function DO2	**00 = output** 01 = on when cnt value >= ref. value 10 = on when cnt value <= ref. value 11 = pulse when cnt value = ref. value
Signal evaluation (A, B)	**00 = pulse and direction** 01 = rotary sensor: single 10 = rotary sensor: double 11 = rotary sensor: fourfold
Sensor/ input filter (A)	**0 = 2,5 µs (200 kHz)** 1 = 25 µs (20 kHz)
Sensor/ input filter (B)	**0 = 2,5 µs (200 kHz)** 1 = 25 µs (20 kHz)
Sensor/ input filter (DI)	**0 = 2,5 µs (200 kHz)** 1 = 25 µs (20 kHz)
sensor (A)	**0 = normal** 1 = inverted
Direction input (B)	**0 = normal** 1 = inverted
Group diagnostics	**0 = release** 1 = block
behavior CPU/ master stop	**00 = turn off DO1** 01 = proceed with operating mode 10 = DO1 switch to substitute value 11 = DO1 hold last value

Count modes

The count modes are used for supporting different counter applications such as the counting of bulk goods.

The following modes can be selected:

- Continuous counting, such as for positioning with 24 VDC incremental sensors
- Single-action counting, such as for counting units up to a maximum limit
- Periodical count, such as in applications with recurring count operations

Maximum count range

- The upper count limit is +2 147 483 647 (2^{31}-1)
- The lower count limit is -2 147 483 648 (-2^{31})

12.1.8 Main count direction

The main count direction determines the behavior of the counter when the set count limit is reached. On reaching a count limit, the count value "jumps" to a defined value. Three different values are possible:

- Lower limit
- Upper limit
- Load value

The following table shows which of the three values the counter accepts according to the main count direction set and the operating mode:

Mode		
Main count direction	**Upper count limit**	**Lower count limit**
– *Continuous count*		
none	Jump to lower limit	Jump to upper limit
Up	Jump to lower limit	Jump to upper limit
Down	Jump to lower limit	Jump to upper limit
– *Single count*		
none	Jump to lower limit	Jump to upper limit
Up	Jump to load value	Jump to upper limit
Down	Jump to lower limit	Jump to load value
– *Periodical count*		
none	Jump to load value	Jump to load value
Up	Jump to load value	Jump to upper limit
Down	Jump to lower limit	Jump to load value

Reset states with main count direction set for none/up counting

- Load value: 0
- Counter value0
- Reference value DO1:0
- Reference value DO2:0

Reset states with main count direction set for none/down counting

- Load value:upper limit
- Count value:upper limit
- Reference value 1:upper limit
- Reference value 2:upper limit

12.1.9 Limit values of count mode

Specific conditions must be fulfilled in order to ensure that internal and external events are processed correctly. The following sections describe the limit values for both types of events.

Minimum number of count pulses between internal events

A certain minimum number of count pulses must be ensured between the parameters when setting Upper count limit, Reference value and Lower limit value.

This ensures that internal operations are carried out before a new event occurs.

Illustration of the minimum number of count pulses between two events in relation to the counter frequency:

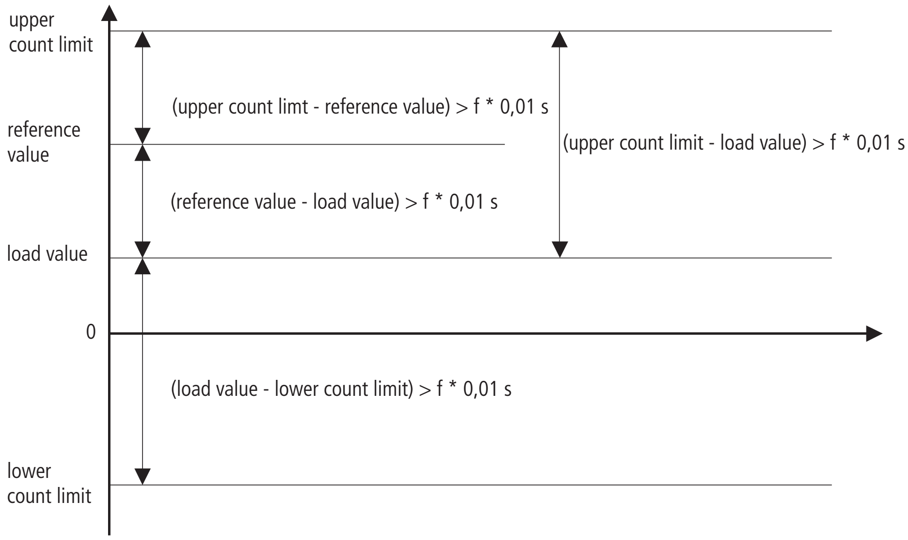


Fig. 254: Limit values of count mode

f = Counter frequency in Hz

Counter frequency	Minimum number of count pulses at different count frequencies
200 kHz	2000 pulses
100 kHz	1000 pulses
50 kHz	500 pulses
10 kHz	100 pulses
1 kHz	10 pulses

Time between direction signal (B) and counter signal (A)

On pulse generators with a direction signal, it must be ensured that there is a gap of at least 5 µs/ 50 µs between the direction signal (B) and the counter signal (A), depending on the input filter configured.

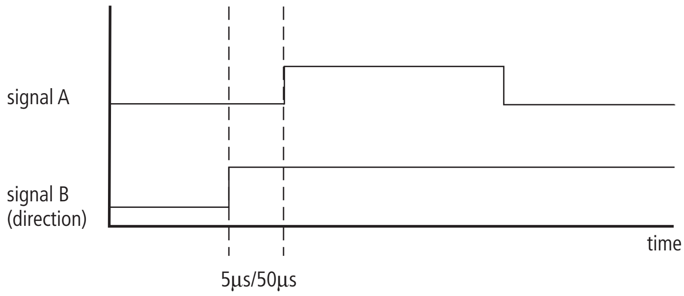


Fig. 255: Time between direction signal and counter signal

Continuous count

Definition

In this mode the counter module counts after the release signal from the load value continuously between the upper and lower limit.

- If the counter counts up and reaches the upper count limit, it will jump to the lower count limit when another counter signal is received, and will continue to count without signal loss from this point.
- If the counter counts down and reaches the lower count limit, it will jump to the upper count limit when another counter signal is received, and will continue to count without signal loss from this point.
- In this mode the function does not depend on the main count direction.

These settings are illustrated in the following diagram:

- Operating mode: continuous count
- Main count direction: none, up or down

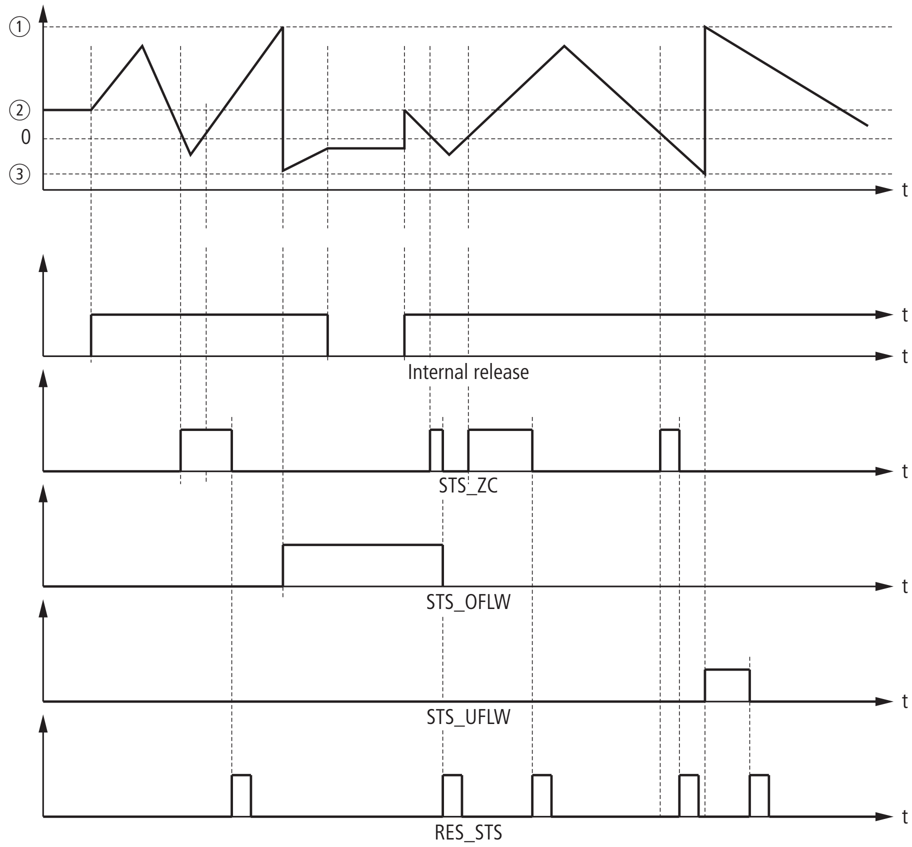


Fig. 256: Continuous counting with status bit

① Upper count limit

② Load value

③ Lower count limit

Single count

Definition

In this mode the counter module runs a single-action count after the release signal from the load value to the upper or lower limit value, depending on the main count direction set.

1 No main count direction
If the counter counts up and reaches the upper count limit, it will jump to the lower count limit when another counter signal is received. The internal release signal is automatically reset.
If the counter counts down and reaches the lower count limit, it will jump to the upper count limit when another counter signal is received. The internal release signal is automatically reset.

2 Main count direction up
If the counter counts up and reaches the upper count limit, it will jump to the load value when another counter signal is received. The internal release signal is automatically reset.
If the counter counts down and reaches the lower count limit, it will jump to the upper count limit when another counter signal is received. The internal release signal is automatically reset.

3 Main count direction down
If the counter counts up and reaches the upper count limit, it will jump to the lower count limit when another counter signal is received. The internal release signal is automatically reset.
f the counter counts down and reaches the lower count limit, it will jump to the load value when another counter signal is received. The internal release signal is automatically reset.

The internal release signal is automatically reset if the counter passes either the upper or lower limit values. A rising edge must be present in order for counting to be restarted. This occurs either by resetting and setting the hardware release signal (digital input if this is configured as HW gate), or by resetting and setting the software release (SW_GATE bit in the control interface/process output).

The following three diagrams show the counter's behavior in ”single-action count” mode with the three main count directions: none, up, down.

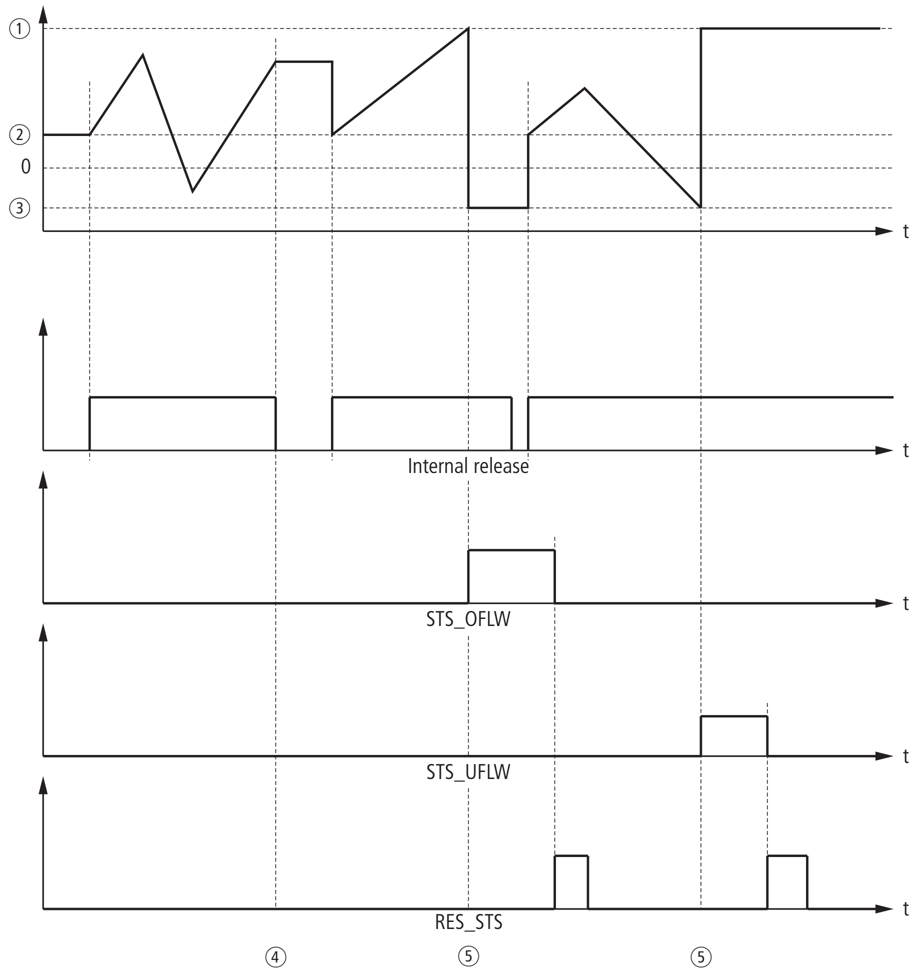


Fig. 257: Single count without main count direction

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, internal release

⑤ Release stop, automatic

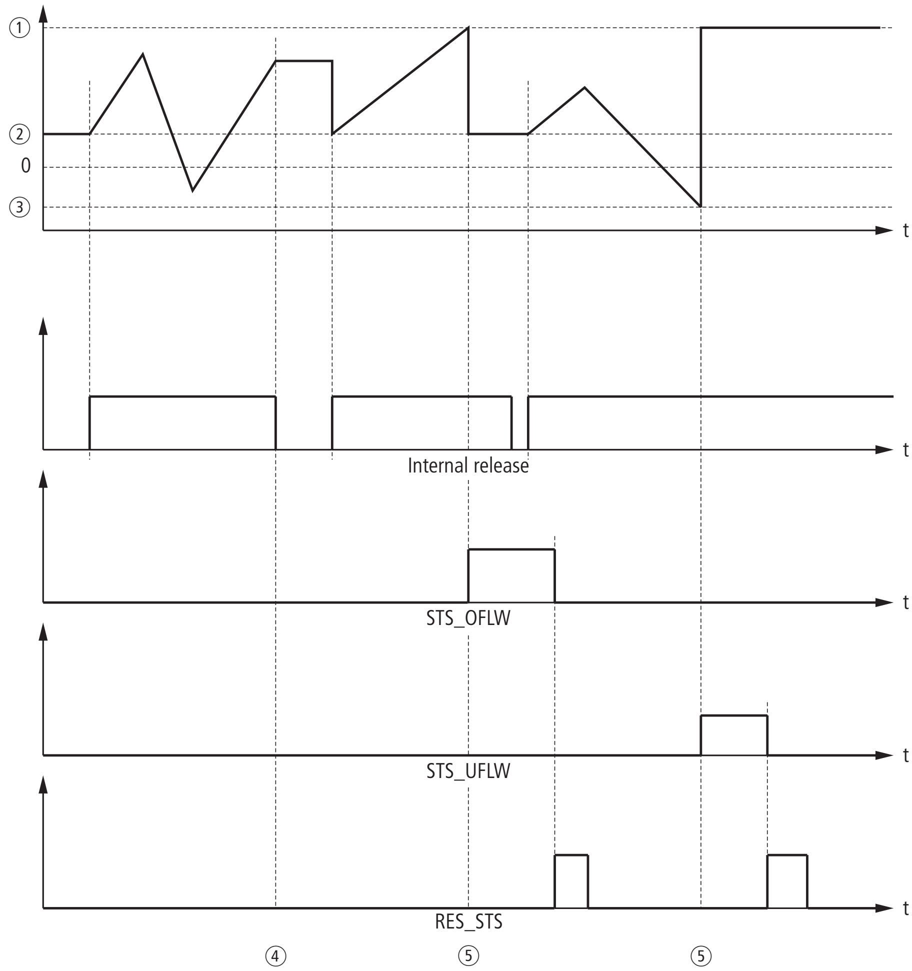


Fig. 258: Single count with main count direction down

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, internal release

⑤ Release stop, automatic

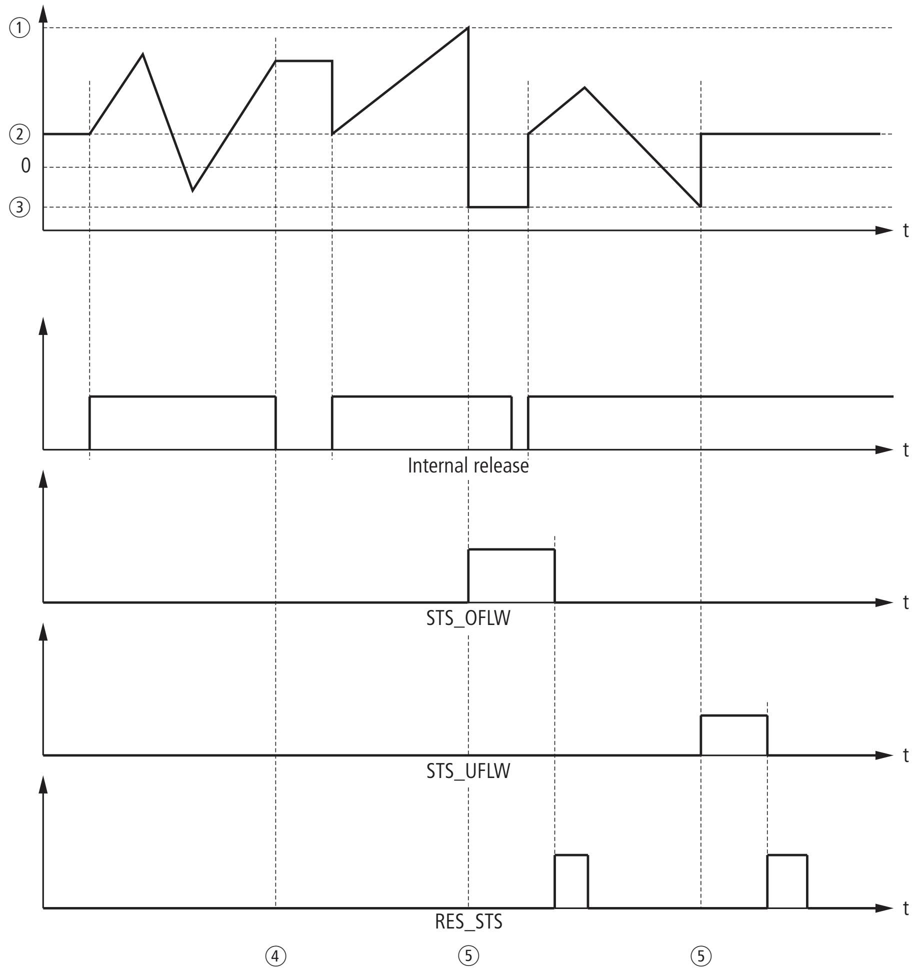


Fig. 259: Single count with main count direction down

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, internal release

⑤ Release stop, automatic

Periodical count

Definition

In this operating mode the electronic module counts periodically after the release signal is set within the defined counter range and in the defined main count direction:

1 No main count direction
If the counter counts up and reaches the upper or lower count limit, it will jump to the load value when another counter signal is received, and will continue to count from there without losing a signal.

2 Main count direction up
If the counter counts up and reaches the upper count limit, it will jump to the load value when another counter signal is received, and will continue to count from there without losing a signal.
If the counter counts down and reaches the lower count limit, it will jump to the upper count limit when another counter signal is received, and will continue to count from there.

3 Main count direction down
If the counter counts up and reaches the upper count limit, it will jump to the lower count limit when another counter signal is received, and will continue to count from there.
If the counter counts down and reaches the lower count limit, it will jump to the lower count limit when another counter signal is received, and will continue to count from there.

The following three diagrams show the counter's behavior in ”periodical count” mode with the three main count directions: none, up, down.

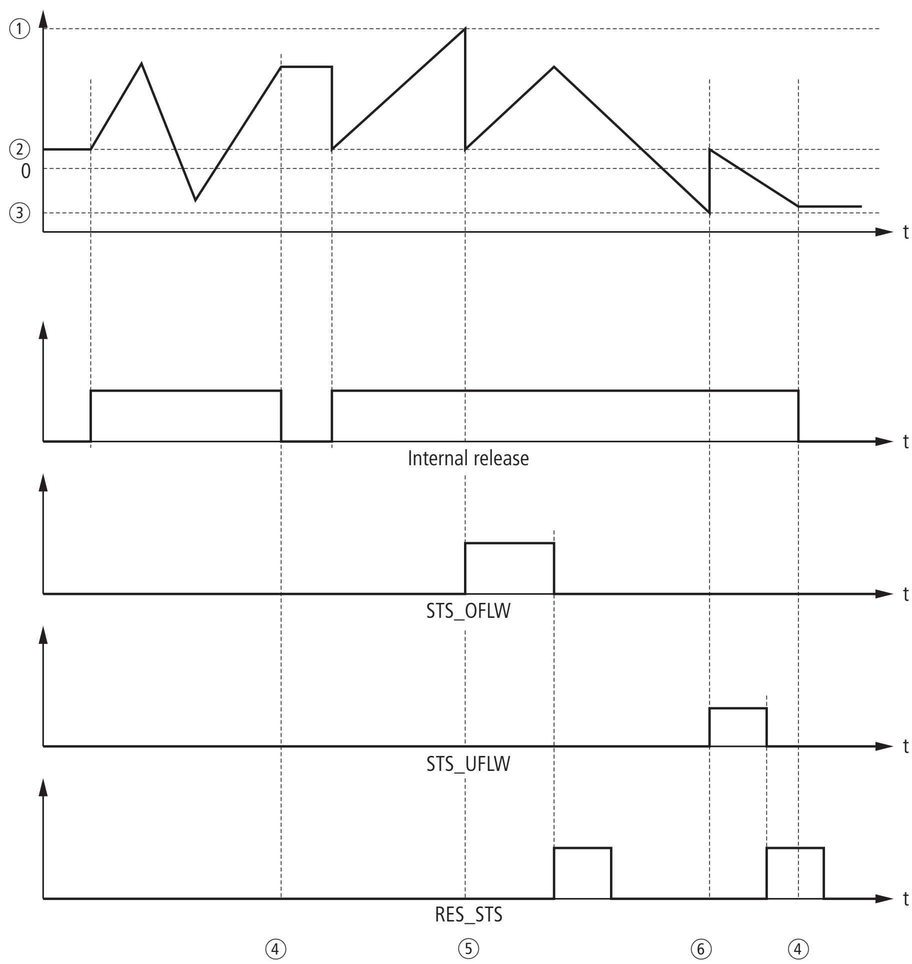


Fig. 260: Periodical count without main count direction

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, internal release

⑤ Overflow

⑥ Underflow

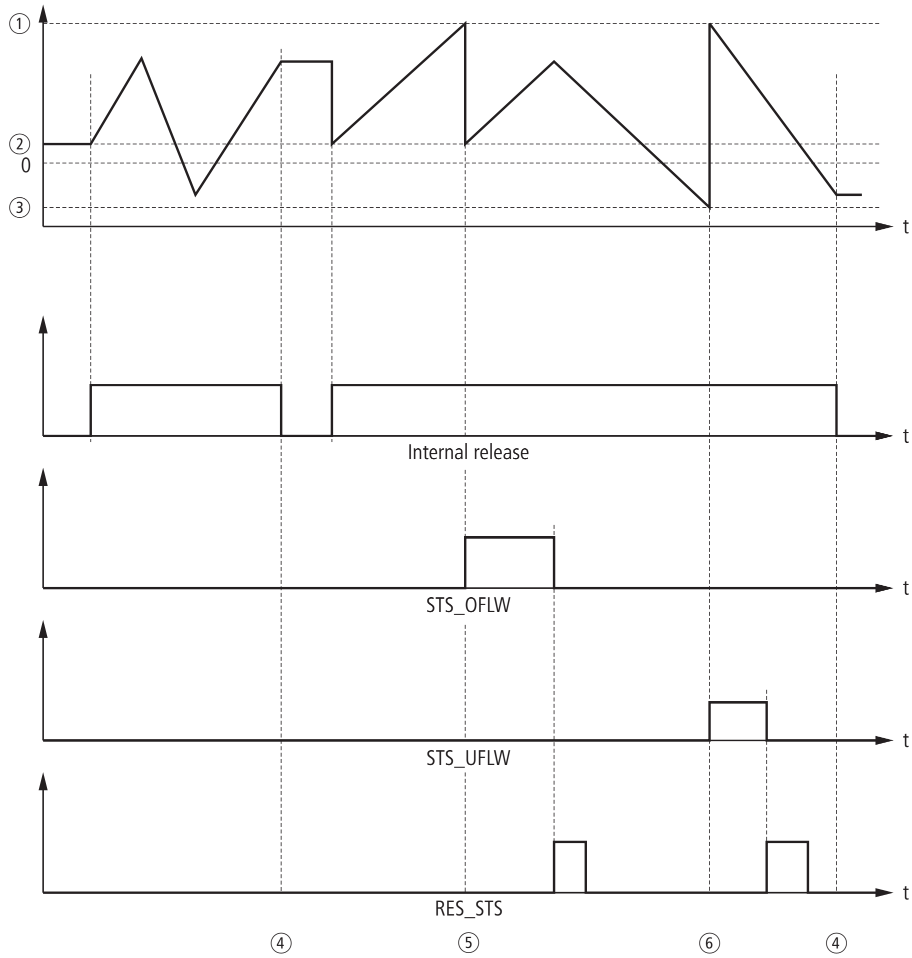


Fig. 261: Periodical count with main count direction up

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, manual

⑤ Overflow

⑥ Underflow

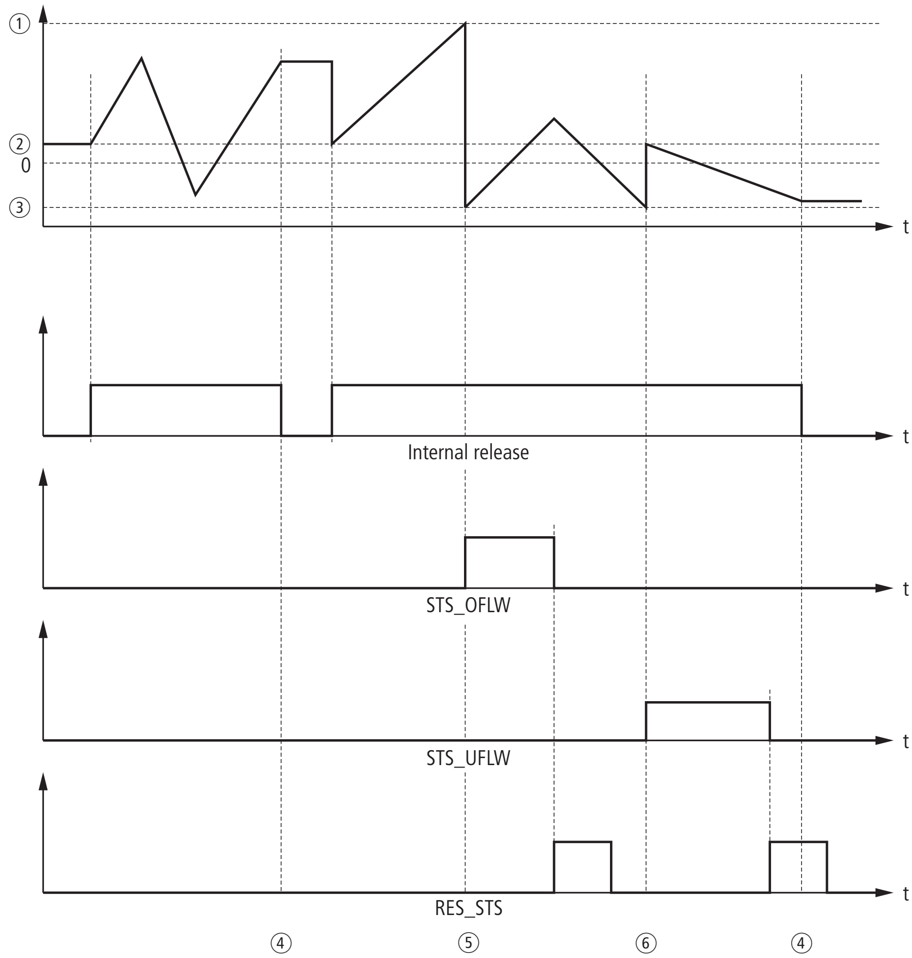


Fig. 262: Periodical count with main count direction down

① Upper count limit

② Load value

③ Lower count limit

④ Release stop, manual

⑤ Overflow

⑥ Underflow

12.1.10 Measurement mode

Measurement mode - process data mapping

NOTE
With PROFIBUS, PROFINET and CANopen, the I/O data of this module is localized within the process data of the whole station via the hardware configuration tool of the fieldbus master.
For DeviceNet, EtherNet/IP and Modbus TCP a detailed mapping table can be created with the TURCK BL20 DTM in PACTware.

Measurement mode - process input data

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Input	n	n + 7	Measured value							
	n + 1	n + 6								
	n + 2	n + 5								
	n + 3	n + 4								
Diag-nostics	n + 4	n + 3	ERR_ 24Vdc	ERR_ DO	ERR_ PARA	reserved		RES_ STS_A	ERR_ LOAD	STS_ LOAD
Status	n + 5	n + 2	STS_ DN	STS_ UP	reserved		STS_ DO1	res.	STS_ DI	STS_ GATE
	n + 6	n + 1	res.	STS_ UFLW	STS_ OFLW	res.	STS_ CMP1	res.		res.
	n + 7	n	reserved							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Bit	Description
ERR_24Vdc	short-circuit sensor pwr supply This diagnostics information must be acknowledged with the EXTF_ACK (process output) control bit.
ERR_DO	Short-/open circuit/excess temperature at the output DO1
ERR_PARA	– 1: Parameter error ERR_PARA is a group diagnostics bit. With the separate diagnostics message bits 3…6 describe the parameter errors in more detail. – 0: The parameter definition is correct as per specification.
RES_STS_A	– 1: Resetting of status bits running. The last process output telegram contained: RES_STS = 1. – 0: The last process output telegram contained: RES_STS = 0.
ERR_LOAD	1: Error with load function Control bits LOAD_UPLIMIT and LOAD_LOLIMIT must not be set at the same time during the transfer. The value of LOAD_UPLIMT and LOAD_LOLIMIT was selected outside of the permissible range. Permissible values for LOAD_LOLIMIT: 0…199 999 999 x10^{-3} Hz 0…24 999 999 × 10^{-3} U/min. 0…99 999 999 ms Permissible values for LOAD_UPLIMIT: 1…200 000 000 × 10^{-3} Hz 1…25 000 000 × 10^{-3} U/min. 1…100 000 000 ms

Bit	Description
STS_LOAD	Status of load function Set, if the load function is running.
STS_DN	Status direction down. The direction is determined by a signal at the physical input B. The ”signal evaluation parameter (A, B)” must be set to ”pulse and direction”.
STS_UP	Status direction up. The direction is determined by a signal at the physical input B. The ”signal evaluation parameter (A, B)” must be set to ”pulse and direction”.
STS_DO1	The DO1 status bit indicates the status of digital output DO1.
STS_DI	The DI status bit indicates the status of digital input DI.
STS_GATE	1: Measuring operation running.
STS_UFLW	1: The lower measuring limit was undershot. The bit must be reset with RES_STS: 0 $\rightarrow$ 1 zurückgesetzt werden.
STS_OFLW	1: The upper measuring limit was exceeded. The bit must be reset with RES_STS: 0 $\rightarrow$ 1 zurückgesetzt werden.
STS_CMP1	1: Measuring terminated The measured value is updated with every elapsed time interval. The end of a measurement (expiry of the time interval) is indicated with the status bit STS_CMP1. The bit must be reset vie the process output with RES_STS: 0 $\rightarrow$ 1.

Measurement mode - process output data

The structure of the process output data depends on the module's parameterization.

1 Process output data with parameter values for:
Function DO1

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	m + 7	reserved						MODE_DO1	
	m + 1	m + 6	reserved							
	m + 2	m + 5								
	m + 3	m + 4								
Con-trol	m + 4	m + 3	EXTF_ ACK	reserved		CTRL_ DO1	SET_ DO1	RES_ STS	res.	SW_ GATE
	m + 5	m + 2	reserved			LOAD _ DO_ PARA M	res.	LOAD _ INT-TIME	LOAD _ UPLIM IT	LOAD _ LOLIM IT
	m + 6	m + 1	reserved							
	m + 7	m								

2 Process output data with parameter values for:
Upper limit or
Lower limit

Data	Byte	Byte DP/ PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Output	m	m + 7	Upper limit or lower limit							
	m + 1	m + 6								
	m + 2	m + 5								
	m + 3	m + 4								
Control	m + 4	m + 3	EXTF_ ACK	reserved		CTRL_ DO1	SET_ DO1	RES_ STS	res.	SW_ GATE
	m + 5	m + 2	reserved			LOAD _DO_ PARA M	res.	LOAD _INT-TIME	LOAD _UP-LIMIT	LOAD _LO-LIMIT
	m + 6	m + 1	reserved							
	m + 7	m								

3 Process output data with parameter values for:
Integration time

Data	**Byte**	**Byte DP/ PN**	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
Output	m	m + 7	Integration time							
	m + 1	m + 6								
	m + 2	m + 5	reserved							
	m + 3	m + 4								
Control	m + 4	m + 3	EXTF_ ACK	reserved		CTRL_ DO1	SET_ DO1	RES_ STS	res.	SW_ GATE
	m + 5	m + 2	reserved			LOAD _DO_ PARA M	res.	LOAD _INT-TIME	LOAD _UP-LIMIT	LOAD _LO-LIMIT
	m + 6	m + 1	reserved							
	m + 7	m								

m = Offset of output data; depending on extension of station and the corresponding fieldbus.

Bit	**Description**
MODE_DO1	MODE_DO1 is only valid, if LOAD_DO_PARAM: 0 → 1. The physical output DO1 can show the status of the data bit SET_DO1 or comparison results if CTRL_DO1 = 1. MODE_DO1 defines which function DO1 is to accept: – **00**: The output DO1 shows the status of the control bit SET_DO1. – **01**: The output DO1 indicates a measurement outside of the limits, i.e. above the upper measuring limit or below the lower measuring limit. STS_OFLW = 1 or STS_UFLW = 1 (process input). – **10**: Output DO1 indicates a value below the lower measuring limit. STS_UFLW = 1 (process input) – **11**: Output DO1 indicates a value above the upper measuring limit. STS_OFLW = 1 (process input)
EXTF_ ACK	Error acknowledgment: The error bits must be acknowledged with the control bit EXTF_ACK after the cause of the fault has been rectified. This control bit must then be reset again. Any new error messages are not set while the EXTF_ACK control bit is set!
CTRL_DO1	– 0: The output DO1 is blocked. – 1: The output DO1 is released.
SET_DO1	If CTRL_DO1 = 1 and the physical output DO1 is set to indicate the value SET_DO1, DO1 can be set and reset directly with SET_DO1. DO1 can be set for this function via the process output (MODE_DO1 = 00 and LOAD_DO_PARAM 0 → 1). The output DO1 can also be set before commissioning via the separate parameter data. The default setting for DO1 is to indicate the status of SET_DO1.
RES_STS	0 → 1 Initiate resetting of status bits. Status bits STS_UFLW, STS_OFLW, and STS_CMP1 (process input) are reset. Bit RES_STS_A = 1 (process input) acknowledges that the reset command has been received. RES_STS can now be reset to 0.
SW_GATE	0 → 1 Measuring is started (software release). 1 → 0 Measuring is stopped.

Bit	Description
LOAD_DO_ PARAM	Parameter setting of the physical output DO1 0 → 1: DO1 can indicate the status of different data bits as a signal. The current telegram (byte 0) determines the data bits to which DO1 is to refer.
LOAD_ INTTIME	Parameter setting of the Integration time 0 → 1: Bytes 0 to 1 of this process output represent a factor for defining the integration time for frequency measurement and for determining the rotational speed. The integration time can be adjusted between 10 ms and 10 s in 10 ms increments and is produced by multiplying the factor × 10 ms. With period duration measurement, this factor determines the number of periods measured in order to calculate a mean value. A factor 1…1000 (1hex…3E8hex) is permissible.
LOAD_ UPLIMIT	Parameter setting of the upper measuring limit 0 → 1: The value in bytes 0…3 is accepted as upper measuring limit.. LOAD_UPLIMT: 1…200 000 000 × 10^{-3} Hz 1…25 000 000 × 10^{-3} U/min 1…100 000 000 ms
LOAD_ LOPLIMIT	Parameter setting of the lower measuring limit 0 → 1: The value in bytes 0…3 is accepted as lower measuring limit.. LOAD_LOLIMIT: 0…199 999 999 x10^{-3} Hz 0…24 999 999 × 10^{-3} U/min 0…99 999 999 ms

Measurement mode - parameters

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 0	Bit 0	Word 0	Bit 0	Byte 15	Bit 0	wiring type
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	
Byte 1	Bit 0		Bit 8	Byte 14	Bit 0	Digital input DI
	Bit 1		Bit 9		Bit 1	Function DI
	Bit 2		Bit 10		Bit 2	reserved
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	

Standard byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
	Bit 0		Bit 0		Bit 0	Lower limit
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 2	Bit 7		Bit 7	Byte 13	Bit 7	
	Bit 0		Bit 0		Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
Byte 3	Bit 7	Word 1	Bit 7	Byte 12	Bit 7	
	Bit 0		Bit 8		Bit 0	
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
Byte 4	Bit 7	Word 2	Bit 15	Byte 11	Bit 7	

Standard						PROFIBUS PROFINET		Parameters
byte-oriented		word-oriented						
Byte 5	Bit 0	Word 2	Bit 0	Byte 10	Bit 0			Upper count limit (HWORD)
	Bit 1		Bit 1		Bit 1			
	Bit 2		Bit 2		Bit 2			
	Bit 3		Bit 3		Bit 3			
	Bit 4		Bit 4		Bit 4			
	Bit 5		Bit 5		Bit 5			
	Bit 6		Bit 6		Bit 6			
	Bit 7		Bit 7		Bit 7			
Byte 6	Bit 0		Bit 0	Byte 9	Bit 0			
	Bit 1		Bit 1		Bit 1			
	Bit 2		Bit 2		Bit 2			
	Bit 3		Bit 3		Bit 3			
	Bit 4		Bit 4		Bit 4			
	Bit 5		Bit 5		Bit 5			
	Bit 6		Bit 6		Bit 6			
	Bit 7		Bit 7		Bit 7			
Byte 7	Bit 0	Word 3	Bit 8	Byte 8	Bit 0			
	Bit 1		Bit 9		Bit 1			
	Bit 2		Bit 10		Bit 2			
	Bit 3		Bit 11		Bit 3			
	Bit 4		Bit 12		Bit 4			
	Bit 5		Bit 13		Bit 5			
	Bit 6		Bit 14		Bit 6			
	Bit 7		Bit 15		Bit 7			

Standard byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Byte 8	Bit 0	Word 4	Bit 0	Byte 7	Bit 0	Integration time [n*10ms]
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 9	Bit 0		Bit 0	Byte 6	Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 10	Bit 0	Word 5	Bit 8	Byte 5	Bit 0	Sensor pulse per revolution
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	
Byte 11	Bit 0		Bit 0	Byte 4	Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 12	Bit 0	Word 6	Bit 0	Byte 3	Bit 0	Substitute value DO
	Bit 1		Bit 1		Bit 1	Diagnostic DO1
	Bit 2		Bit 2		Bit 2	Function DO1
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	reserved
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 13	Bit 0		Bit 0	Byte 2	Bit 0	Signal evaluation (A, B)
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	Sensor/ input filter (A)
	Bit 3		Bit 3		Bit 3	Sensor/ input filter (B)
	Bit 4		Bit 4		Bit 4	Sensor/ input filter (DI)
	Bit 5		Bit 5		Bit 5	sensor (A)
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	Direction input (B)
Byte 14	Bit 0	Word 7	Bit 0	Byte 1	Bit 0	Group diagnostics
	Bit 1		Bit 1		Bit 1	reserved
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	behavior CPU/ master stop
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	
Byte 15	Bit 0		Bit 0	Byte 0	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	

Parameters	settings
wiring type	**100000 = frequency measurement** 100001 = revolutions measurement 100010 = period duration measurement
Digital input DI	**0 = normal** 1 = inverted
Function DI	**0 = input** 1 = HW gate
Lower limit	0…16 777 214 × 10^{-3}
Lower limit (HWORD)	**0**···255 (Unsigned8)
Lower limit (LWORD)	**0**…65535
upper limit	1…16 777 215 × 10^{-3}
Upper limit (HWORD)	**0**···255 (Unsigned8)
Upper limit (LWORD)	**0**…65535
Integration time [n*10ms]	1…1 000; **10**
Sensor pulse per revolution	1…65535
Substitute value DO 1	**0** 1
Diagnostic DO1	**0 = 1** 1 = off
Function DO1	**00 = output** 01 = outside of limit 10 = below lower limit 11 = above upper limit
Signal evaluation (A, B)	**00 = pulse and direction** 01 = rotary sensor: single
Sensor/ input filter (A)	**0 = 2.5 µs (200 kHz)** 1 = 25 µs (20 kHz)
Sensor/ input filter (B)	**0 = 2.5 µs (200 kHz)** 1 = 25 µs (20 kHz)
Sensor/ input filter (DI)	**0 = 2.5 µs (200 kHz)** 1 = 25 µs (20 kHz)
sensor (A)	**0 = normal** 1 = inverted
Direction input (B)	**0 = normal** 1 = inverted
Group diagnostics	**0 = release** 1 = block
behavior CPU/ master stop	**00 = turn off DO1** 01 = proceed with operating mode 10 = DO1 switch to substitute value 11 = DO1 hold last value

Measuring procedure

The measuring operation is started by setting the internal software release signal, or by setting the hardware and software release signal if the digital input is configured as a hardware release.

Measuring is carried out within a definable integration time that can be adjusted via the control interface/process output. The measured value is then updated.

After the integration time has elapsed, STS_MVAL indicates that an actual measured value is present. This bit must be reset via the RES_STS status bit in the control interface.

Frequency measurement

Definition

In this operating mode the module counts the pulses received within a specified integration time.

The integration time can be set by a parameter or via the control interface/process output during operation. It can be set in 10 ms increments to between 10 ms and 10 s.

The value of the determined frequency is made available as a 10^{-3} Hz value. You can read the measured frequency value in the check-back interface/process input.

The displayed value cannot be updated until the integration time has elapsed.

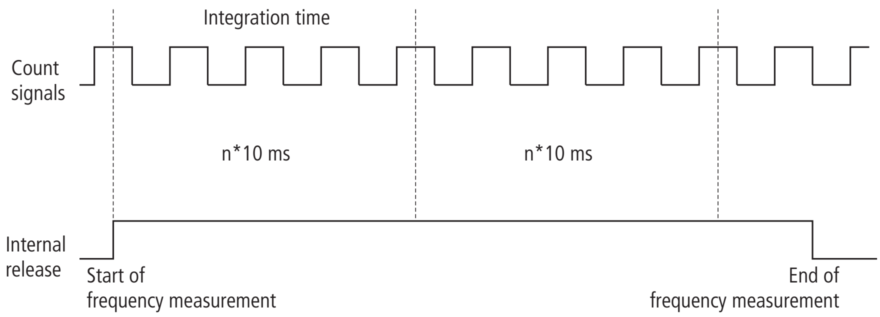


Fig. 263: Frequency measurement with release function

Limit value monitoring

The limit values can be configured and defined at a later time via the control interface/process output. The following limit value ranges are possible:

Range defined by parameters
→ The value range is restricted by the 3 byte parameter length

- Lower limit n_u is 0…16 777 214 × 10^{-3} Hz
- Upper limit $_o$ is 1…16 777 215 × 10^{-3} Hz

The upper limit must be greater than the lower limit. The diagnostics messages "upper limit wrong" and "lower limit wrong" indicate parameter definitions that are outside of the permissible value range. The diagnostics messages are cleared when valid parameters are entered.

Range defined via the control interface/process output

(LOAD_UPLIMIT/LOAD_LOLIMIT)

- Lower limit n_u is 0…199 999 999 × 10^{-3} Hz
- Upper limit $_o$ is 1…200 000 000 × 10^{-3} Hz

The upper limit must be greater than the lower limit. An error is indicated by the ERR_LOAD status bit via the check-back interface/process input. The status bit is cleared when a valid value is entered.

Possible measurement ranges

Integration time	f_{min}	f_{max}
10 s	0.1 Hz	200 000 Hz
1 s	1 Hz	200 000 Hz
0.1 s	10 Hz	200 000 Hz
0.01 s	100 Hz	200 000 Hz

Revolutions measurement

Definition

In this operating mode, the counter module counts the pulses received from a rotary sensor within a predefined integration time. The number of "sensor pulses per revolution" must be defined beforehand by parameters in the system. The number of "sensor pulses per revolution" and the pulses counted determine the speed of the connected motor.

The integration time is defined by measuring parameters. It can be set in 10 ms increments to between 10 ms and 10 s.

The speed is indicated in units of 1×10^{-3} rpm.

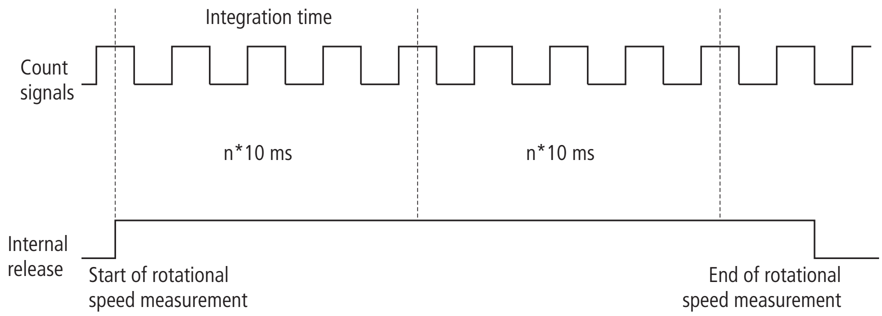


Fig. 264: Revolutions measurement with release function

Limit value monitoring

The limit values can be configured and defined at a later time via the control interface/process output. The following limit value ranges are possible:

Range defined by parameters

→The value range is restricted by the 3 byte parameter length

- Lower limit n_u is 0…16 777 214 × 10^{-3} Hz
- Upper limit n_u is 1…16 777 215 × 10^{-3} Hz

The upper limit must be greater than the lower limit. The diagnostics messages "upper limit wrong" and "lower limit wrong" indicate parameter definitions that are outside of the permissible value range. The diagnostics messages are cleared when valid parameters are entered.

Range defined via the control interface/process output

(LOAD_UPLIMIT/LOAD_LOLIMIT)

- Lower limit n_u is 0…24 999 999 × 10^{-3} Hz
- Upper limit n_u is 1…25 000 000 × 10^{-3} Hz

The upper limit must be greater than the lower limit. An error is indicated by the ERR_LOAD status bit via the check-back interface/process input. The status bit is cleared when a valid value is entered.

Possible measuring ranges with 60 pulses per sensor revolution

Integration time	n_{min}	n_{max}
10 s	1 rpm	000 rpm
1 s	1 rpm	000 rpm
0.1 s	10 rpm	000 rpm
0.01 s	100 rpm	000 rpm

Possible measuring ranges with 60000 pulses per sensor revolution

Integration time	n_{min}	n_{max}
10 s	1 rpm	200 rpm
1 s	1 rpm	200 rpm
0.1 s	1 rpm	200 rpm
0.01 s	1 rpm	200 rpm

Period duration measurement

Definition

In this operating mode the counter module measures the precise time between two rising edges of the counter signal in ms by counting the pulses of an exact internal quartz crystal reference frequency (1 MHz). An averaging operation can be carried out over 1 to 1000 periods. It is defined by the integration time parameter or by the LOAD_INTTIME status bit in the control interface/process output.

The displayed measured value cannot be updated until the set number of periods have elapsed.

The measured value is displayed in units of ms in the check-back interface/process input.

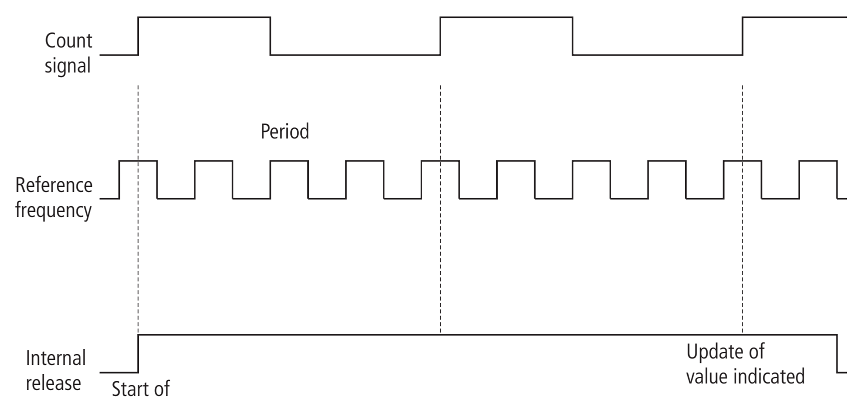


Fig. 265: Period duration measurement with release function; number of periods = 2

Limit value monitoring

The limit values can be configured and defined at a later time via the control interface/process output. The following limit value ranges are possible:

Range defined by parameters

→The value range is restricted by the 3 byte parameter length

- Lower limit n_u is 0…16 777 214 ms
- Upper limit n_o is 1…16 777 215 ms

The upper limit must be greater than the lower limit. The diagnostics messages ”upper limit wrong” and ”lower limit wrong” indicate parameter definitions that are outside of the permissible value range. The status bit is cleared when a valid value is entered.

Range defined via the control interface/process output

(LOAD_PREPARE/ LOAD_VAL)

- Lower limit n_u is 0…99 999 999 ms
- upper limit n_o is 1…100 000 000 ms

The upper limit must be greater than the lower limit. An error is indicated by the ERR_LOAD status bit via the check-back interface/process input. The status bit is cleared when a valid value is entered.

Possible measurement ranges

Measuring cycle via number of periods	t_{min}/update after	t_{max}/uupdate after
1000	10 µs/10 ms	10000 µs/10 s
100	10 µs/1 ms	100000 µs/10 s
10	100 µs/1 ms	1000000 µs/10 s
1	1000 µs/1 ms	10000000 µs/10 s

With the measuring cycles selected here the display is updated after a maximum of 10 s.

12.1.11 Functions and explanations

Software gate and hardware gate

A release signal is required in order to start counting/measuring.
The counter module controls the starting and stopping of the counting/measuring operation by means of so-called "gates". A software gate and a hardware gate are provided for implementing this control both via the software (process output/control interface) and via a physical output:

- The software gate initiates the release via the SW_GATE control bit. The release is activated by the rising edge from 0 → 1 of the SW_GATE control bit. If Function DI = HW Gate is set at the same time, it should be ensured that a High signal is present at the digital input. With DI digital input = normal this is 24 VDC.
  A stop is initiated by resetting the SW_GATE control bit from 1 → 0. If Function DI = HW Gate is set, the counting/measuring operation can be stopped either by the software gate or the hardware gate.
- A Hardware gate initiates a release via a 24 VDC signal at the digital input. This function is configured with Function DI = HW gate. The release is then only possible if the SW_GATE bit =1 at the same time.

This bit is set when there is a rising edge from 0 → 1 at the input and reset with a falling edge from → 0.
The edge change can be reversed by inverting the digital input.
Invert digital input = yes

NOTE
If the counting operation is aborted, counting begins from the load value on restart. If the counting operation is aborted, counting begins from the load value on restart. If the counting operation is interrupted, however, the counter continues on restart from the actual counter value.

Synchronization

Synchronization must be configured before operating the counter module (Function DI = Synchronization when edge positive). The rising edge of a reference signal at the input is used to set the counter to the load value.

A single-action or periodical synchronization can be selected. This is possible under the following conditions:

- The counting operation must be started with the software release.
- The Release Synchronization (CRTL_SYN) control bit must be set.
- With single-action synchronization the first 0 → 1 edge at the digital input sets the counter to the load value after the release bit is set.
- With periodical synchronization the first and every subsequent → 1 edge at the digital input sets the counter to the load value after the release bit is set.
- After synchronization is successfully completed the STS_SYN status bit is set. It can only reset by the RES_STS control bit.
- The STS_DI check-back bit indicates the status of the reference signal at the digital input.

When single-action synchronization is set, a subsequent synchronization operation can be initiated by resetting and setting the Release synchronization (CRTL_SYN) control bit. This is executed on the next 0 →1 edge at the digital input.

After synchronization is successfully completed the STS_SYN status bit is set. This bit must be reset by the RES_STS control bit.

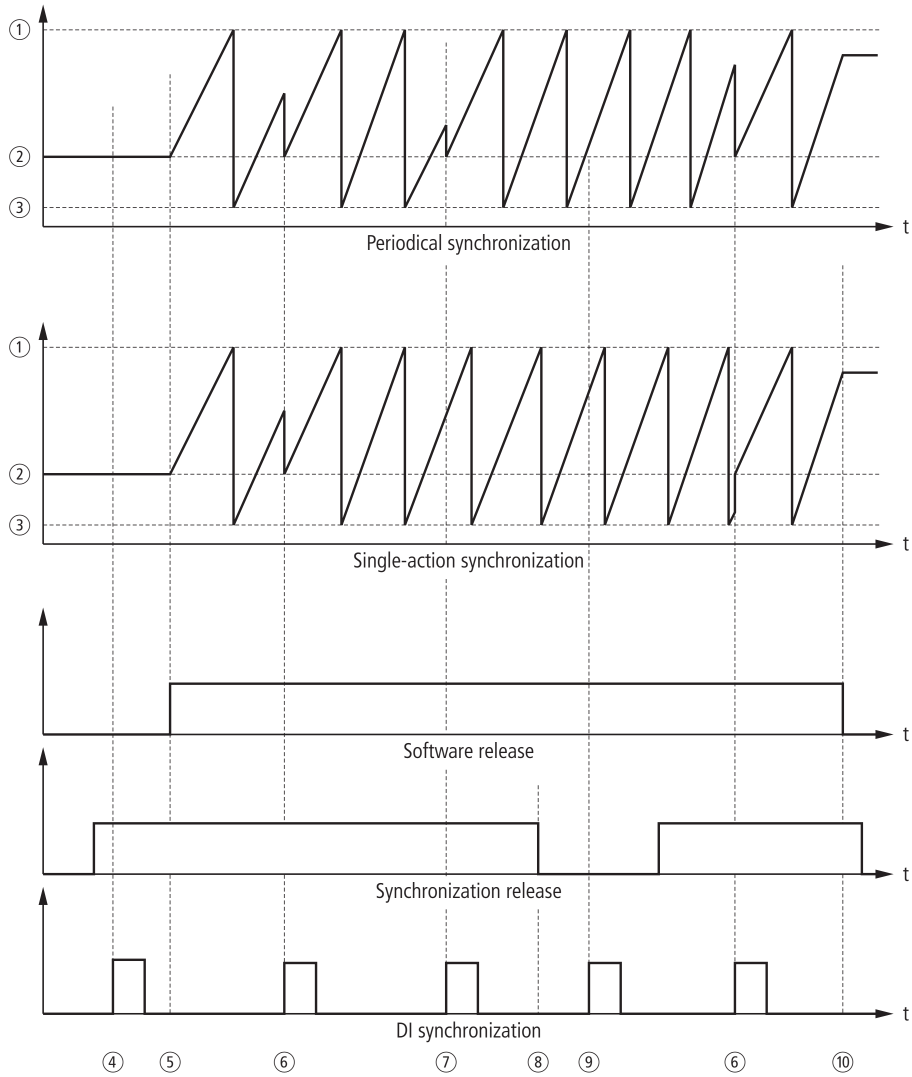


Fig. 266: Synchronization with continuous counting

① Upper count limit

② Load value

③ Lower count limit

④ Synchronization without release

⑤ Release set

⑥ 1. synchronization

⑦ 2. synchronization

⑧ Stop synchronization

⑨ No synchronization

⑩ Release reset

Latch-retrigger function

This function enables the event-driven evaluation of the counter status.

The actual internal counter status of the electronic module is retained when there is an edge at the digital input. The check-back interface/process input data supplies the ”frozen” value. The internal counter status is retriggered, i.e. the load value is loaded and counting is resumed from the load value.

In order to execute this function the counting mode must be released with the software gate.

Bit STS_DI (Status DI) indicates the status of the Latch and Retrigger signal. The edge signal cannot be inverted.

The load value with which the operating mode starts is displayed before the first edge after the software release is set.

A direct loading of the counter does not change the counter status indicated.

NOTE
Ensure that input DI is not inverted otherwise this will generate an error/diagnostics message.

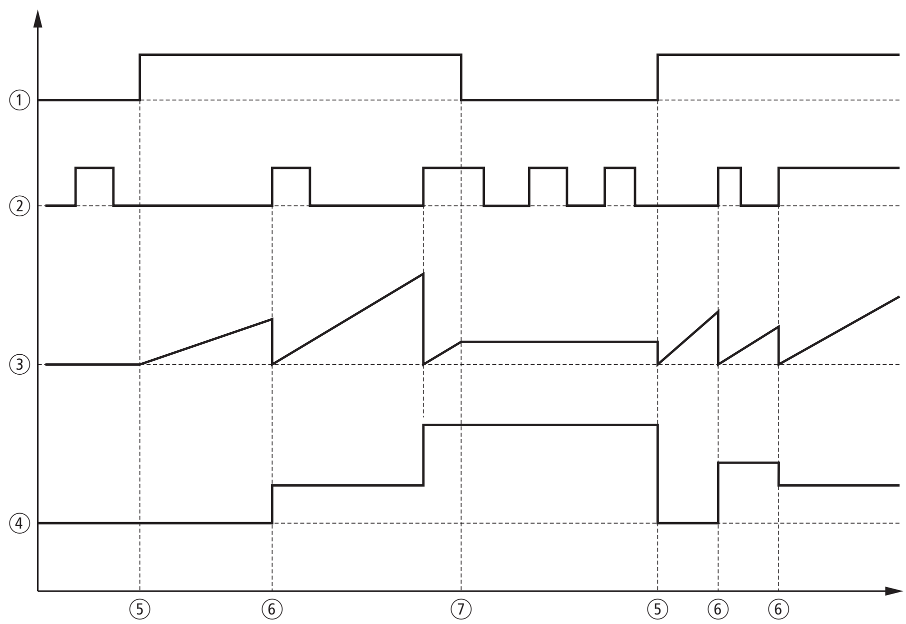


Fig. 267: Latch-retrigger-function with a parameterized abbort of the count operation

① Software release

② Digital input

③ Internal counter status

④ Displayed counter status

⑤ Start, manual

⑥ Latch

⑦ Stop

Behavior of the DI digital input

The digital input can be run with different sensors (positive switch or push-pull).

The input signal can be inverted (exception: in Latch and retrigger function).

The STS_DI status bit indicates the status of the digital input.

The following digital input functions are available for selection in count mode:

- Digital input
- Hardware release (HW gate)
- Latch retrigger function when edge positive
- Synchronization when edge positive

The following digital input functions are available for selection in measurement mode:

- Digital input
- Hardware release (HW gate)

Behavior of the digital outputs DO1/DO2

Count mode

The digital outputs can be activated depending on the counter status and reference values.

The module is provided with a ”real” digital output and a ”virtual” digital output that is only present as a status bit in the check-back interface/process input.

Two reference values can be stored on the counter module and assigned to the digital outputs separately.

The following functions can be selected:

- Output (no switching via comparator)
- Set if counter value ≥ reference value
- Set if counter value ≤ reference value
- Pulse if counter value = reference value

Comparison results for comparator 1 are assigned to the physical output DO1.

Comparison results for comparator 2 are assigned to the virtual output DO2.

Permissible value range for the two reference values

Lower count limit
to
Upper count limit

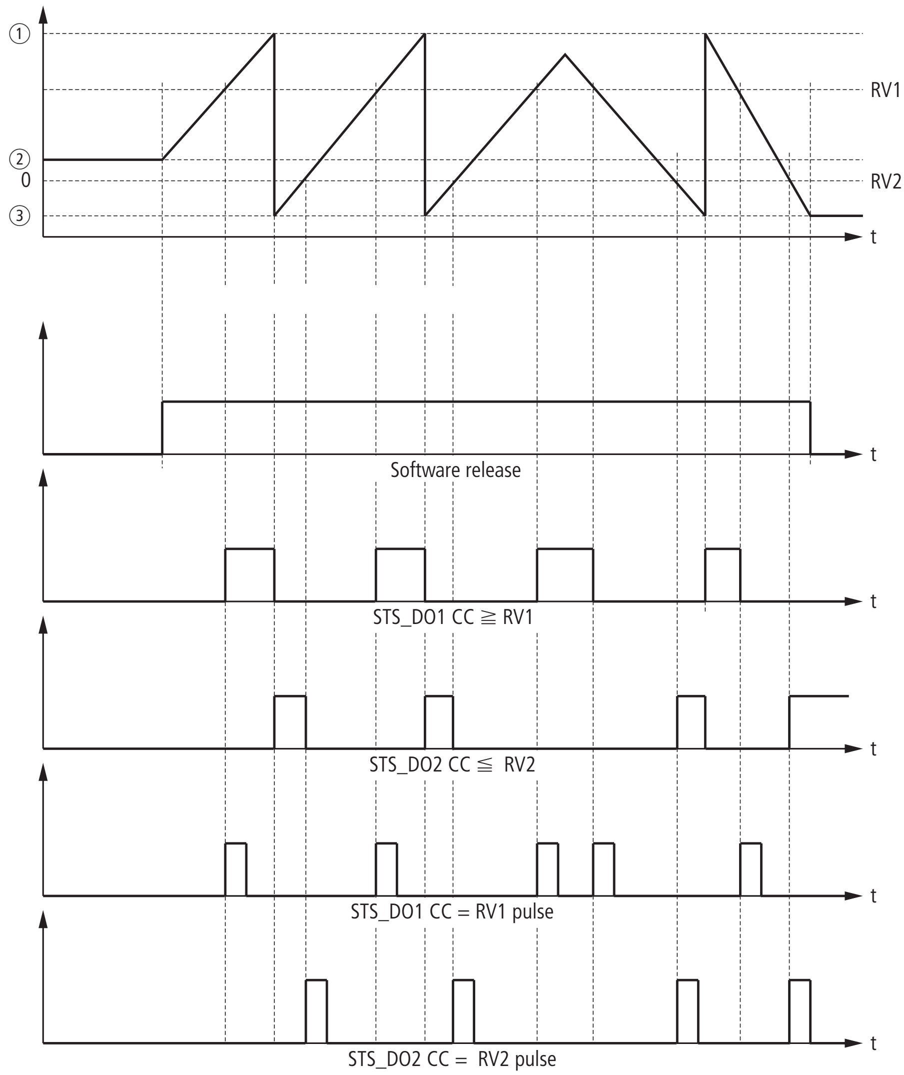


Fig. 268: Continuous counting with release function

① Upper count limit

② Load value

③ Lower count limit

RV1 = reference value 1

RV2 = reference value 2

CC = counter content

The count limits configured represent the upper and lower count limits.

The behavior of the digital outputs depend on:

- Hysteresis
- Pulse duration

The behavior of the digital outputs can be configured before operation or by means of a control command during operation.

DO1/DO2 in output mode

In output mode, the outputs can be set and reset via the process output/control interface. This requires that the relevant output is released (CTRL_DO1, CTRL_DO2). Set/reset (SET_DO1, SET_DO2) can then be carried out irrespective of the counter status.

Measurement mode

An upper and lower measuring limit can be set on the counter module

In measurement mode only the physical output DO1 is active.

The following functions can be selected:

- Output (no switching when upper/lower measuring limit reached)
- Measured value outside of the set limits
- Measured value below the lower limit
- Measured value above the upper limit

Releasing the output

Control bit CTRL_DO1 is used to release the output.

Control bit SET_DO1 is used to activate or deactivate the released output.

The status of the output is stored in the check-back interface/process input and can be scanned with the status bit (STS_DO1).

12.1.12 Hysteresis for digital output DO1/DO2

In count mode, the hysteresis controls the switching of the outputs DO1/DO2 with comparisons.

A sensor may stand still at a specified position and "oscillate" around this position. This condition will cause the counter status to fluctuate by a specified value. If the reference value RV1/RV2 is within this fluctuation range, this would mean that the DO1/DO2 output would switch on and off in time with the fluctuating signal.

A programmable hysteresis function can therefore be used in order to prevent switching resulting from small fluctuations. This hysteresis can be set between 0 and 255 (0 means Hysteresis switched off).

The hysteresis can also be changed using the LOAD_DO_PARAM control command.

If the output is set for Switching ≥ Reference value, the digital output will have the following behavior (example for DO1 - DO2 will respond accordingly):

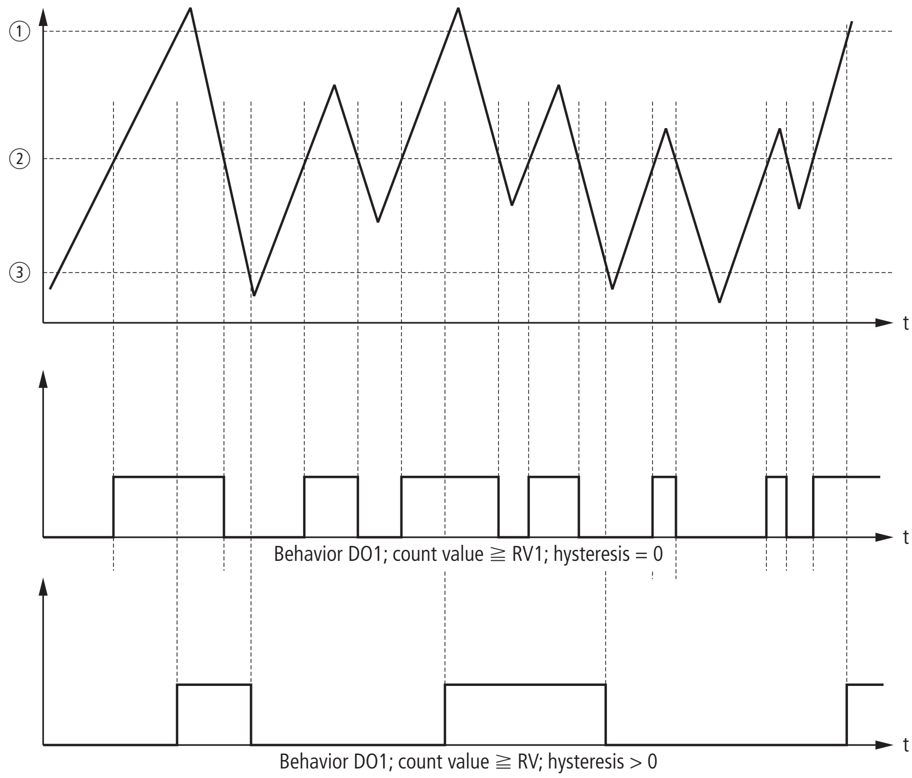


Fig. 269: Hysteresis with output set to Switch >= reference value

① Reference value + hysteresis

② Reference value RV1

③ Reference value - hysteresis

If the output is set for Switch on counter value = reference value, a pulse is generated at output DO1.

Signal evaluation for encoders

The evaluation options can be set in the BL20 counter module configuration. The following settings are possible: The following error states are possible:

- 1-port
- 2-port
- 4-port

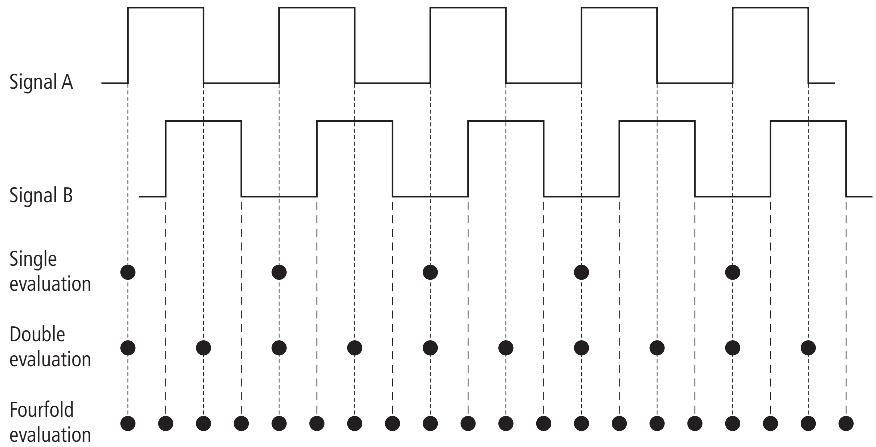


Fig. 270: Evaluation options for count mode (measurement mode only allows single evaluation)

Scan points with different evaluations

The set configuration determines how the counter status is incremented or decremented according to the rising and falling edges of signals A and B. The following evaluations are possible:

- Single evaluation:
  Only the rising edge of signal A is evaluated.
- Double evaluation:
  Both the rising and falling edge of signal A are evaluated.
- Fourfold evaluation:
  Both the rising and falling edge of signal A and B are evaluated.

In count mode rotary sensors with single, double and fourfold evaluation can be selected.

In measurement mode only rotary sensors with single evaluation can be selected.

Pulse and direction

Count mode

Input A receives the counter signal and input B the direction signal.

A signal at input A can either increment or decrement the counter status depending on the state of input B.

Measurement mode

In this mode input B can receive a signal for the rotational direction. The process input/check-back interface returns the status rotation direction via STS_DN and STS_UP.

NOTE

The signals at A and B can be inverted.

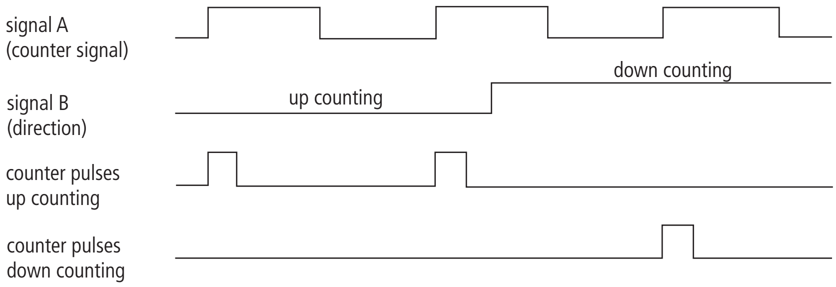


Fig. 271: Changing the counter status on counter signal and direction signal

Load value direct/in preparation

A load value can be assigned to the counter. This value can either be set via the connected controller or via the BL20-DTM in PACTware. The type of setting (direct/optional) is set via a bit in the controller:

1. The direct load causes the counter to accept the load value directly as the new counter value.
2. The load value can also be loaded in preparation. In this case, the load value is accepted as the new counter value in response to any of the following events:
   - Lower or upper count limit is reached when no main count direction has been configured.
   - Reaching the upper count limit with the main count direction set to up counting.
   - Reaching the lower count limit with the main count direction set to down counting.

Pulse duration on reaching the reference value

The pulse duration starts from when the digital output is set and can be specified in order to adapt to the actuators used. It specifies how long the output is to be set. The pulse duration can be set in 2 ms increments to between 2 and 510 ms.

If the pulse duration = 0, the output is set for as long as the comparison condition is fulfilled.

NOTE
No pulse is generated if the counter value goes above the counter value, e.g. jumps from the upper limit to the lower limit when counting up.

12.1.13 Resetting of status bits

Status bits:
STS_ND, STS_UFLW, STS_OFLW, STS_CMP2, STS_CMP1, STS_SYN

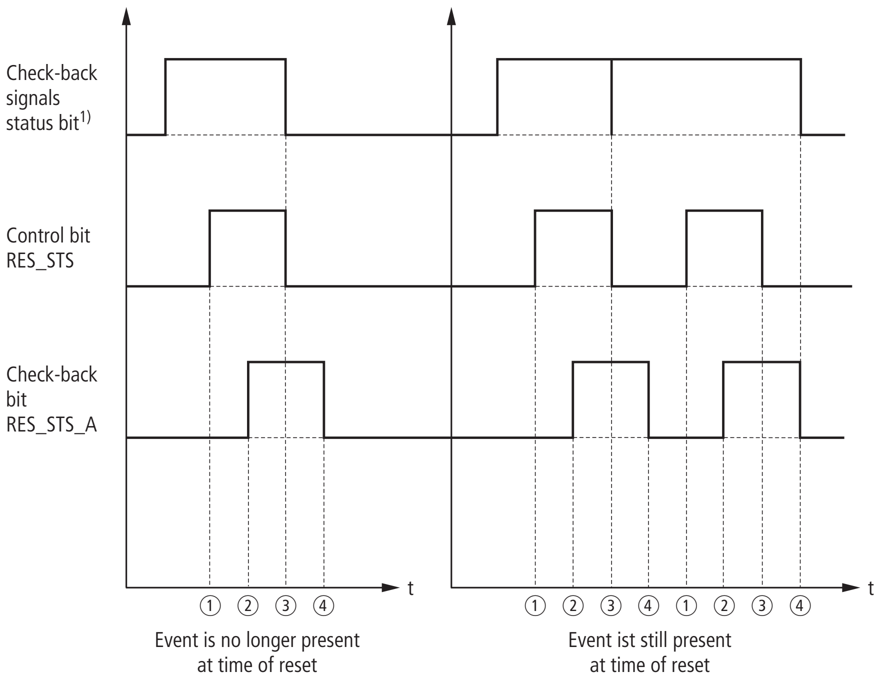


Fig. 272: Resetting of status bits

① Reset requested by the controller

② Reset by electronic module

③ Reset request revoked by controller

④ Reset executed in electronic module

12.1.14 Transfer of values/load function

Control bits: LOAD_VAL, LOAD_PREPARE, LOAD_CMP_VAL1, LOAD_CMP_VAL2, LOAD_DO_PARAM, LOAD_INTTIME, LOAD_UPLIMIT, LOAD_LOLIMIT

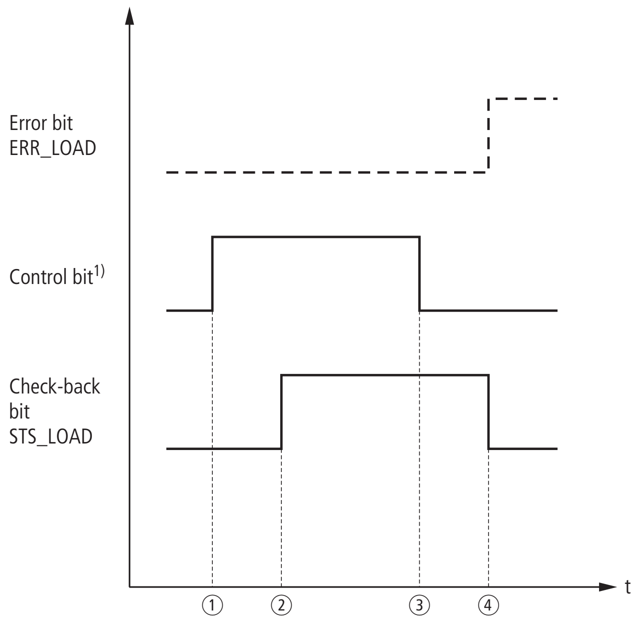


Fig. 273: Transferring values with the load function

① Controller requests value transfer/ value available

② Reset understood by electronic module

③ Request revoked by controller/ value available

④ Value accepted/ transfer complete

NOTE
Only one of the status bits1) mentioned should be set. Otherwise the ERR_LOAD error is indicated until all the stated control bits have been reset.

Count mode

The following values can be changed using the load function during operation:

- Counter status (LOAD_VAL)
- Load value (LOAD_PREPARE)
- Reference value1 (LOAD_CMP_VAL1)
- Reference value2 (LOAD_CMP_VAL2)
- Behavior of the digital outputs DO1/DO2 (LOAD_DO_PARAM)

NOTE
When changing the behavior of the digital output via the control interface/process output (value LOAD_DO_PARAM) the values for pulse duration and hysteresis are changed as well! These changes are stored in a volatile memory, i.e. when the module is reset (removed/fitted) they are overwritten by the values configured via the gateway.

Measurement mode

The following values can be changed using the load function during operation:

- Behavior of the digital output DO1 (LOAD_DO_PARAM)
- Lower limit (LOAD_LOLIMIT)
- Upper limit (LOAD_UPLIMIT)

Error acknowledgment

The Error Digital output error (ERR_DO) and Short circuit sensor supply (ERR_24Vdc) status bits must be acknowledged. The errors are detected by the counter module and shown in the check-back interface/process input. They can also initiate a diagnostics message with the appropriate parameter definition.

The following figure shows the chronological relationship between the occurrence of an error and its acknowledgment:

Error bit: ERR_DO or ERR_24Vdc

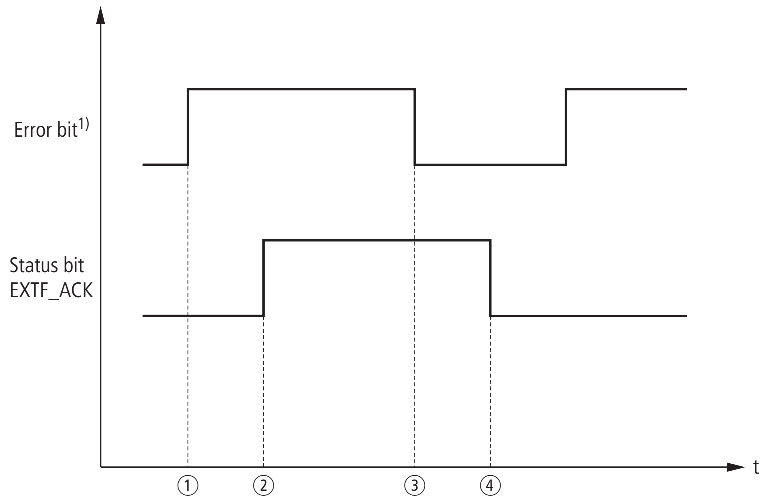


Fig. 274: Error detection

① Error occurred/ module sets error bit and diagnostics message if necessary/ error detection continues

② Error bit acknowledged/ any diagnostics message present is cleared/ further error detection not possible.

③ Error bit was reset/ further error detection not possible.

④ The status bit EXTF_ACK is reset/ further error detection possible.

12.2 BL20-E-2CNT-2PWM – 2 counter-/encoders, 2 PWM-outputs

The description of this technology module can be found in a separate manual on www.turck.de:

Type	Document no.
BL20-E-2CNT-2PWM	D301223

12.3 RS232 interface – BL20-1RS232

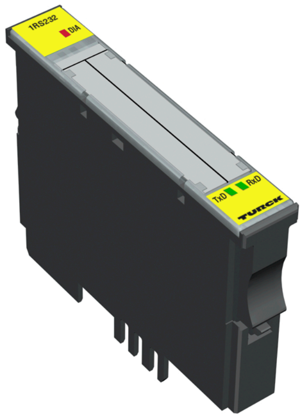


Fig. 275: BL20-1RS232

The module BL20-1RS232 transmits serial data through the BL20 system via a RS232 interface and enables the connection of different devices (printer/ scanner/ bar code reader), which as well provide a serial RS232 interface.

12.3.1 Data transfer method

The RS232-module enables flexible serial data transfer. An operational data transfer method can be set by the module's parameters.

The data transfer can be parameterized as follows:

- Data rate: 300…115200 bps.
- Data bits: 7 or 8 data bits in one data frame
- Parity: none, odd or even
- Stop bits: 1 or 2 bit.

NOTE
The data flow control can be realized via a hardware handshake (RTS/CTS) or a software handshake (XON/XOFF).

12.3.2 Data exchange

For the data exchange with a field device, the RS232-module provides a 64-byte transmit-buffer and a 128-byte receive-buffer. This is a hardware-restriction. The data telegrams which have to be sent or received can be larger.

The data transfer from the PLC into the transmit-buffer of the module or from the receive-buffer of the
module to the PLC is realized via a 8-byte transmission channel in the **Process output data (page 400)**or **Process input data (page 398)**.
To ensure the error-free data transmission, 2 byte of each data package are used to display status-, control- and diagnosis information. The amount of user data is therefore reduced to 6 byte within a data package

12.3.3 Technical data

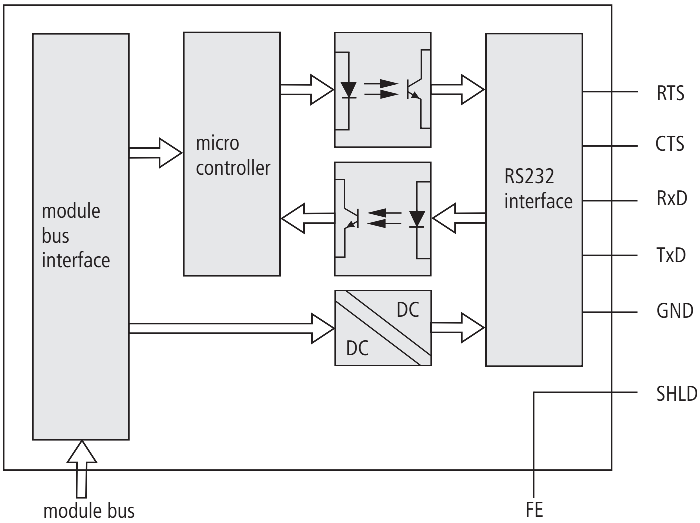


Fig. 276: Block Diagram

Technical Data	
Designation	BL20-1RS232
Number of channels	1
pPower supply	vie module bus
Voltage from module bus U_{MB}	5 VDC
Voltage range	4.75…5.25 VDC
Field supply	24 DC
Voltage range	18…30 VDC
Nominal current from supply terminal I_L	0 mA
Nominal current from module bus I_{MB}	≤ 140 mA
memory	128 byte receive buffer 64 byte transmit buffer
In-/outputs	
Transmission level active (U_{RS1})	-15…-3 VDC
Transmission level inactive (U_{RS0})	3…15 VDC
Transmission channels	2 (1/1) TxD and RxD, full duplex
transmission rate	300…115200 Baud (parameterizable) Data, Parity, Stop (default: 9600 baud, 7 bit, impair, 2 stop-bits)
RS232 cable length	Max. 15 m
Data flow control	Software handshake (Xon/ Xoff) Hardware handshake (RTS/ CTS)

Technical Data	
Diagnostic data can be written into the process image (depending on the parameterization)	
Isolation voltage	
U_{TMB} (module bus /RS232)	Max. 500 V_{eff}
U_{field} (field voltage/ RS232)	Max. 500 V_{eff}

Base modules

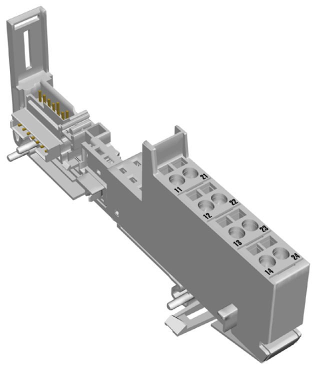


Fig. 277: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S4T-SBBS
- with screw connection
  BL20-S4S-SBBS

Wiring diagram

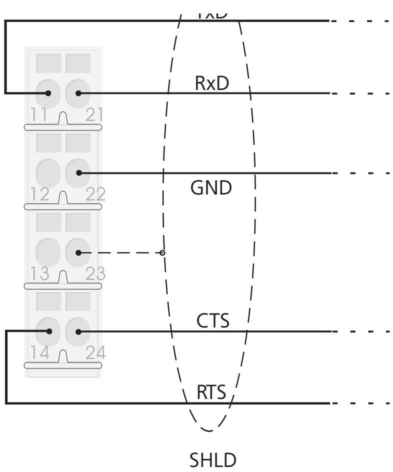


Fig. 278: Wiring diagram BL20-S4x-SBBS

12.3.4 Pin assignment

Assignment of signals for a 9-pole submin D-plug

Pin- no.	Signal designation	
1	DCD	Data Carrier Detect
2	RxD	Receive Data
3	TxD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	RI	Ring Indicator

NOTE
The table rows highlighted in grey indicate signals that are also available at the terminals of the base module.

12.3.5 Process input data

The RS232-module sends the data, received by the device, into a 128-byte receive-buffer. The module then transmits the data segmented via the module bus and the gateway to the PLC.

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

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

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Status byte							
n	n + 7	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
		Diagnostics							
n + 1	n + 6	Buf_ Ovfl	Frame _ERR	HndSh _ ERR	HW_ Fail	PRM_ ERR	reserved		TXBuf-NotEm pty
		Data bytes							
n + 2	n + 5	RX_data byte 0							
n + 3	n + 4	RX_data byte 1							
n + 4	n + 3	RX_data byte 2							
n + 5	n + 2	RX_data byte 3							
n + 6	n + 1	RX_data byte 4							
n + 7	n	RX_data byte 5							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Designation	Value	Description
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 diagnostics message is sent only if the parameter "Deactivate diagnostics = no/0". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. The value TX_CNT was transferred together with the last data segment of the process output data. The value TX_CNT_ACK is a confirmation of successful acceptance of the data segment using TX_CNT.
RX_CNT	0-3	This value is transferred together with every data segment. The RX_CNT values are sequential: 00->01->10->11->00…(dezimal: 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.

Designation	Value	Description
TXBufNotEmpty	0-1	This bit signalizes that the transmit buffer still contains data. It is automatically reset when the last character is sent. The bit can be used as control bit for actively triggering the sending of the TX data buffer.
BufOvfl; FrameErr; Hnd-ShErr; 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". see Diagnostic data (page 403)

Schematic diagram of the receive sequence

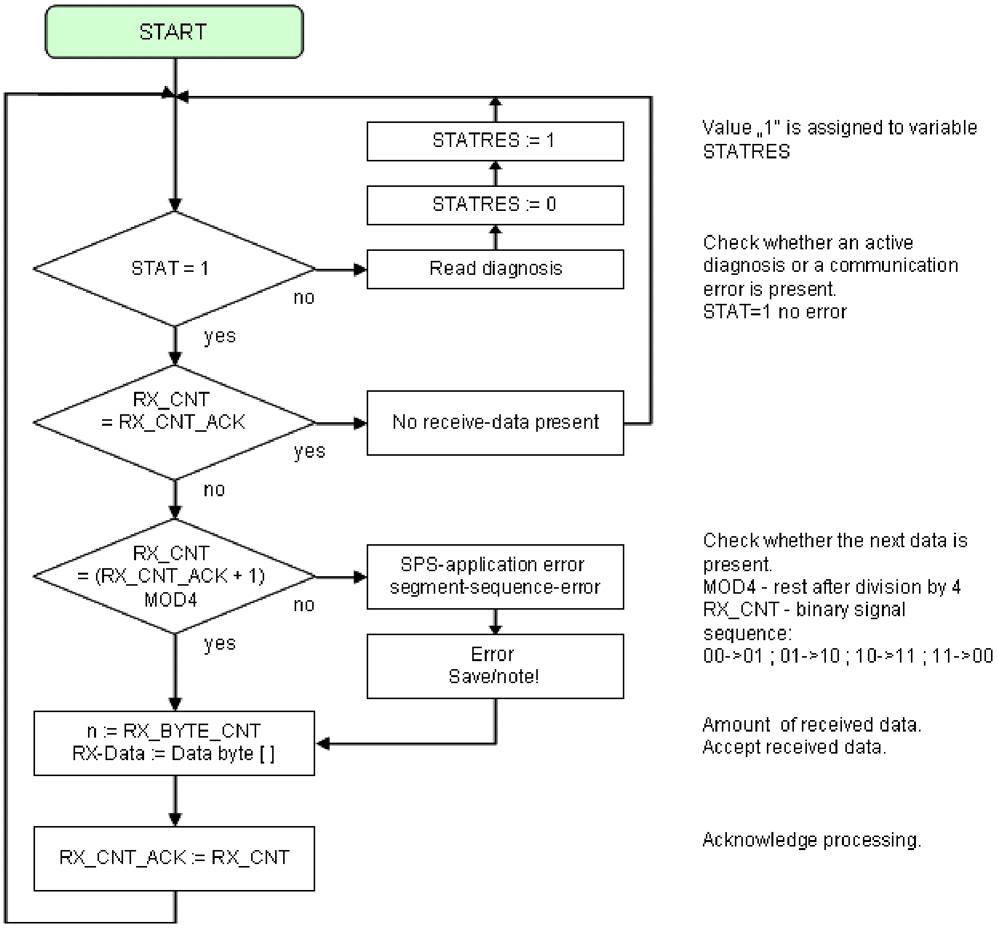


Fig. 279: Schematic diagram of the receive sequence

12.3.6 Process output data

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

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

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

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Control byte							
n	n + 7	STATRES	RX_CNT_ACK		TX_CNT		TX_BYTE_CNT		
		Flushing of receive- or transmit-buffer							
n + 1	n + 6	reserved					TXBuf Dis	RXBUF FLUSH	TXBUF FLUSH
		Data bytes							
n + 2	n + 5	TX_data byte 0							
n + 3	n + 4	TX_data byte 1							
n + 4	n + 3	TX_data byte 2							
n + 5	n + 2	TX_data byte 3							
n + 6	n + 1	TX_data byte 4							
n + 7	n	TX_data byte 5							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

process input data

Designation	Value	Description
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 diagnostics message is sent only if the parameter "Deactivate diagnostics = no/0". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. The value TX_CNT was transferred together with the last data segment of the process output data. The value TX_CNT_ACK is a confirmation of successful acceptance of the data segment using TX_CNT.
RX_CNT	0-3	This value is transferred together with every data segment. The RX_CNT values are sequential: 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.

Designation	Value	Description
TXBufNotEmpty	0-1	This bit signalizes that the transmit buffer still contains data. It is automatically reset when the last character is sent. The bit can be used as control bit for actively triggering the sending of the TX data buffer.
BufOvfl; FrameErr; Hnd-ShErr; 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".

Process output data

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.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. The value RX_CNT was transferred together with the last data segment of the process input 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: 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.
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.
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.
TXBufDis	0-1	Setting this bit deactivates the sending of the TX buffer. The bit can be used as control bit for actively triggering the sending of the TX data buffer.

Schematic diagram of the transmit sequence

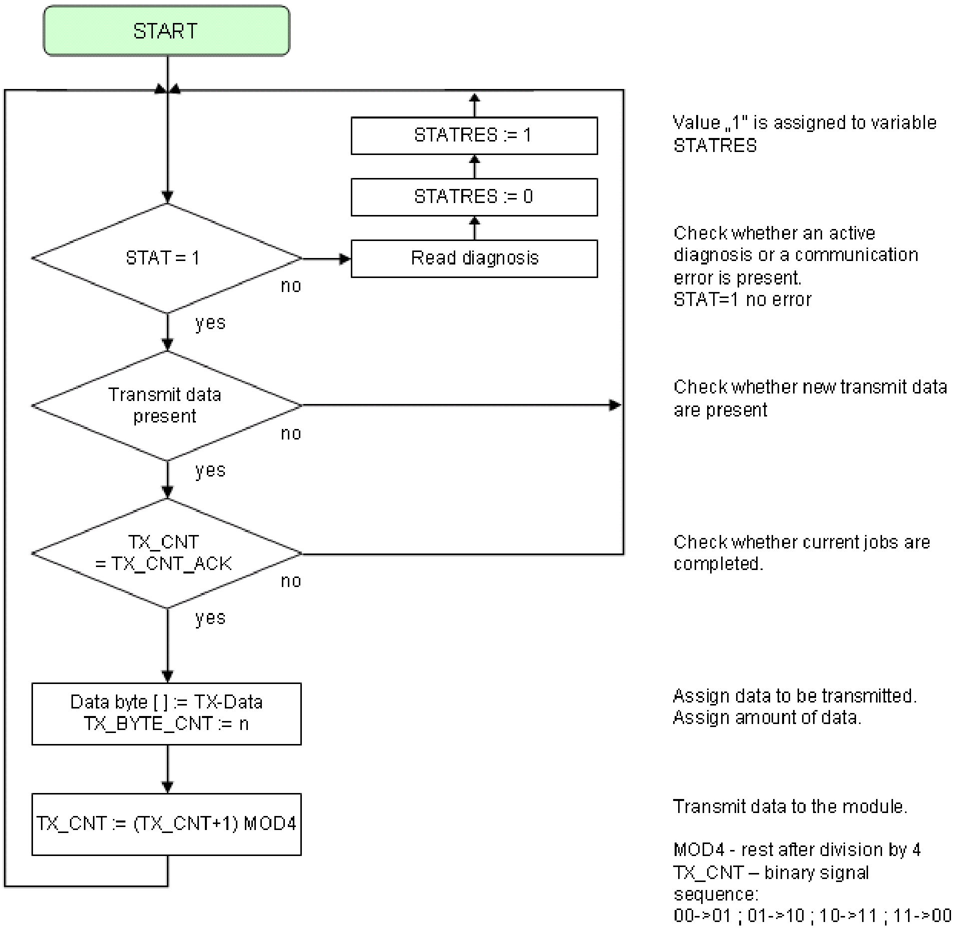


Fig. 280: Schematic diagram of the transmit sequence

12.3.7 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. This concerns modules located between this module and the gateway. Check the supply of the module bus.
	Red flashing 0.5 Hz	Diagnostics pending	
	Off	No error messages or diagnostics	–
TxD	Green	Data transmission active	-
	Off	No data transmission	-
RxD	Green	Data are currently received	-
	Off	No data are received	-

Diagnostic data

This module has the following diagnostic data per channel:

Diagnostic byte assignment, Process input data (page 398)

Diagnostics	Meaning
buffer overflow (Buf_Ovfl)	Overflow of the receive-buffer (RX-buffer).
Frame error (Frame_ERR)	The RS232-module has to be parameterized for adaptation to the data structure of the data terminal equipment (DTE). A frame error occurs in case of inconsequent parameterization (num-ber of data bits, stop bits, method of parity,...).
Data flow control error Data flow control (HndSh_ERR)	The DTE connected t the module does not react to XOFF or RTS hand-shake. The internal receive-buffer may overflow (buffer-overflow = 1).
Hardware error (HW_Fail)	The module has to be replaced (e.g. error in EEPROM or UART)
Parameterization error (PRM_ERR)	The parameter settings can not be supported.

12.3.8 Module parameters

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 0	Bit 0	Word 0	Bit 0	Byte 3	Bit 0	transmission rate
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	reserved
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	Extended status/control mode
	Bit 7		Bit 7		Bit 7	Deactivate all diagnostics
Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Stop bits
	Bit 1		Bit 9		Bit 1	Parity
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	Data bits
	Bit 4		Bit 12		Bit 4	Data flow control
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	reserved
	Bit 7		Bit 15		Bit 7	

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Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 2	Bit 0		Bit 0	Byte 1	Bit 0	XON character
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 3	Bit 0	Word 1	Bit 8	Byte 0	Bit 0	XOFF character
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	

Parameter name	Value	Meaning
transmission rate	300 bps 600 bps 1200 bps 2400 bps 4800 bps **9600 bps** 14400 bps 19200 bps 28800 bps 38400 bps 57600 bps 115200 bps	
Extended status/control mode	0 = no **1 = yes**	If the Extended status/control mode is activated, the diagnostic messages are mapped into byte 6 of the process input data (independent of parameter "deactivate diagnostics"). Byte 6 of the process output data contains two bits which may be set to flush the transmit- or the receive-buffer. Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.

Parameter name	Value	Meaning
Deactivate all diagnostics	**0 = no** 1 = yes	Sending of diagnostics activated/deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnosis embedded in the process input data.
Stop bits	0 = 1	Number of stop bits.
	1 + 2	
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.
Data bits	**0 = 7**	The number of data bits is 7.
	1 + 8	The number of data bits is 8.
Data flow control	**00 = none**	Data flow control is switched off.
	01 = XON/XOFF	Software handshake Software handshake (XON/XOFF) is switched on.
	10 = RTS/CTS	Hardware handshake Hardware handshake (RTS/CTS) is switched on.
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.
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.

12.4 RS485/422-interface – BL20-1RS485/422

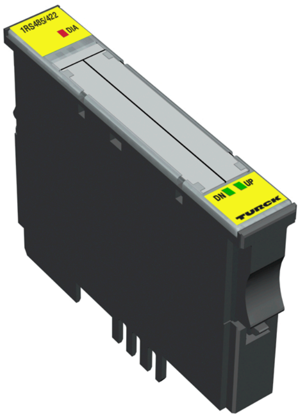

Fig. 281: BL20-1RS485/422

The module BL20-1RS485/422 allows the transfer of serial data streams via the RS485/422 interface and therefore enables various devices to be connected, such as printers, scanners or bar code readers that use the RS485/422 interface for communication. The interface transfers the data received from the device to the PLC or transfers data to be sent from the PLC to the device.

12.4.1 Data transfer method

The RS485/422-module enables flexible serial data transfer. The RS422 connection mode supports two wire simplex or four wire full-duplex transmission. The RS485 connection supports two wire half-duplex transmission.

An operational data transfer method can be set by the module's parameters.

The data transfer can be parameterized as follows:

- Data rate: 300…115200 Bit/s.
- Data bits: 7 or 8 data bits in one data frame
- Parity: none, odd or even
- Stop bits: 1 or 2 bit.

The data flow control can be implemented in RS422 operation with a software handshake (XON/XOFF) routine.

12.4.2 Data exchange

For the data exchange with a field device, the RS485/422-module provides a 64-byte transmit-buffer and a 128-byte receive-buffer. This is a hardware-restriction. The data telegrams which have to be sent or received can be larger.

The data transfer from the PLC into the transmit-buffer of the RS485/422-module or from the receive-buffer of the module to the PLC is realized via a 8-byte transmission channel in the **Process input data (page 411)** or **Process output data (page 413)**.

To ensure the error-free data transmission, 2 byte of each data package are used to display status-, control- and diagnosis information. The amount of user data is therefore reduced to 6 byte within a data package

12.4.3 Technical data

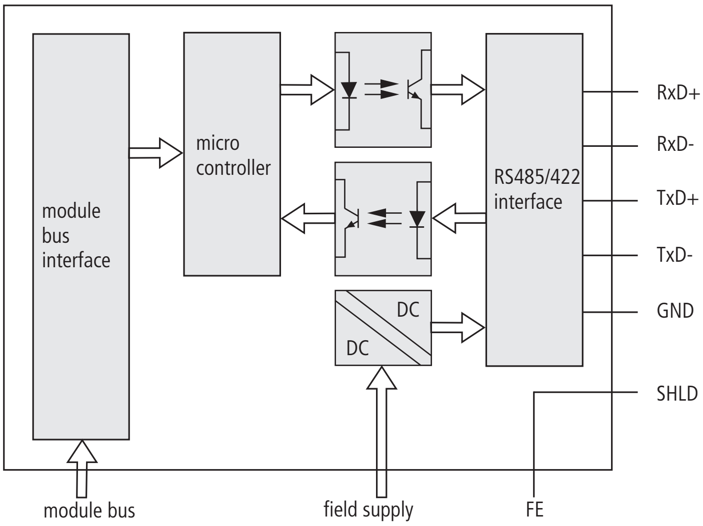

Fig. 282: Block diagram RS422

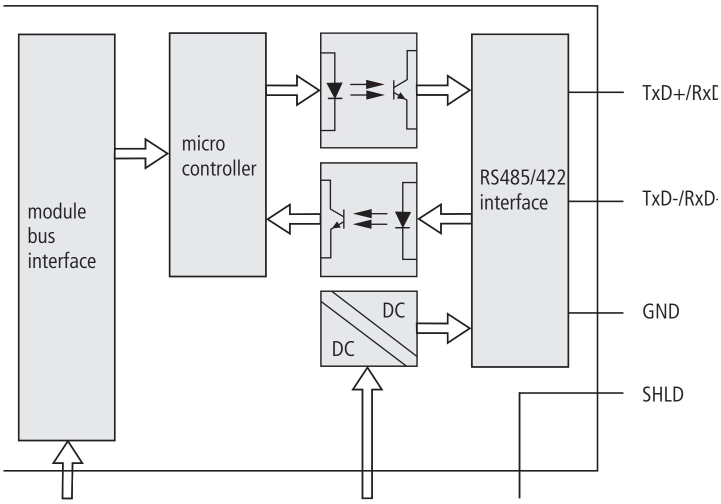

Fig. 283: Block diagram RS485

Technical data	
Designation	BL20-1RS485/422
Number of RS485/422 interfaces	1
Nominal voltage from supply terminal	18…30 VDC
Nominal current from supply terminal (field) I_L	25 mA
Voltage from module bus	4.75…5.25 VDC
Nominal current consumption from 5 VDC (module bus) I_{MB}	60 mA

Technical data	
Transmission channels	RxD, TxD
Data buffer	
Receive buffer?	128 byte
Transmit buffer	64 byte
RS422 connection type	Two wire simplex or Four wire full-duplex
RS485 connection type	Two wire half-duplex
transmission rate	Max. 115200 Bit/s (parameterizable)
RS485/422 cable length	Max. 30 m
Cable impedance	120 Ω
Bus terminating resistors	120 Ω (external)
Isolation voltage	
U_{TMB} (module bus/ field voltage/ RS485)	Max. 500 V_{eff}
U_{field} (field voltage/ RS485)	Max. 500 V_{eff}

12.4.4 Base modules

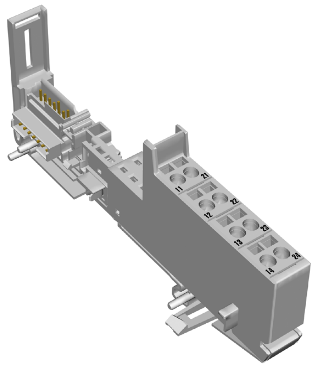

Fig. 284: Base module BL20-S4T-SBBS

- with tension clamp connection
  BL20-S4T-SBBS
- with screw connection
  BL20-S4S-SBBS

12.4.5 Wiring diagram

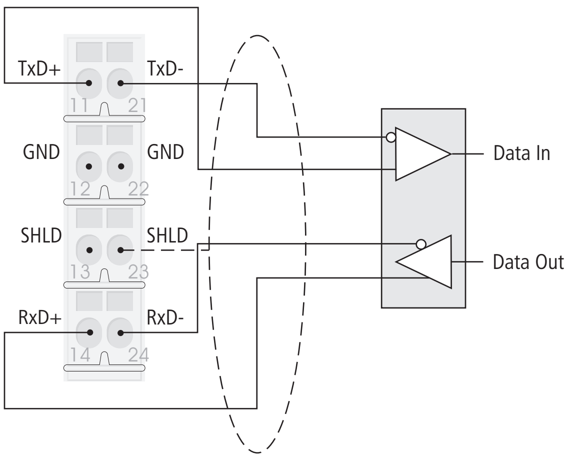

Fig. 285: Wiring diagram BL20-S4×-SBBS in RS422 operation

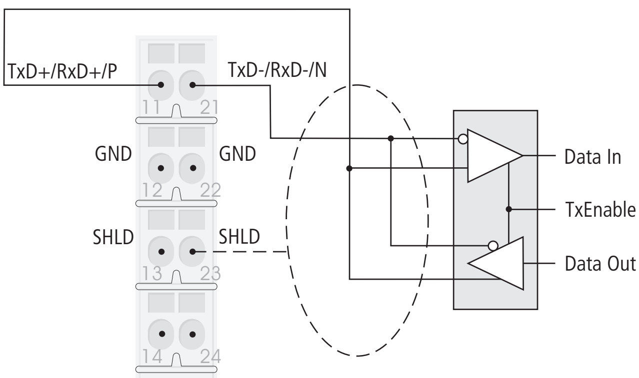

Fig. 286: Wiring diagram BL20-S4×-SBBS in RS485 operation

Signal types – Pin assignment RS485

Signal designation		
RxD	Receive Data	Receive data
TxD	Transmit Data	Transmit data
GND	Ground	Signal ground

12.4.6 Process input data

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:

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

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Status byte							
n	n + 7	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
		Diagnostics							
n + 1	n + 6	Buf_ Ovfl	Frame_ ERR	HndSh _ ERR	HW_ Fail	PRM_ ERR	reserved		TXBuf-NotEm pty
		Data bytes							
n + 2	n + 5	RX_data byte 0							
n + 3	n + 4	RX_data byte 1							
n + 4	n + 3	RX_data byte 2							
n + 5	n + 2	RX_data byte 3							
n + 6	n + 1	RX_data byte 4							
n + 7	n	RX_data byte 5							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Designation	Value	Description
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 diagnostics message is sent only if the parameter "Deactivate diagnostics = no/0". 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: 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.
TXBufNotEmpty	0-1	This bit signalizes that the transmit buffer still contains data. It is automatically reset when the last character is sent. The bit can be used as control bit for actively triggering the sending of the TX data buffer.
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".

Schematic diagram of the receive sequence

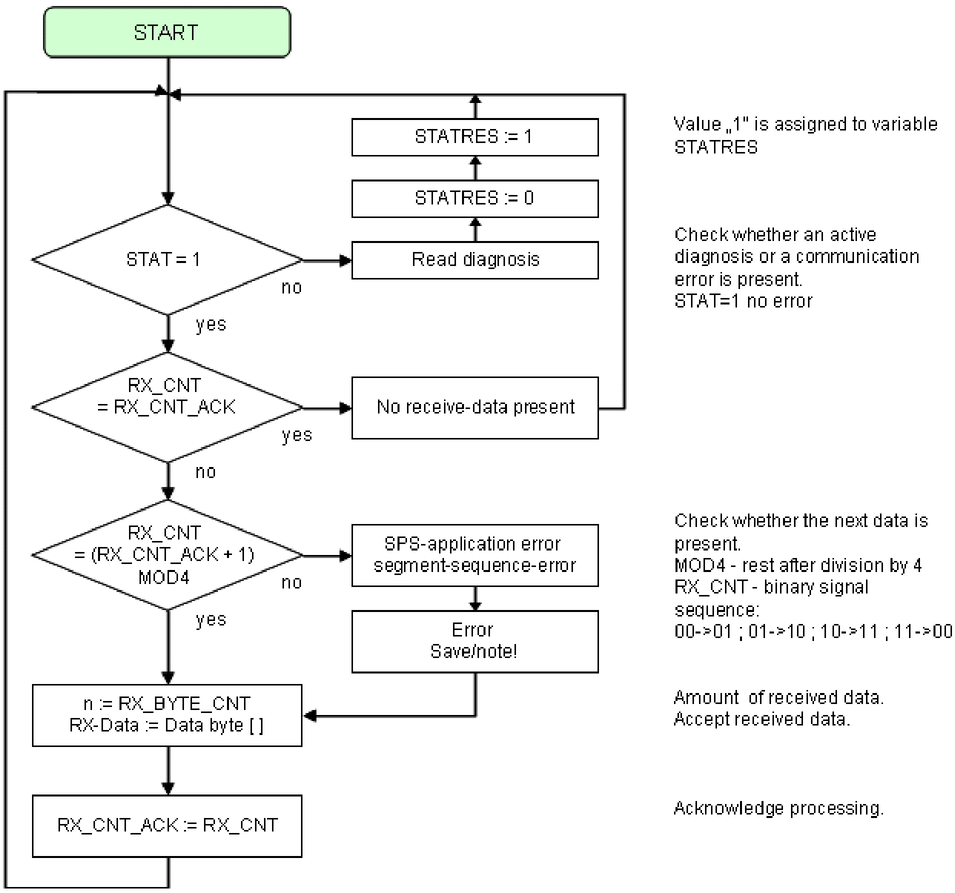

Fig. 287: Schematic diagram of the receive sequence

12.4.7 Process output data

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

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

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

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Control byte							
n	n + 7	STATRES	RX_CNT_ACK		TX_CNT		TX_BYTE_CNT		
		Flushing of receive- or transmit-buffer							
n + 1	n + 6	reserved					TXBuf-Dis	RXBUF FLUSH	TXBUF FLUSH
		Data bytes							
n + 2	n + 5	TX_data byte 0							
n + 3	n + 4	TX_data byte 1							
n + 4	n + 3	TX_data byte 2							
n + 5	n + 2	TX_data byte 3							
n + 6	n + 1	TX_data byte 4							
n + 7	n	TX_data byte 5							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

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 RX_CNT was transferred together with the last data segment of the process input 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: 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.

Designation	Value	Description
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. At TXBUF FLUSH = 1, the falling edge from 1 → 0 of STATRES, the send buffer is cleared.
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 receive buffer.
TXBufDis	0-1	Setting this bit deactivates the sending of the TX buffer. The bit can be used as control bit for actively triggering the sending of the TX data buffer.

Schematic diagram of the transmit sequence

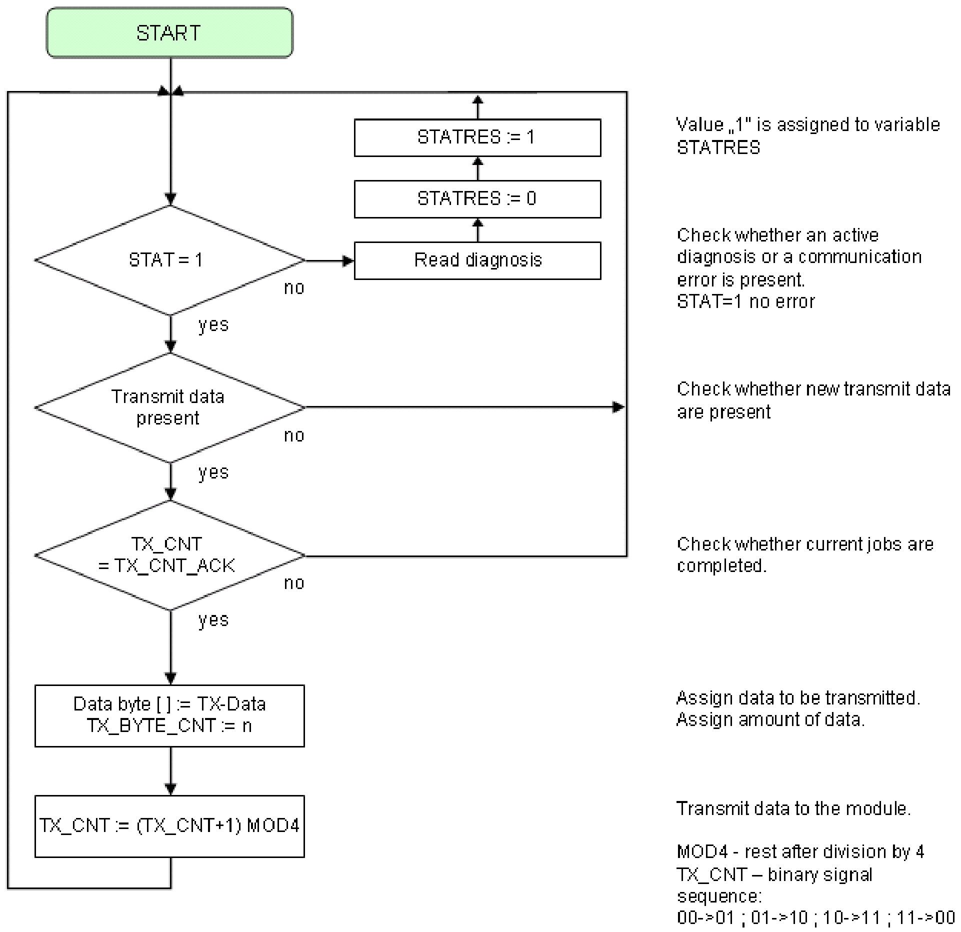

Fig. 288: Schematic diagram of the transmit sequence

12.4.8 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communi-cation failure	Check if more than two ad-joining electronics mod-ules have been pulled. This concerns modules located between this module and the gateway. Check the supply of the module bus.
	Red flashing, 0.5 Hz	Diagnostics pending Diagnostics	-
	Off	No error messages or diagnostics	–
TxD	Green	Data transmission active	-
	Off	No data transmission	-
RxD	Green	Data are currently received	-
	Off	No data are received	

Diagnostics

This module has the following diagnostic data per channel:

Diagnostic byte assignment, Process input data (page 398).

Diagnostics	Meaning
buffer overflow (Buf_Ovfl)	Overflow of the receive-buffer (RX-buffer).
Frame error (Frame_ERR)	The RS485/422-module has to be parameterized for adaptation to the data structure of the data terminal equipment (DTE). A frame error occurs in case of inconsequent parameterization (num-ber of data bits, stop bits, method of parity,...).
Data flow control error Data flow control (HndSh_ERR)	The DTE connected to the RS485/422-module does not react to XOFF or RTS handshake. The internal receive-buffer may overflow (buffer-overflow = 1).
Hardware error (HW_Fail)	The module has to be replaced (e.g. error in EEPROM or UART)
Parameterization error (PRM_ERR)	The parameter settings can not be supported.

12.4.9 Module parameters

Standard byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Byte 0	Bit 0	Word 0	Bit 0	Byte 3	Bit 0	transmission rate
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	RS422/RS485
	Bit 5		Bit 5		Bit 5	reserved
	Bit 6		Bit 6		Bit 6	Extended status/control mode
	Bit 7		Bit 7		Bit 7	Deactivate all diagnostics
Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Stop bits
	Bit 1		Bit 9		Bit 1	Parity
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	Data bits
	Bit 4		Bit 12		Bit 4	Data flow control
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	reserved
	Bit 7		Bit 15		Bit 7	

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Standard						
byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Byte 2	Bit 0	Word 1	Bit 0	Byte 1	Bit 0	XON character
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 3	Bit 0		Bit 8	Byte 0	Bit 0	XOFF character
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	

Parameter name	Value	Meaning
transmission 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	
RS422/RS485	0 = RS422 **1 = RS485**	Parameterization of the module as RS422 or RS485-interface.

Parameter name	Value	Meaning
Extended status/control mode	0 = no **1 = yes**	If the Extended status/control mode is activated, the diagnostic messages are mapped into byte 6 of the process input data (independent of parameter "deactivate diagnostics"). Byte 6 of the process output data contains two bits which may be set to flush the transmit- or the receive-buffer. Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.
Deactivate all diagnostics	0 = no **1 = yes**	Sending of diagnostics activated/deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnosis embedded in the process input data.
Stop bits	0 = 1	Number of stop bits.
	1 + 2	
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.
Data bits	**0 = 7**	The number of data bits is 7.
	1 + 8	The number of data bits is 8.
Data flow control	00 = none	The data flow control is switched off.
	01 = XON/XOFF	Software handshake (XON/XOFF) is switched on.
XON character (RS422)	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.
XOFF character (RS422)	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.

12.5 SSI-interface – BL20-1SSI

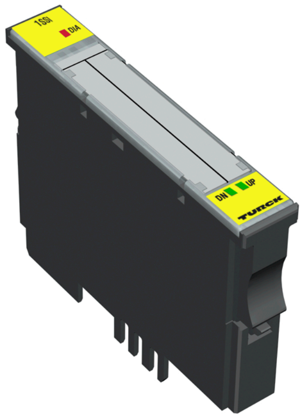

Fig. 289: BL20-1SSI

The SSI module is used for connecting SSI encoders with a maximum word length of 32 bits and a maximum bit transmission rate of 1 Mbps. It provides a 24 VDC (500 mA) power supply. In order to read SSI encoder data, the module outputs a clock signal with which the encoder value can be read via the signal input. The clock signal and the signal input are based on the RS422 protocol.

12.5.1 Data transfer method

The BL67-1SSI module enables the SSI data to be transferred according to the requirements of the-application. An operational data transfer method can be set by the module's parameters.

- Gray code or binary code data transmission is possible.
- Bit transmission rates from 62.5 kbps…1 Mbps are possible.

The SSI encoder value can be represented in a data frame with between 1…32 bits. Bits can be deactivated at both the LSB and MSB side of the frame. At the MSB side this is done by a masking operation, which causes invalid bits to be set to 0. At the LSB side, the invalid bits are removed by shifting the entire data frame to the right. The missing bits on the MSB side are filled with zeros.

12.5.2 Data exchange

The data transfer between the PLC to the SSI-module is cyclic. The cyclic data transfer from the PLC to the SSI-module is done via the **Process output data (page 425)**, The cyclic data transfer from the SSI-module to the PLC via the **Process input data (page 422)**.

The process output data is used for writing the registers and requesting data from them. It is possible to stop the communication with the SSI encoder and activate or deactivate comparison operations.

The process input data is used for reading the contents of the registers inside the modules. In this case, the SSI encoder value is part of the register. The writing of these registers can be controlled. The results of different comparison operations can be supplied, and the communication status with the SSI encoder can also be displayed. Status messages that were generated by the connected SSI encoder can be passed to the PLC as process input data.

The diagnostics messages are also embedded in the process input data.

The parameter and diagnostics interface allows acyclic data to be transferred in addition to this cyclic data. The parameters for the data transmission on the SSI module, such as bit transmission rate, telegram length etc. are set via the parameter interface. The diagnostics interface supplies the higher level system with error messages, such as parameter errors.

12.5.3 Technical data

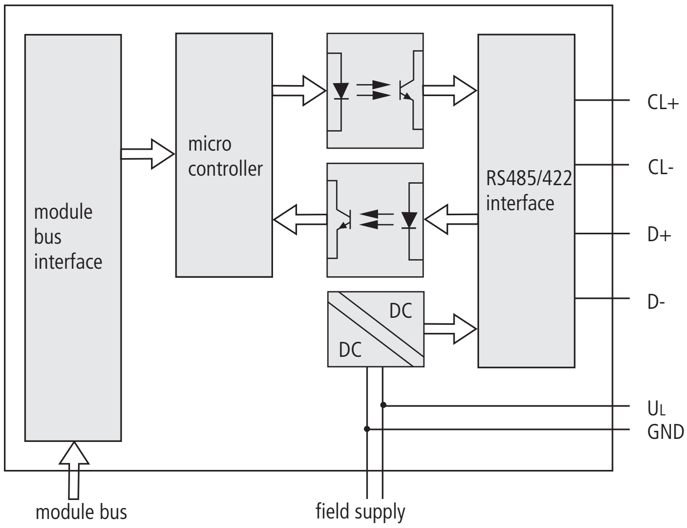

Fig. 290: Block diagram BL20-1SSI

The module is provided with two RS422 interfaces that form one SSI interface. One RS422 interface works as the clock generator for reading the data, which is then received on the other RS422 interface.

Technical data	
Designation	BL20-1SSI
Number of SSI-interfaces	1
Encoder voltage	24 VDC (-15 %/+20 %)
Encoder current	Max. 500 mA (non short-circuit proof)
Clock output type	RS422
Signal input type	RS422
RS422 cable length	Max. 30 m
Nominal voltage from supply terminal U_L	24 VDC
Nominal current from supply terminal (field) I_L	25 mA (without encoder current)
Nominal current consumption from 5 VDC (module bus) I_{MB}	< 50 mA
Power loss of the module	< 1 W
Isolation voltage	
U_{TMB} (module bus/ field)	500 V_{eff}
U_{FE} (field/ functional earth)	500 V_{eff}
U_{field} (field voltage/IO-connectors)	0 V

12.5.4 Base modules

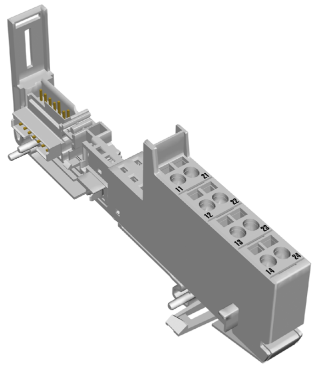

Fig. 291: Base module BL20-S4T-SBBS

- with tension clamp connection BL20-S4T-SBBS
- with screw connection BL20-S4S-SBBS

12.5.5 Wiring diagram

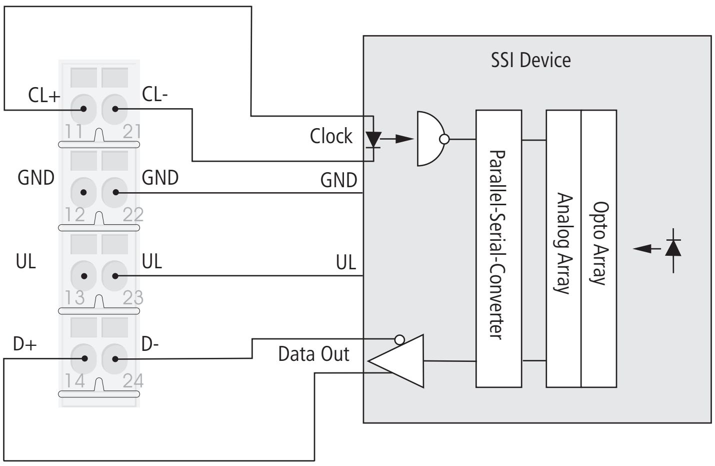

Fig. 292: Wiring diagram BL20-S4x-SBBS

12.5.6 Signal types – Pin assignment SSI

Signal designation	
CL	Clock
D	Data
GND	Ground

12.5.7 Process input data

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

The process input data is the data that is transferred to the PLC from the BL20-1SS1 via a gateway.

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 acknowledgment that the read operation was successful.
- 1 byte can be used to transfer status messages of the SSI encoder. This byte also contains an acknowledgment 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 × 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.

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Diagnostics							
n	n + 7	STS_STOP	-	-	ERR_ PARA	STS_ UFLW	STS_ OFLW	ERR_ SSI	SSI_DI AG
		Status messages SSI							
n + 1	n + 6	STS_UP	STS_DN	REL_ CMP2	FLAG CMP2	STS_ CMP2	REL_ CMP1	FLAG CMP1	STS_ CMP1
n + 2	n + 5	REG_WR_ ACEPT	REG_ WR_AKN	-	-	SSI_S TS3	SSI_S TS2	SSI_S TS1	SSI_S TS0
n + 3	n + 4	REG_RD_ ABORT	-	REG_RD_ADR					
		Data bytes							
n + 4	n + 3	REG_RD_DATA, data byte 0							
n + 5	n + 2	REG_RD_DATA, data byte 1							
n + 6	n + 1	REG_RD_DATA, data byte 2							
n + 7	n	REG_RD_DATA, data byte 3							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Meaning of the data bits (process input)

Designation	Value	Description
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1)
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
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)
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)
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.
STS_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.
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)
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.
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) ≥ (REG_CMP1)
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)

Designation	Value	Description
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.
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)
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
SSI_STS0	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_STS1	0	
	1	
SSI_STS2	0	
	1	
SSI_STS3	0	
	1	
REG_WR_AKN	0	No modification of the data in the register bank by process output, i.e. REG_WR = 0. A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.)
	1	A modification of the register contents by a process output was initiated, which means REG_WR = 1, see Process output data (page 425). A write job would not be accepted with the next telegram of process output data.
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_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.

Designation	Value	Description
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_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.

12.5.8 Process output data

Field output data is output from the SSI-module to a field device.

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

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

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

Byte	Byte DP/PN	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
		Control data							
n	n + 7	STOP	-	-	-	-	-	-	-
n + 1	n + 6	-	-	-	CLR CMP2	EN CMP2	-	CLR CMP1	EN CMP1
n + 2	n + 5	REG_WR	-	REG_WR_ADR					
n + 3	n + 4	-	-	REG_RD_ADR					
		Data bytes							
n + 4	n + 3	REG_WR_DATA, data byte 0							
n + 5	n + 2	REG_WR_DATA, data byte 1							
n + 6	n + 1	REG_WR_DATA, data byte 2							
n + 7	n	REG_WR_DATA, data byte 3							

n = offset of input data; depending on extension of station and the corresponding fieldbus.

Designation	Value	Description
STOP	0	Request to read the SSI encoder cyclically
	1	Request to interrupt communication with the encoder
EN_CMP1	0	Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_C-MP1 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 compari-son with the SSI encoder value.

Designation	Value	Description
CLR_CMP1	0	Default status, i.e. reset of FLAG_CMP1 not active.
	1	Reset of FLAG_CMP1 active.
EN_CMP2	0	Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_C-MP2 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_CMP2	0	Default status, i.e. no reset of FLAG_CMP2 active.
	1	Reset of FLAG_CMP2 active.
REG_WR_ADR	0…63	Address of the register, which has to be written with REG_WR_DATA.
REG_WR	0	Default status, i.e. there is no request to overwrite the content of the register with the address stated at REG_WR_ADR with REG_WR_-DATA. Bit REG_WR_AKN is reset (0) if necessary.
	1	Request to overwrite the content of the register with address REG_WR_ADR with REG_WR_DATA.
REG_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_DATA	0… 2^{32}-1	Value which has to be written to the register with the address REG_WR_ADR.

12.5.9 Internal registers - read and write operations

The SSI module is provided with a universal register interface that enables access to up to 64 registers.

These are accessed via the process data. For write access, it must be ensured beforehand that the register write interface is in the default status and that a write access operation is therefore not currently active. This is ensured if REG_WR = 0 in the process output data, and is confirmed in the process input data with REG_WR_AKN = 0. Write access is then possible. The following values must be transferred with the process output data for this:

- REG_WR_ADR = register address,
- REG_WR_DATA = value to be written (32 bit)
- REG_WR = 1 (write command)

The SSI module acknowledges the processing of the write command via the process input data by signaling REG_WR_AKN = 1. REG_WR_ACEPT = 1 in the process input data confirms whether the write operation to the register was successfully completed. If the register could not be written (no access authorization, out of value range,...), this is indicated by REG_WR_ACEPT = 0. The write operation must then be terminated by REG_WR = 0 in order to resume the default state.

The address specified at REG_RD_ADR of the process output data is used for read access. The read register content is entered in REG_RD_DATA (bytes 4-7) if the address at REG_RD_ADR was accepted in the process input data and if REG_RD_ABORT = 0 confirms that the register was read error-free. REG_RD_ABORT = 1 indicates that the register could not be read. REG_RD_ADR in the process input data then contains the address that could not be accessed successfully. The user data is then set to ZERO.

Register access and meaning

Designation	No.	Description	Default (HEX)
REG_SSI_POS	0	Actual binary SSI encoder value	
REG_MAGIC_NO	1	Magic number (0xaa55cc33)	
REG_HW_VER	2	Hardware version	
REG_SW_VER	3	Software version	
REG_SF	4	Special Function register	
	5…13	reserved	
REG_WR_ADR	14	Pointer register OUT	
REG_RD_ADR	15	Pointer register IN	
REG_DIAG1	16	Diagnostics	
	17…19	reserved	
REG_PARA1	20	parameter data	0×1901 0000
	21…31	reserved	
REG_GRAY_POS	32	Actual Gray-coded SSI encoder value.	
REG_SSI_FRAME	33	Complete frame read from SSI encoder.	
REG_CMP1	34	Reference value 1	0×0000 0000

Designation	No.	Description	Default (HEX)
REG_CMP2	35	Reference value 2	0x0000 0000
REG	36…47	reserved	
REG_LOWER_ LIMIT	48	Lower limit	0x0000 0000
REG_UPPER_ LIMIT	49	upper limit	0xFFFF FFFF
REG_OFFSET	50	Offset value	0x0000 0000
REG_SSI_MASK	51	Selection of the SSI encoder diag- nostics transferred to the diagnos- tics interfaces.	0x0000 0000
REG	52…63	reserved	

Designation		Interfaces				
		Process output	Storage in module	Process input	Param.	Diagn.
REG_SSI_POS	0			RD		
REG_MAGIC_NO	1			RD		
REG_HW_VER	2			RD		
REG_SW_VER	3			RD		
REG_SF	4	WR	volatile	RD		
REG_WR_ADR	14			RD		
REG_RD_ADR	15			RD		
REG_DIAG1	16			RD		RD
REG_PARA1	20	WR	non volatile	RD	WR	
REG_GRAY_POS	32			RD		
REG_SSI_FRAME	33			RD		
REG_CMP1	34	WR	volatile	RD		
REG_CMP2	35	WR	volatile	RD		
REG_LOWER_LIMIT	48	WR	non volatile	RD		
REG_UPPER_LIMIT	49	WR	non volatile	RD		
REG_OFFSET	50	WR	non volatile	RD		
REG_SSI_MASK	51	WR	non volatile	RD		

NOTE
The non volatile registers can be written maximum 100.000 times.

Comparison value 1, comparison value 2

The recorded encoder position can be compared with two loadable values. The character ″x″ below stands for ″1″ or ″2″. The register contents are loaded into the register REG_CMPx using in a write operation. The comparison functions are activated by setting bit EN_CMPx = 1 in the process output data. The results of the continuous comparison operations are displayed in the process input data via STS_CMPx, REL_CMPx and FLAG_CMPx. Bit REL_CMPx indicates as the actual status message the relation of the actual value (register content of REG_SSI_POS) to the comparison value (register content of REG_CMPx). Bit STS_CMPx is non-retentive and indicates whether the current actual value (REG_SSI_POS) and the comparison value (REG_CMPx) match. FLAG_CMPx is also used as a marker to indicate that the status (REG_SSI_POS = REG_CMPx) is present or has been passed. This bit must be reset by the application via the process output data using CLR_CMPx = 1. If the comparator is inactive (EN_CMPx = 0), the signals from STS_CMPx, REL_CMPx and FLAG_CMPx are always zero.

Comparator EN_CMPx = 0		
Process input data		**Process output data**
	REL_CMPx = 0 STS_CMPx = 0 FLAG_CMPx = 0	
Comparator EN_CMPx = 1		
Process input data		**Process output data**
(REG_SSI_POS) < (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx =0 FLAG_CMPx = Z0 The value Z0 of this flag is 1 as soon as the comparison values match. The value remains 1 until it is reset.	Reset of FLAG_CMPx with CLR_C-MPx = 1
(REG_SSI_POS) > (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx =0 FLAG_CMPx = Z0 The value Z0 of this flag is 1 as soon as the comparison values match. The value remains 1 until it is reset.	Reset of FLAG_CMPx with CLR_C-MPx = 1
(REG_SSI_POS) = (REG_CMPx)		
	REL_CMPx = 1 STS_CMPx = 1 FLAG_CMPx = 1	Rest of FLAG_CMPx not possible, as long as equality exists.

Lower limit, upper limit

The recorded encoder position can be compared with two loadable values. The upper limit value must be entered in the REG_UPPER_LIMIT register and the lower limit value in REG_LOWER_LIMIT. Writing these registers with values that are different to the default values will activate the monitoring of the limits, and bits STS_OFLW and STS_UFLW will be enabled in the process input data. The diagnostics function will indicate the presence of values above or below the default values.

"Encoder value overflow" and "Encoder value underflow" signals will also indicate this via the acyclic diagnostics interface.

The limit values are set by default to the maximum and minimum value.

Register access	process input data	Diagnostics
REG_UPPER_LIMIT at default value $FFFFFFFF_h$	STS_OFLW = 0	Value: 0
Register content of REG_UPPER_LIMIT less than $FFFFFFFF_h$	(REG_SSI_POS) ≤ (REG_UPPER_LIMIT)	Value: 0
	STS_OFLW = 0	
	(REG_SSI_POS) > (REG_UPPER_LIMIT)	Value: 1 Text: Overflow
	STS_OFLW = 1	

Register access	process input data	Diagnostics
REG_LOWER_LIMIT at default value $FFFFFFFF_h$	STS_UFLW = 0	Value: 0
Register content of REG_LOWER_LIMIT larger than 0	(REG_SSI_POS) ≥ (REG_LOWER_LIMIT)	Value: 0
	STS_UFLW = 0	
	(REG_SSI_POS) < (REG_LOWER_LIMIT)	Value: 1 Text: Underflow
	STS_UFLW = 1	

Offset function / load value

This function is activated by writing the REG_OFFSET register with a value <> 0. The content of the register is then subtracted from the SSI encoder value and stored in REG_SSI_POS. All limit values, such as lower limit, upper limit, comparison value 1, comparison value 2 then refer to the newly calculated value (REG_SSI_POS).

The calculation is thus:

(REG_SSI_POS) = SSI encoder - (REG_OFFSET)´

This function can be deactivated by writing the REG_OFFSET with zero.

Status messages of the SSI encoder

Some SSI encoders not only transfer the position value in the data frame that they transfer to the module but also supply additional status messages. It is useful to include these status messages in the application in order to analyze the measured value.

Writing the REG_SSI_MASK register allows up to four individual bits to be taken from the data frame of the SSI encoder and transferred to the SSI_STSx bits of the process input data.
It is also possible to output the "SSI encoder group diagnostics message" with an acyclic diagnostics operation when a status message is initiated.

Masking with REG_SSI_MASK

Process input data			**REG_SSI_MASK**					
	Byte	**Bit 7**	**Bit 6**	**B 5**	**B 4**	**B 3**	**B 2**	**B 1**
SSI_STS0	0	EN_ D0_RMS0	EN_D0_DS	-	SSI_FRAME_BIT_SEL0			
SSI_STS1	1	EN_ D1_RMS1	EN_D1_DS	-	SSI_FRAME_BIT_SEL1			
SSI_STS2	2	EN_ D2_RMS2	EN_D2_DS	-	SSI_FRAME_BIT_SEL2			
SSI_STS3	3	EN_ D3_RMS3	EN_D3_DS	-	SSI_FRAME_BIT_SEL3			

Designation	**Value**	**Description**
EN_Dx_RMSx	0	The transfer of the SSI status messages to the process input data is not activated
	1	The transfer of the SSI status messages to the process input data is activated
EN_ Dx_DS	0	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
SSI_FRAME_BIT_SEL	0-31	Definition of the selected bits in the frame of the SSI encoder to be evaluated or copied. default 0

The following applies to bit 0 (SSI group diagnostics) of the diagnostics interface and SSI_DIAG of the process input data:

(SSI_STS0 & EN_D0_DS) ||(SSI_STS1 & EN_D1_DS) || (SSI_STS2 & EN_D2_DS) || (SSI_STS3 & EN_D3_DS)

Resetting the register bank

If register REG_SF is written with the signature:

„LD20" = 0 × 6C643230

all default values of the retentive registers (incl. parameter registers) are reset.

If register REG_SF is written with the signature:

„LD48" = 0 × 6C643438

all default values of the retentive registers except the parameter registers are reset.

NOTE

Overwritten values are lost.all default values of the retentive registers (incl. parameter registers) are reset.

12.5.10 Diagnostic and status messages

LED status displays

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure	Check if more than two ad-joining electronics modules have been pulled. This concerns modules located between this module and the gateway. Additionally check, if the SSI.encoder is correctly working and supports the data cable test in the required form.
	Off	No error messages or diagnostics	–
UP	Green	Direction of movement up	–
	Off	No direction of movement up	–
DN	Green	Direction of movement down	–
	Off	No direction of movement down	–

Diagnostics

This module has the following diagnostic data per channel:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
-	-	-	Configuration error	Sensor value underflow	Sensor value uverflow	Wire break	SSI Group diagnostics

Diagnostics	Meaning
SSI group diagnostics	Status messages of the SSI encoder present.
Wire break	SSI encoder signal faulty (e.g. due to a cable break).
Hardware error	The module has to be replaced (e.g. error in EEPROM or UART)
Overflow	SSI encoder value above upper limit. Overflow occurred.
Underflow	SSI encoder value below lower limit. Underflow occurred.
Parameterization error	The parameter settings can not be supported.

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12.5.11 Module parameters

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 0	Bit 0	Word 0	Bit 0	Byte 3	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	Sensor idle data cable test
	Bit 6		Bit 6		Bit 6	reserved
	Bit 7		Bit 7		Bit 7	
Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	Invalid bits (LSB)
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	Invalid bits (MSB)
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	reserved

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 2	Bit 0		Bit 0	Byte 1	Bit 0	transmission rate
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	reserved
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 3	Bit 0	Word 1	Bit 8	Byte 0	Bit 0	Data frame bits
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	reserved
	Bit 7		Bit 15		Bit 7	Data format

:

Parameter name	Value	
Sensor Sensor idle data test	**activate**	ZERO test of data cable.
	Deactivate web server	After the last valid bit, a ZERO test of the data cable is not carried out.
Number of invalid bits (LSB)	0…15	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.

Parameter name	Value	
Invalid bits (MSB)	0…7	Number of invalid bits on the MSB 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
transmission rate	1000000 bps **500000 bps** 250000 bps 125000 bps 100000 bps 83000 bps 71000 bps 62500 bps	
Number of data frame bits	1…32	Number of bits of the SSI data frame. SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: **25** = 19hex
Data format	**Binary coded**	SSI encoder sends data in binary code
	GRAY coded	SSI encoder sends data in GRAY code

12.6 BL20-E-1SWIRE

Fig. 293: BL20-E-1SWIRE

12.6.1 Features

The BL20-E-1SWIRE makes it possible to operate an SWIRE bus with up to 16 SWIRE slaves. A 6-core cable is used here for power and data transfer.

A BL20-Station may contain a maximum number of 3 SWIRE-modules.

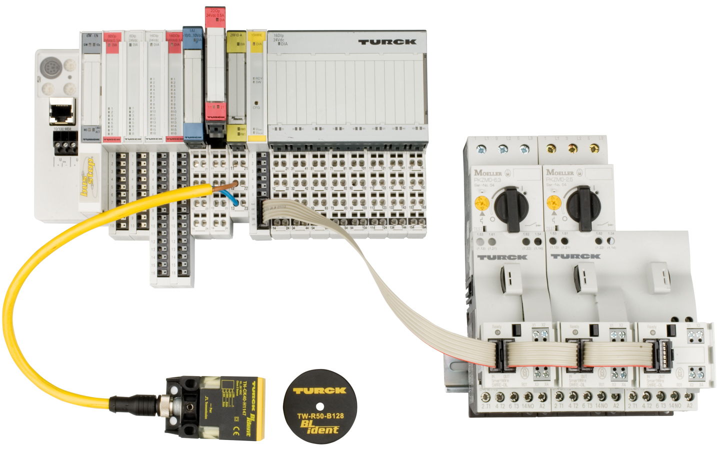

Fig. 294: BL20-E-1SWIRE in the system

The voltage UAUX for supplying the relays and the USW for supplying the electronic equipment must be connected separately on the BL20-E-1SWIRE. Both power supplies must be fed from a single power supply unit although it is possible to disconnect UAUX separately. The SWIRE slaves and the accessories must be purchased from Turck.

The product BL20-E-1SWIRE connects the motor starters networked via SWIRE as local components to different standard fieldbus systems.

The maximum number of BL20-E-1SWIRE modules per BL20 station is restricted by:

- the number of process data, diagnostics, parameter and configuration bytes of the BL20-E-1SWIRE:
  - 8 byte input data
  - 8 byte output data
  - 24 byte parameter data
  - 8 byte diagnostics data.
- and the field bus system used.

From version VN 01-04, BL20-E-1SWIRE can be run in conformance with the Moeller SmartWire standard. For this the "Moeller Conformance" function has been implemented. See s. **S. 458**, **Moeller SWIRE conformance criteria**.

Process input data

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
n -1	Data of modules to the left							
n	SWIRE Slave 2				SWIRE Slave 1			
	SC2		PKZ-ST2	SI2	SC1		PKZ-ST1	SI1
n+1	SWIRE Slave 4				SWIRE Slave 3			
	SC4		PKZ-ST4	SI4	SC3		PKZ-ST3	SI3
n +2	SWIRE Slave 6				SWIRE Slave 5			
	SC6		PKZ-ST6	SI6	SC5		PKZ-ST5	SI5
n + 3	SWIRE Slave 8				SWIRE Slave 7			
	SC8		PKZ-ST8	SI8	SC7		PKZ-ST7	SI7
n +4	SWIRE Slave 10				SWIRE Slave 9			
	SC10		PKZ-ST10	SI10	SC9		PKZ-ST9	SI9
n +5	SWIRE Slave 12				SWIRE Slave 11			
	SC12		PKZ-ST12	SI12	SC11		PKZ-ST11	SI11
n+6	SWIRE Slave 14				SWIRE Slave 13			
	SC14		PKZ-ST11	SI14	SC13		PKZ-ST13	SI13
n+7	SWIRE Slave 16				SWIRE Slave 15			
	SC16		PKZ-ST16	SI16	SC15		PKZ-ST15	SI15
n+8 ff.	Data of modules to the right							

Design.	Status	Comment		
SIx		Switch status, relay x		
		SIx supplies the switch status of the contactor coil of the SWIRE slave as a feed-back 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 sub-sequent feedback signal.		
	0	Out	Off	Contactor coil is switched off
	1	ON	On	Contactor coil is switched on
PKZSTx		Switch status, PKZ x		
	0	Out	Off	The motor-protective circuit breaker is off or has tripped
	1	ON	On	The motor-protective circuit breaker is switched on
SCx		Communication error, slave x		
		Setting the parameter $SC_{DIAG}Sx$ sets the SCx-bit in the process input data. The information is provided as status information in the PLC for the user.		
	0	ON LINE	ON LINE	Status of slave x:
	1	Off LINE	Off LINE	Status of slave x: diagnostics available

Process output data

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

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

12.6.2 Function parameterization

Scan physical structure and store in the BL20-E-1SWIRE

In order for the SWIRE bus to start operation, the physical structure must match the SWIRE configuration stored in the BL20-E-1SWIRE. On power up, the physical structure of the SWIRE bus is scanned and compared with the SWIRE configuration stored in the BL20-E-1SWIRE (configuration check of number of slaves, type and assigned address). If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE (SW LED flashing):

- the physical structure of the SWIRE bus must be stored in the BL20-E-1SWIRE
- or the physical structure must be corrected.

The parameter setting determines how the physical structure of the SWIRE bus is stored:

- manually (see section "Manual SWIRE configuration (default setting)", s. S. 439)
- or automatically (see section "Automatic SWIRE configuration", s. S. 439).

NOTE
Only the manual SWIRE configuration is possible if the "Moeller Conformance" function is active. The BL20-E-1SWIRE is factory set with a stored configuration of "Zero" slaves

Storing with manual and automatic SWIRE configuration:

- The slaves physically located on the SWIRE bus are scanned.
- Each slave is assigned an address which is stored in the corresponding slave.
- The configuration is stored in the BL20-E-1SWIRE.

Manual SWIRE configuration (default setting)

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).

The parameter "Disable CfG" has to be set to "0 " (see Module parameters (page 451))

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.

The parameters "Disable CfG" and "MC" have to be set to "1" (see Module parameters (page 451))

Activate and deactivate PLC configuration check

During the PLC configuration check, the configuration stored in the BL20-E-1SWIRE is compared with the SET configuration stored in the PLC. The complete device ID must match. If the two configurations match completely, the entire SWIRE bus is ready for data exchange (RDY LED lit). If the two configurations do not match, the system responds according to other parameter settings (see **System behavior with negative configuration checks and slave failure**, s. **S. 440**).

PLC configuration check active (default setting)

Parameter „configuration" = 0 (see **Module parameters (page 451)**)

PLC configuration check inactive

Parameter „configuration" = 1 (see **Module parameters (page 451)**)

System behavior with positive configuration checks

1. The physical structure of the SWIRE bus is scanned on power up and compared with the configuration stored in the BL20-E-1SWIRE.
   – The SWIRE bus starts operation (SW LED lit) if the physical structure of the SWIRE bus matches the SWIRE configuration stored in the BL20-E-1SWIRE.
2. 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. The complete device ID must match.
   – If the two configurations match completely, the entire SWIRE bus is ready for data exchange (RDY LED lit).
3. The system then starts data exchange.
4. The physical structure of the SWIRE bus is monitored continuously during operation so that any changes on the bus or slave failures can be detected.

System behavior with negative configuration checks and slave failure

ATTENTION

SWIRE bus energized

Destruction of the device

➤ De-energize the SWIRE bus before carrying out any changes.

The system behavior when the result of a configuration check is negative, depends on the individual parameter settings

NOTE

The following functions are deactivated if the "Moeller Conformance" function is active:

– Automatic SWIRE configuration
– Bus oriented configuration check
– Slave oriented configuration check

The following occurs if the physical structure of the SWIRE bus is found not to match the configuration stored in the BL20-E-1SWIRE on power up (SW LED flashing):

- If the "Moeller Conformance" function is deactivated, the physical structure is continuously compared with the configuration stored in the BL20-E-1SWIRE. The SWIRE bus starts operation as soon as the matching configurations are detected:
  – After the physical structure was stored in the BL20-E-1SWIRE:
  - Automatically (if the automatic SWIRE configuration is activated)

- Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).

– After the physical structure has been rectified.

- The operation is aborted if the "Moeller Conformance" function is activated. The SWIRE bus only starts operation:

The following occurs if the PLC configuration check (PLC configuration check must be activated) finds that the configuration stored in the BL20-E-1SWIRE does not completely match the SET configuration stored in the PLC:

- If the configuration check is set to line oriented or the "Moeller Conformance" function is activated, the operation is aborted for the entire SWIRE bus (RDY LED flashing).
- If the configuration check is set to slave-oriented:
  – The SWIRE slaves that match are ready for data exchange.
  – The operation is aborted for the SWIRE slaves that do not match.

The system behaves as follows if a modification to the bus or a slave failure is detected:

- If the "Moeller Conformance" function is activated, the system retains data exchange with the functional SWIRE slaves.
- If the "Moeller Conformance" function is deactivated, SWIRE communication on the entire SWIRE bus is aborted. The physical structure is then compared cyclically with the configuration stored in the BL20-E-1SWIRE.
  – The SWIRE bus starts operation as soon as the matching configurations are detected:
    - After the physical structure was stored in the BL20-E-1SWIRE:
      - Automatically (if the automatic SWIRE configuration is activated)
      - Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).
    - After the physical structure has been rectified.
  – Depending on the parameter settings, the data exchange is then either started or the operation is aborted:
    - The data exchange is resumed immediately if the PLC configuration check is deactivated.
    - If the PLC configuration check is activated and the configuration check is set to Bus-oriented, data exchange is only restarted if the configuration stored in the BL20-E-1SWIRE matches the SET configuration stored in the PLC. The operation for the entire SWIRE bus is aborted if they do not match completely.
  – If the PLC configuration check is activated and the configuration check is set to Slave-oriented, the configuration stored in the BL20-E-1SWIRE is compared with the SET configuration stored in the PLC:
    - The SWIRE slaves that match resume data exchange.
    - The operation is aborted for the SWIRE slaves that do not match.

Line oriented configuration check (default setting)

NOTE
This function is automatically deactivated if the "Moeller Conformance" function is active.

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 is compared continuously with the configuration stored in the BL20-E-1SWIRE. The SWIRE bus starts operation as soon as the matching configurations are detected:

- After the physical structure was stored in the BL20-E-1SWIRE:
  - Automatically (if the automatic SWIRE configuration is activated)
  - Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).
- After the physical structure has been rectified.

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. If the two configurations do not match completely (RDY LED flashing), the operation is aborted for the entire SWIRE bus (RDY LED flashing).

SWIRE communication is aborted for the entire SWIRE bus, if a bus modification or slave failure is detected during operation. The physical structure is then compared cyclically with the configuration stored in the BL20-E-1SWIRE.

- The SWIRE bus starts operation as soon as the matching configurations are detected:
  - After the physical structure was stored in the BL20-E-1SWIRE:
    - Automatically (if the automatic SWIRE configuration is activated)
    - Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).
  - After the physical structure has been rectified.
- Depending on the parameter settings, the data exchange is then either started or the operation is aborted:
  - The data exchange is resumed immediately if the PLC configuration check is deactivated.
  - If the PLC configuration check is activated, data exchange is only restarted if the configuration stored in the BL20-E-1SWIRE fully matches the SET configuration stored in the PLC. The operation for the entire SWIRE bus is aborted if they do not match completely.

Parameter setting:

Parameter „MNA“ and „MC“ = 0 (see **Module parameters (page 451)**)

Slave oriented configuration check

> **NOTE**
> This function is automatically deactivated if the ”Moeller Conformance” function is active.

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 is compared continuously with the configuration stored in the BL20-E-1SWIRE. The SWIRE bus starts operation as soon as the matching configurations are detected:

- After the physical structure was stored in the BL20-E-1SWIRE:
  - Automatically (if the automatic SWIRE configuration is activated)
  - Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).
- After the physical structure has been rectified.

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.

SWIRE communication is aborted for the entire SWIRE bus, if a bus modification or slave failure is detected during operation. The physical structure is then compared cyclically with the configuration stored in the BL20-E-1SWIRE.

- The SWIRE bus starts operation as soon as the matching configurations are detected:
  - After the physical structure was stored in the BL20-E-1SWIRE:
    - Automatically (if the automatic SWIRE configuration is activated)
    - Or manually (if the automatic SWIRE configuration is deactivated), by pressing the CFG button (only functions if the SW LED is flashing).
  - After the physical structure has been rectified.
- Depending on the parameter settings, the data exchange is then either started or the operation is aborted:
  - The data exchange is resumed immediately if the PLC configuration check is deactivated.
  - 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.
    - The SWIRE slaves that match resume data exchange.
    - The operation is aborted for the SWIRE slaves that do not match.

Parameter setting:

- Parameter „MNA“ = 1 and „MC“ = 0 (see **Module parameters (page 451)**)

12.6.3 MC (Moeller Conformance)

If the ”Moeller Conformance” function is activated, the BL20-E-1SWIRE behaves according to the Moeller SWIRE conformance criteria. See **Moeller SWIRE conformance criteria**, s. **S. 458**.

If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE (SW LED flashing) when USW is switched on, the SWIRE bus only starts operation:

- After the physical structure was stored in the BL20-E-1SWIRE:
  - Manually, by pressing CFG button (only functions if the SW LED is flashing). After the configuration is stored, the physical structure is compared once more with the configuration stored in the BL20-E-1SWIRE.
- If the physical structure of the SWIRE bus matches the configuration stored in the BL20-E-1SWIRE the next time that U_{SW} is switched on.

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. If the two configurations do not match completely (RDY LED flashing), the operation is aborted for the entire SWIRE bus (RDY LED flashing).

The system retains data exchange with the functional SWIRE slaves if a modification or slave failure is detected in the SWIRE bus during operation.

Parameter setting:

- Parameter „MC“ = 1 (see **Module parameters (page 451)**)

12.6.4 Further parameters

The parameters U_{AUXERR}, TYP_{ERR}, TYP_{INFO}, PKZ_{ERR}, PKZ_{INFO}, SD_{ERR} and SD_{INFO} enable events to be indicated to the PLC as an error message or not.

Diagnostics

Faulty system states are indicated by means of a number of different diagnostics messages. 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.

12.6.5 Technical features

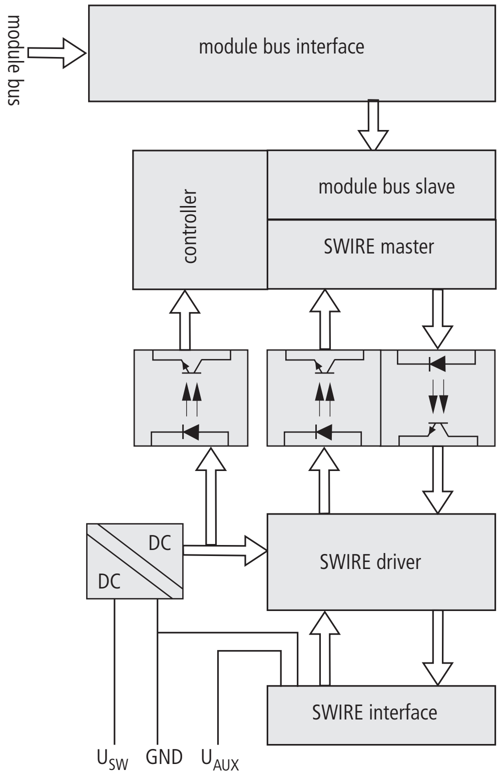

Fig. 295: Block diagram

Technical data

Technical data	
Designation	BL20-E-1SWIRE
Number of SWIRE buses	1
Number of slaves per bus	16
pPower supply	
Field voltage (range)	24 VDC (18…30 VDC)
Field current (SWIRE buses at full load)	max 600 mA
Power supply of contactors (range)	24 VDC (18…30 VDC)
Power supply current of contactors	3 A
Rated current from module bus (module bus voltage)	60 mA (4,75…5,25 VDC)
Power supply of SWIRE slaves (short-circuit protected)	17 VDC
Power supply current of all SWIRE slaves (short-circuit protected)	max 500 mA
Insulation voltage between SWIRE and the module bus	500 V_{eff}

Technical data	
Insulation voltage between power supply of contactors and the field voltage	500 V_{eff}
Insulation voltage between SWIRE and power supply of contactors	none
Product standard	EN 61131-2
Protection class	IP 20

Approved SWIRE slaves

The following slaves on the SWIRE bus are currently approved for the BL20-E-1SWIRE:

ID	Device	Manufacturer
0×20	SWIRE-DIL	Moeller

12.6.6 Wiring diagram and pin assignment

The following diagram is an example of the connected SWIRE power supply with a disconnection function (emergency-off) for the coil supply of the SWIRE relays.

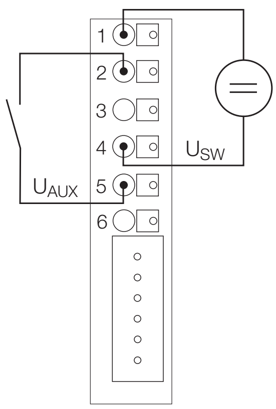

Fig. 296: connection of the operating voltage for BL20-E-SWIRE with disconnectable coil power supply

The following diagram is a connection example for the SWIRE power supply. The coil supply voltage for the SWIRE relays is connected via PIN 2.

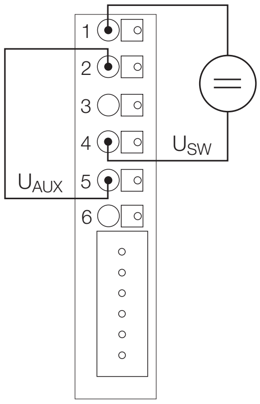

Fig. 297: Connection of the operating voltage without emergency stop

Pin	Assignment	Connection
1	U_{SW} operating voltage supply of the SWIRE bus	PIN 1 and PIN 2 are bridged internally!
2	U_{SW} operating voltage supply of the SWIRE bus	
3	GND frame potential	PIN 3 and PIN 4 are bridged internally!
4	GND frame potential	
5	U_{AUX} relay power supply	PIN 4 and PIN 6 are bridged internally!
6	U_{AUX} relay power supply	

12.6.7 Diagnostic and status messages

LED status displays

LED	Display	Meaning
Module diagnostics		
DIA	Off	No error messages or diagnostics
	Red	Module bus communication faulty
	red, flashing	Module indicates a diagnostics message
Configuration status		
Rdy	Off	SWIRE bus not active
	Green	– The SWIRE bus is ready for data exchange. – If the PLC configuration check is activated: – The configuration stored in the BL20-E-1SWIRE matches the SET configuration stored in the PLC. – SW LED and RDY LED are lit: – The SWIRE bus is in data exchange mode
	green, flashing	– The PLC configuration check is carried out. – The configuration stored in the BL20-E-1SWIRE does not match the SET configuration stored in the PLC.
SWIRE bus status		
SW		Off
	Green	– The physical structure of the SWIRE bus matches the configuration stored in the BL20-E-1SWIRE. – The SWIRE bus is in operation. – SW LED and RDY LED are lit: – The SWIRE bus is in data exchange mode

	green, flashing	– The physical structure of the SWIRE bus is compared to the configuration stored in the BL20-E-1SWIRE.
		– The physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE.
		– The SWIRE bus cannot be assigned a valid configuration. Possible causes:
		  – SWIRE bus with zero slaves.
		  – SWIRE slave faulty.

Indication of the SWIRE bus operating voltage		
U_{SW}	Off	– The voltage U_{SW} is faulty. – The module bus voltage is not present.
	Green	– The voltage U_{SW} is within the permissible range and the module bus voltage is present.
Indication of the relay supply of the bus		
U_{AUX}	Off	– The voltage U_{AUX} is faulty.
	Green	– The voltage U_{AUX} is in the permissible range.

Diagnostics

Designation	Value	Comment
SW_{ERR}	SWIRE MASTER	
	If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE, this bit indicates an error.	
	0	Data exchange The physical structure of the SWIRE bus was accepted and the SWIRE bus is in operation.
	1	Offline The physical structure was not accepted, the SWIRE bus does not start operation (SW LED flashing).
RDY_{ERR}	PLC SLAVE	
	This bit indicates an error if the configuration stored in the BL20-E-1SWIRE does not match the SET configuration stored in the PLC.	
	0	OK No error present. The SWIRE bus is ready for data exchange.
	1	Offline The configuration stored in the BL20-E-1SWIRE was not accepted. The data exchange is prevented (RDY LED flashing).
COM_{ERR}	Communication SWIRE	
	A communication error is present, as long as a slave can no longer be reached, its internal timeout has elapsed or communication is faulty. The master cannot carry out data exchange with at least one slave.	
	0	No error present.
	1	An error is present.
U_{SWERR}	Voltage U_{SW}	
	Voltage fault in U_{SW}, voltage (17 VDC) for supplying the SWIRE slaves	
	0	No error present.
	1	Voltage errors
$GENERAL_{ERR}$	Error message	
	The creation of a function block shows that systems/function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.	
	0	No diagnostics message present
	1	One/several diagnostics messages present
SD_{ERR}	Communication SWIRE slaves	
	If the parameter SD_{ERR}A is set for group diagnostics, this bit indicates an error as soon as only one slave on the bus sets its SD_{ERR}.	
	0	No error is present or diagnostics function has been deactivated via the parameter setting.
	1	An error is present.

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

Designation	Value	Comment
$PKZ_{ERR}Sx$	Only SWIRE-DIL: 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	The PKZ of the slave has not tripped or diagnostics function has been deactivated via the parameter setting.
	1	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.

12.6.8 Module parameters

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 0	Bit 0	Word 0	Bit 0	Byte 3	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	Disable Cfg
	Bit 2		Bit 2		Bit 2	Configuration
	Bit 3		Bit 3		Bit 3	MNA
	Bit 4		Bit 4		Bit 4	MC
	Bit 5		Bit 5		Bit 5	reserved
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 1	Bit 0		Bit 8	Byte 2	Bit 0	SD_{INFO}
	Bit 1		Bit 9		Bit 1	SD_{ERR}
	Bit 2		Bit 10		Bit 2	PKZ_{INFO}
	Bit 3		Bit 11		Bit 3	PKZ_{ERR}
	Bit 4		Bit 12		Bit 4	TYP_{INFO}
	Bit 5		Bit 13		Bit 5	TYP_{ERR}
	Bit 6		Bit 14		Bit 6	U_{AUXERR}
	Bit 7		Bit 15		Bit 7	reserved

Standard						
byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters
Byte 2	Bit 0	Word 1	Bit 0	Byte 1	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 3	Bit 0		Bit 8	Byte 0	Bit 0	reserved (life guarding time up to version VN 01-03)
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	

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Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET	Parameters	
Byte 4	Bit 0	Word 2	Bit 0	Byte 1	Bit 0	$SC_{DIAG}S1$
	Bit 1		Bit 1		Bit 1	$SC_{DIAG}S2$
	Bit 2		Bit 2		Bit 2	$SC_{DIAG}S3$
	Bit 3		Bit 3		Bit 3	$SC_{DIAG}S5$
	Bit 4		Bit 4		Bit 4	$SC_{DIAG}S1$
	Bit 5		Bit 5		Bit 5	$SC_{DIAG}S6$
	Bit 6		Bit 6		Bit 6	$SC_{DIAG}S7$
	Bit 7		Bit 7		Bit 7	$SC_{DIAG}S8$
Byte 5	Bit 0		Bit 8	Byte 0	Bit 0	$SC_{DIAG}S9$
	Bit 1		Bit 9		Bit 1	$SC_{DIAG}S10$
	Bit 2		Bit 10		Bit 2	$SC_{DIAG}S11$
	Bit 3		Bit 11		Bit 3	$SC_{DIAG}S12$
	Bit 4		Bit 12		Bit 4	$SC_{DIAG}S13$
	Bit 5		Bit 13		Bit 5	$SC_{DIAG}S14$
	Bit 6		Bit 14		Bit 6	$SC_{DIAG}S15$
	Bit 7		Bit 15		Bit 7	$SC_{DIAG}S16$

Standard				
byte-oriented		word-oriented		PROFIBUS PROFINET		Parameters

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 6	Bit 0	Word 3	Bit 0	Byte 6	Bit 0	reserved
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
Byte 7	Bit 0		Bit 8	Byte 7	Bit 0	reserved
	Bit 1		Bit 9		Bit 1	
	Bit 2		Bit 10		Bit 2	
	Bit 3		Bit 11		Bit 3	
	Bit 4		Bit 12		Bit 4	
	Bit 5		Bit 13		Bit 5	
	Bit 6		Bit 14		Bit 6	
	Bit 7		Bit 15		Bit 7	

Standard byte-oriented		Standard word-oriented		PROFIBUS PROFINET		Parameters
Byte 8	Bit 0	Word 4	Bit 0	Byte 8	Bit 0	Device ID, slave x
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	
…		…		…		
Byte 24	Bit 0	Word 16	Bit 0	Byte 24	Bit 0	
	Bit 1		Bit 1		Bit 1	
	Bit 2		Bit 2		Bit 2	
	Bit 3		Bit 3		Bit 3	
	Bit 4		Bit 4		Bit 4	
	Bit 5		Bit 5		Bit 5	
	Bit 6		Bit 6		Bit 6	
	Bit 7		Bit 7		Bit 7	

The default values are written in **bold**.

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.	
	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).
	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.

Parameter name	Value	
Configuration	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.	
	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.
	inactive	All slaves are mapped in 4Bit INPUT/ 4Bit OUTPUT without checking the device ID.
MNA active/ passive	Configuration check Line or slave-oriented configuration check (without function if MC = 1)	
	line oriented	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.
	slave oriented	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.	
	inactive	Default behavior
	active	The BL20-E-1SWIRE master responds according to the Moeller SWIRE Conformance criteria.
SD_{INFO}	Slave error field Activate slave diagnostics info field $SD_{ERR}Sx$. As soon as a slave on the bus sets its error bit, this is indicated individually as an error depending on the parameter setting.	
	active	Single diagnostics is activated
	inactive	Single diagnostics is not activated
Byte 2		
SD_{ERR}	Common error - slave error - Activate slave diagnostics SD_{ERR}. 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.	
	active	Group diagnostics is activated
	inactive	Group diagnostics is not activated
PKZ_{INFO}	PKZ error field Activate slave diagnostics info field $PKZ_{ERR}Sx$. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	active	Single diagnostics is activated
	inactive	Single diagnostics is not activated

Parameter name	Value	
PKZ_{ERR}	Group PKZ error field Activate slave diagnostics PKZ_{ERR}. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	active	Single diagnostics is activated
	inactive	Single diagnostics is not activated
TYP_{INFO}	Configuration error field As soon as a SWIRE-DIL slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	active	Single diagnostics is activated
	inactive	Single diagnostics is not activated
TYP_{ERR}	Group configuration error field Activate slave diagnostics TYP_{ERR}. As soon as only one slave on the bus is incorrectly configured, this is indicated as an error depending on the parameter setting.	
	active	Group diagnostics is activated
	inactive	Group diagnostics is not activated
U_{AUXERR}	Error message UAUX- Activate system diagnostics U_{AUXERR}. U_{AUXERR} will generate an error message as soon as the power supply goes below a level at which the function of the relays is not guaranteed.	
	active	Error message U_{AUXERR} activated
	inactive	Error message U_{AUXERR} not activated
Byte 3	reserved	
Byte 4		
reserved (life guarding time up to version VN 01-03)	Up to version VN 01-03: Lifeguarding time of the SWIRE slaves. Lifeguarding time of the SWIRE slaves	
	0×02-0×FF **0×64**	Lifeguarding time of the SWIRE slaves Setting of lifeguarding time, timeout time up to automatic reset of the slaves in the event of communication failure. (n * 10ms) (default 1s) 0×FF: Lifeguarding off
Byte 5 - 6		
$SC_{DIAG}Sx$	Input bit communication error, slave x Slave diagnostics message from Byte 1 / Bit 7 is accepted in the check-back interface as Bit 4	
	active	$SC_{DIAG}Sx$ is accepted
	inactive	$SC_{DIAG}Sx$ is not accepted
Byte 7, 8	reserved	
Byte 9…24		
Device ID, slave x	TYPE setting for the SWIRE slave at position x on the SWIRE bus	
	0×20	SWIRE-DIL-MTB (: 0×FF)
	0×FF	Basic setting (no slave)

12.6.9 Moeller SWIRE conformance criteria

The SWIRE system was developed by Moeller. The BL20-E-1SWIRE supports the SWIRE slaves SWIRE-DIL. For this particular requirements must be fulfilled to ensure compatible operation. The ”Moeller Conformance” function is supported from version VN 01-04.

NOTE
The ”Moeller Conformance” function is deactivated by default.

Special system behavior with the ”Moeller Conformance” function

The following applies if the ”Moeller Conformance” function is activated.

- The following functions are automatically deactivated:
  - Automatic SWIRE configuration
  - Bus oriented configuration check
  - Slave oriented configuration check
- 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).
- he physical structure of the SWIRE bus is scanned once and compared with the SWIRE configuration stored in the BL20-E-1SWIRE once when U_{SW} is switched on, or after a new configuration is stored (by pressing the CFG button while the SW LED is flashing).
- If the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE (SW LED flashing) when USW is switched on, the SWIRE bus only starts operation:
  - After the physical structure was stored in the BL20-E-1SWIRE:
    - Manually, by pressing CFG button (only functions if the SW LED is flashing).
    - After the configuration is stored, the physical structure is compared once more with the configuration stored in the BL20-E-1SWIRE.
  - If the physical structure of the SWIRE bus matches the configuration stored in the BL20-E-1SWIRE the next time that U_{SW} is switched on.
- Even if the ”Moeller Conformance” function is activated, the physical structure of the SWIRE bus is continuously monitored during operation. However, data exchange continues with functioning slaves if slave failures occur. Not until the next power up is operation of the bus with faulty slaves discontinued.

System behavior with the configuration checks ("Moeller conformance"

Parameter setting:
Parameter „MC" = 1

System behavior with configuration checks

1 The physical structure of the SWIRE bus is scanned when U_{SW} is switched on (power up) and compared with the configuration stored in the BL20-E-1SWIRE.

- The SWIRE bus starts operation (SW LED lit) if the physical structure of the SWIRE bus matches the SWIRE configuration stored in the BL20-E-1SWIRE.
- The operation is aborted if the physical structure of the SWIRE bus does not match the configuration stored in the BL20-E-1SWIRE (SW LED flashing). The SWIRE bus only starts operation: The SWIRE bus only starts operation:
  - After the physical structure was stored in the BL20-E-1SWIRE and a match was determined:
  - Manually, by pressing CFG button (only functions if the SW LED is flashing).
    After the configuration is stored, the physical structure is compared once more with the configuration stored in the BL20-E-1SWIRE.
  - If the physical structure of the SWIRE bus matches the configuration stored in the BL20-E-1SWIRE the next time that U_{SW} is switched on.

2 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. The complete device ID must match.

- If the two configurations match completely, the entire SWIRE bus is ready for data exchange (RDY LED lit).
- If the two configurations do not match completely (RDY LED flashing), the operation is aborted for the entire SWIRE bus (RDY LED flashing).

3 The system then starts data exchange.

4 The physical structure of the SWIRE bus is monitored continuously during operation so that any changes on the bus or slave failures can be detected. The system retains data exchange with the functional slaves if a modification or slave failure is detected.

12.7 BL20-E-4IOL – IO-Link Master

The description of this technology module can be found in a separate manual on www.turck.de:

Type	Document no.
BL20-E-4IOL BL20-E-4IOL-10	D301332

12.8 BL ident - BL20-2RFID-S/BL20-2RFID-A

The description of these modules can be found in separate manuals.

The complete *BL ident*-documentation is part of the BL ident-CD:

Ident no.	Type	Document no.
1545052	BLIDENT-CD	D101659

13 Potential Distribution Modules

The potential distribution modules provide 10 or 16 terminals for potential distribution. The use of potential distribution modules allows the transmission of 24 VDC from UL or the GND potential of UL without the use of further terminal blocks.

The potential distribution modules have to be considered for the maximum station extension of BL20 with a maximum number of 74 modules. A maximum of two potential distribution modules can be mounted next to each other. At least one active electronics module (e.g. BL20-E-8DI-24VDC-P) has to follow the two potential distribution modules.

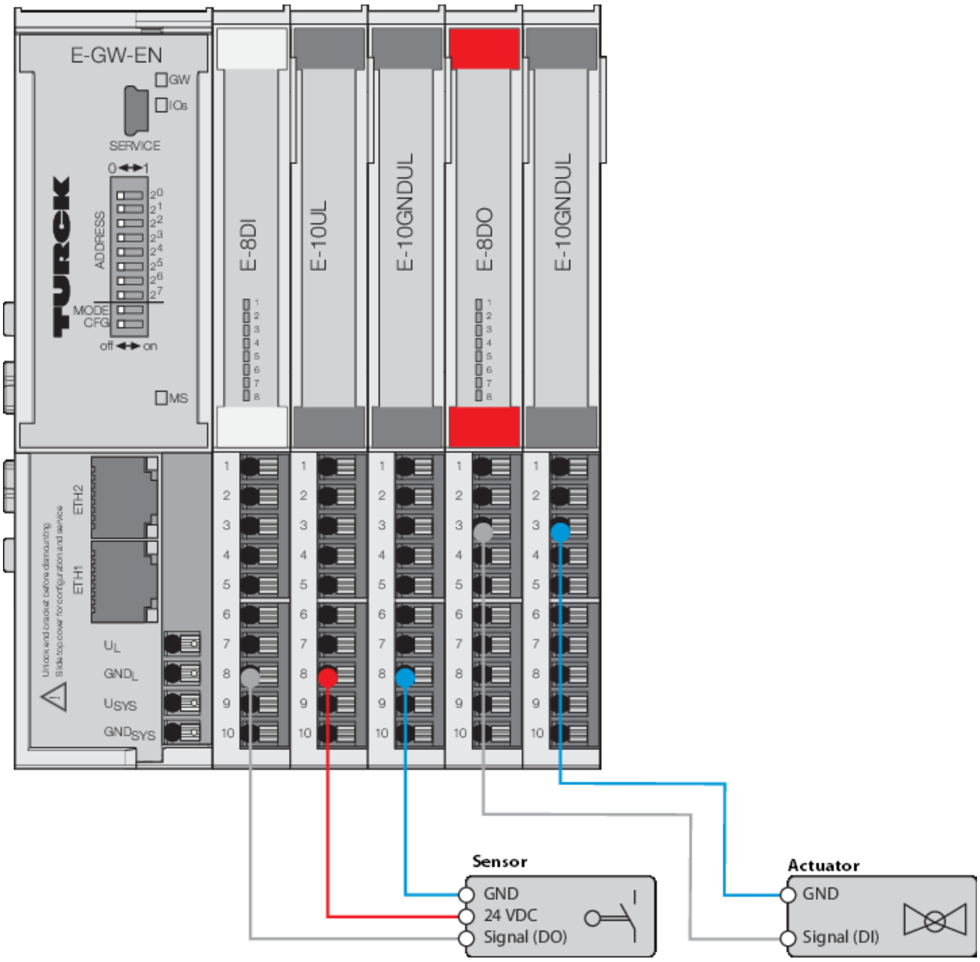

Fig. 298: Potential distribution modules – application example

13.1 Module overview

Module	Function
BL20-E-10UL	10 Push-in contacts for distributing the 24 VDC from UL
BL20-E-10GNDL	10 Push-in contacts for distributing the GND potential from UL
BL20-E-16UL	16 Push-in contacts for distributing the 24 VDC from UL
BL20-E-16GNDL	16 Push-in contacts for distributing the GND potential from UL

13.2 BL20-E-10UL

The module provides the 24 VDC from the field supply UL from the gateway or a Power Feeding module.

13.2.1 Technical data

Technical data	
Number of channels	10
Nominal voltage from supply terminal	24 VDC
Permissible range	18…30 VDC
Output current	
Max. current per channell	10 A
Max. current of the module	10 A
Weight	46 g

13.2.2 Wiring diagram

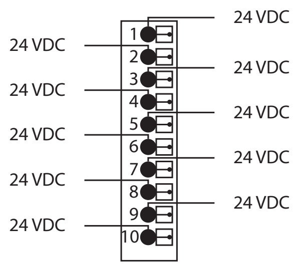

Fig. 299: Wiring diagram

13.3 BL20-E-10GNDL

The module provides the GND potential from the field supply UL from the gateway or a Power Feeding module.

Technical data

Technical data	
Number of channels	10
Nominal voltage from supply terminal	24 VDC
Permissible range	18…30 VDC
Output current	
Max. current per channell	10 A
Max. current of the module	10 A
Weight	46 g

13.3.1 Wiring diagram

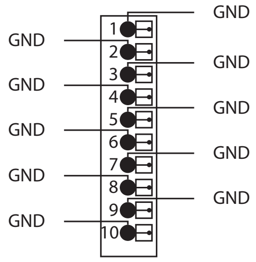

Fig. 300: Wiring diagram

13.4 BL20-E-16UL

The module provides the 24 VDC from the field supply UL from the gateway or a Power Fedding module.

13.4.1 Technical data

Technical data	
Number of channels	16
Nominal voltage from supply terminal	24 VDC
Permissible range	18…30 VDC
Output current	
Max. current per channell	10 A
Max. current of the module	10 A
Weight	52 g

13.4.2 Wiring diagram

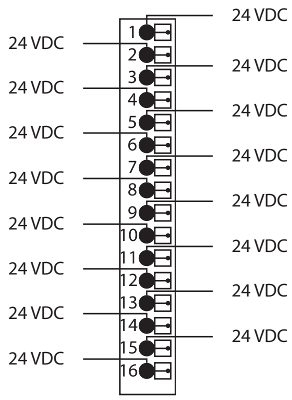

Fig. 301: Wiring diagram

13.5 BL20-E-16GNDL

The module provides the GND potential from the field supply UL from the gateway or a Power Feeding module.

Technical data

Technical data	
Number of channels	16
Nominal voltage from supply terminal	24 VDC
Permissible range	18…30 VDC
Output current	
Max. current per channell	10 A
Max. current of the module	10 A
Weight	52 g

13.5.1 Wiring diagram

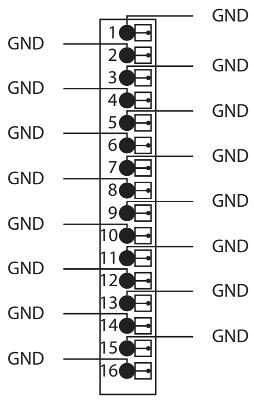

Fig. 302: Wiring diagram

14 Mounting and Wiring

14.1 Mechanical mounting

14.1.1 General mounting rules

- Keep space to the left of the gateway free for the first end bracket. This end bracket can be mounted first (before the gateway) or after having mounted the complete station.
- The gateway is the first electronics component on a BL20 station.
- If a gateway with integrated power supply unit is used, (BL20-GWBR-…), the I/O-modules are mounted subsequently in the order required directly following the gateway.
- When using a gateway without integrated power supply unit, the second component is a Bus Refreshing module, which provides the gateway with 5 VDC via the module bus. It must be ensured that the correct base module is used (see module chapters).
- Should it become necessary, a potential isolation can be achieved by mounting a Power Feeding module (power distribution) before mounting the next module.
- Power Feeding and Bus Refreshing modules can be mounted between the rest of the modules as required.
- An end plate is mounted at the end of each BL20 station.

DANGER

Open electrical contacts

Danger to life due to electric shock when using 120/230 V

➤ Cover open contacts at the end of every station using an end plate.

- The complete BL20 system is secured to the mounting rail by means of two end brackets. The first is to the left of the gateway, the second is placed at the other end of the system and mounted together with the end plate.

Mounting rail

The mounting rails used for BL20 should be mounted onto a galvanized mounting plate with a minimum thickness of 2 mm / 0.08 inch. This allows a reference potential for protective earth (PE) and functional earth to be created. Please allow for a maximum distance of 150 mm / 5.91 inch between mounting holes, when mounting non pre-drilled mounting rails.

14.1.2 Mounting the gateway

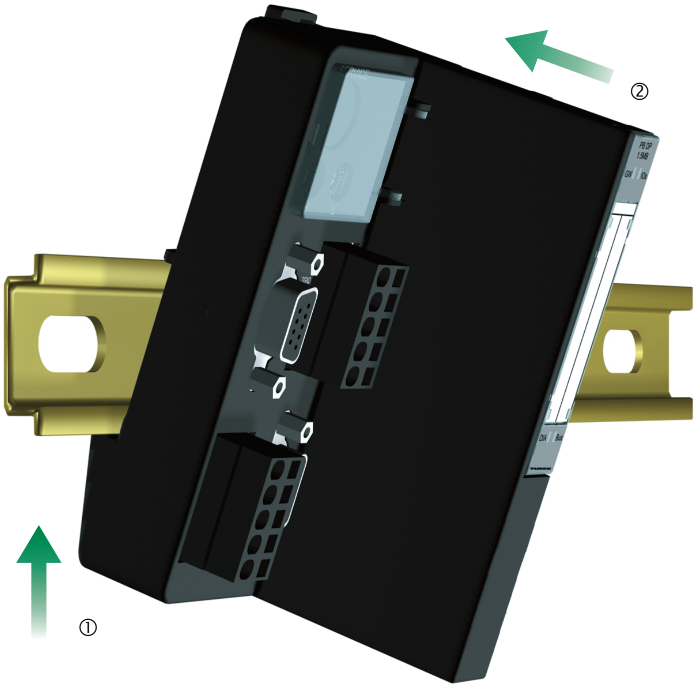

Fig. 303: Mounting the gateway

Please observe:

- The mounting rail must already be mounted.
- An end bracket must be mounted to the left of the gateway. The end bracket can be mounted before or after the station is mounted. If the gateway is mounted first, then a space must be kept free for the end bracket. Please read „Mount ing end brackets and end plates" in this chapter.
- The gateway is the first electronics component on a BL20 station.
- When fully mounted, the gateway's resistance to vibration is provided for by the locating hook located on the underside of the gateway. The locating hook is moved only when the gateway is mounted or dismounted.

Method:

➤ Tilt the top of the gateway towards you, position the groove provided on the rear of the gateway onto the lower edge of the mounting rail①?

➤ Tilt the top of the gateway away from you ② and towards the mounting rail.

➤ Press the gateway until it locks in with an audible click ③.

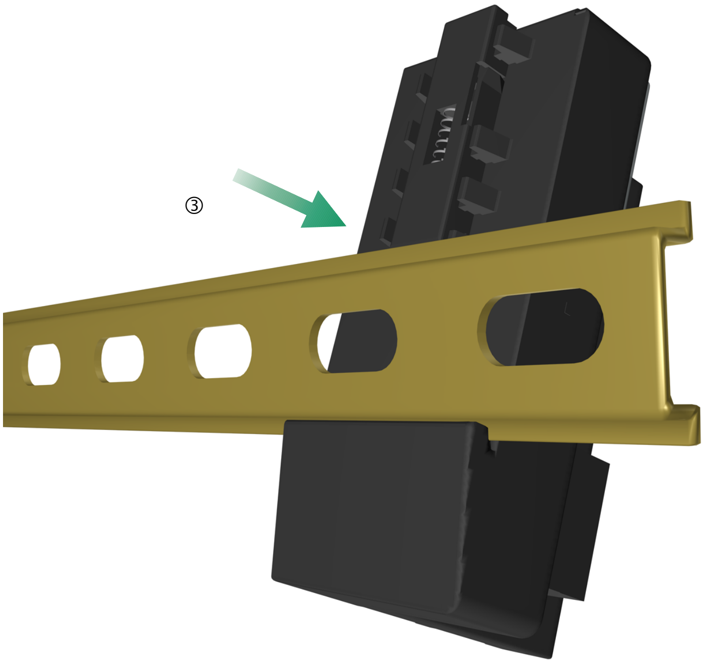

Fig. 304: Locating hook on the gateway

14.1.3 Mounting the base module (block or slice design)

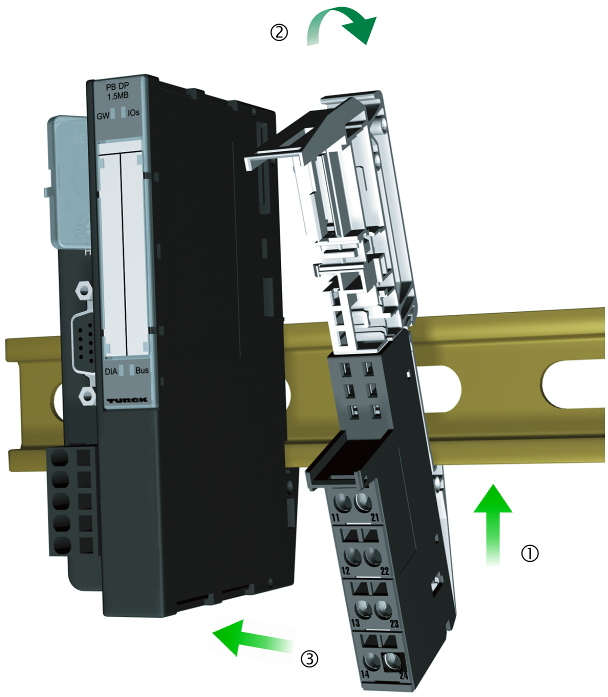

Fig. 305: Mounting the base module for the Bus Refreshing module

Please observe:

- The gateway must already be mounted.
- The base modules are mounted to the right of the gateway onto the mounting rail.
- The first base module following a gateway must be suitable for a Bus Refreshing module which supplies the gateway with power.
- It is recommended that the base modules should be mounted and wired before the electronics modules are mounted.

NOTE

Mixed usage of base modules with screw connections and tension clamp connections is only possible once a new power distribution module has been added. Therefore, all the following base modules must have the same connection technology as the power distribution module (tension clamp or screw connection).

Procedure:

➤ Tilt the top of the gateway towards you, position the groove provided on the rear of the gateway onto the lower edge of the mounting rail①.

➤ Tilt the top of the base module away from you and towards the mounting rail, and press until it locks in with an audible click ②.

➤ Slide the base module as far as possible to the left until the locating hooks lock in with an audible click into the gateway (should this be the first base module to be mounted) or into the next base module ③. This provides a stable connection and guarantees communication via the module bus.

14.1.4 Mounting slot identification and color markers

Slot identification

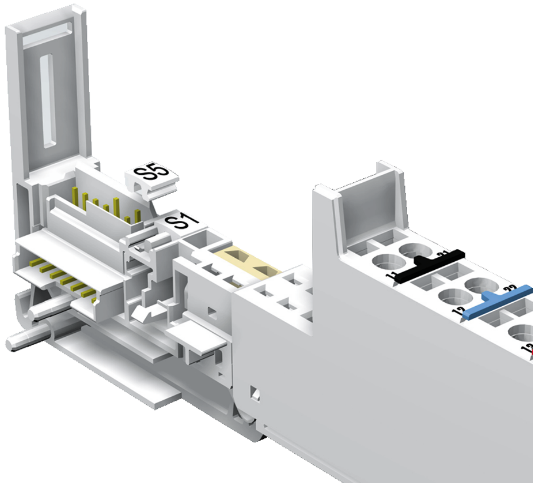

Fig. 306: Slot identification with Dekafix

Please observe:

- Dekafix labels can be used to label mounting slots. There is room for a six-digit label on every base module. For example, the six-digit device short name, which you can define in the BL20 DTM. Dekafix labels must be attached **before the electronics modules are mounted**.

Procedure:

➤ Press the Dekafix labels into the recesses provided in the base module. There is room for a six-digit label on every base module.

Color markers

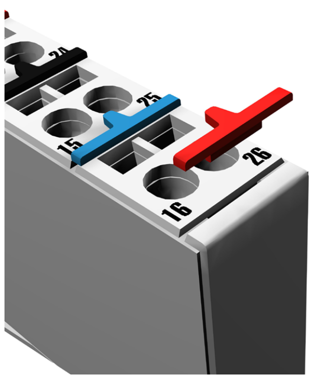

Fig. 307: Color-coding of the connection levels

Please observe:

- The base modules can be fitted with colored connection markers for the purposes of individual identification of channels and to ease cable assignment. The colored connection markers are available as accessories.

Procedure:

➤ Insert the colored connection markers, according to the module wiring (see wiring diagrams in the module chapters), into the slots provided immediately below each connection level on the base module.

The table shows the meaning of the colors and connection types.

Color of markers	Connection type
Black	Signal cable
red	VDC (+24V; +5V)
blue	- 0 V
Red-blue	System supply
Yellow-green	Protective earth conductor
Green	Shield
Brown	Phase L1

14.1.5 Jumpers for relay modules

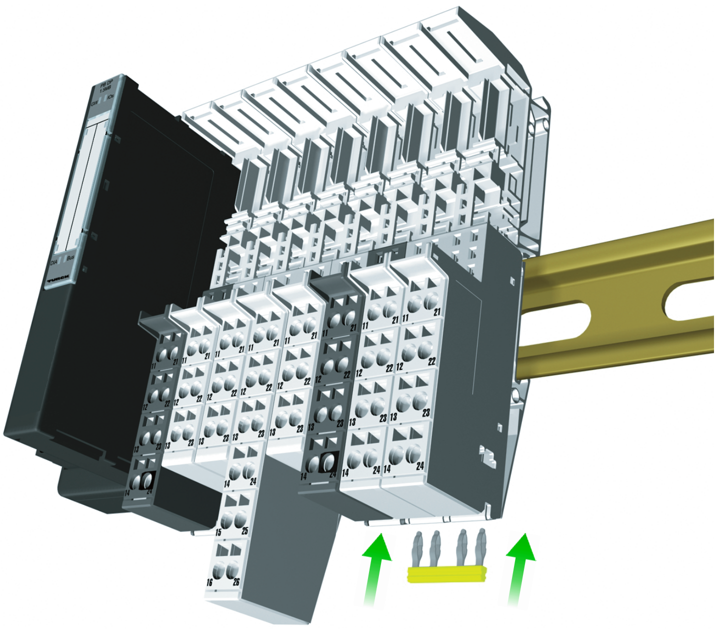

Fig. 308: Plugging jumpers

Please observe:

- To multiply signals and/or save wiring, it can be useful to cross-connect a number of base modules for relays. To achieve this, jumpers (QVR) are available as accessories in various sizes.

Procedure:

➤ Press the jumper as far as it will go into the slots provided on the front (facing down) of two adjoining base modules.

14.1.6 Mounting end brackets and end plates

End bracket

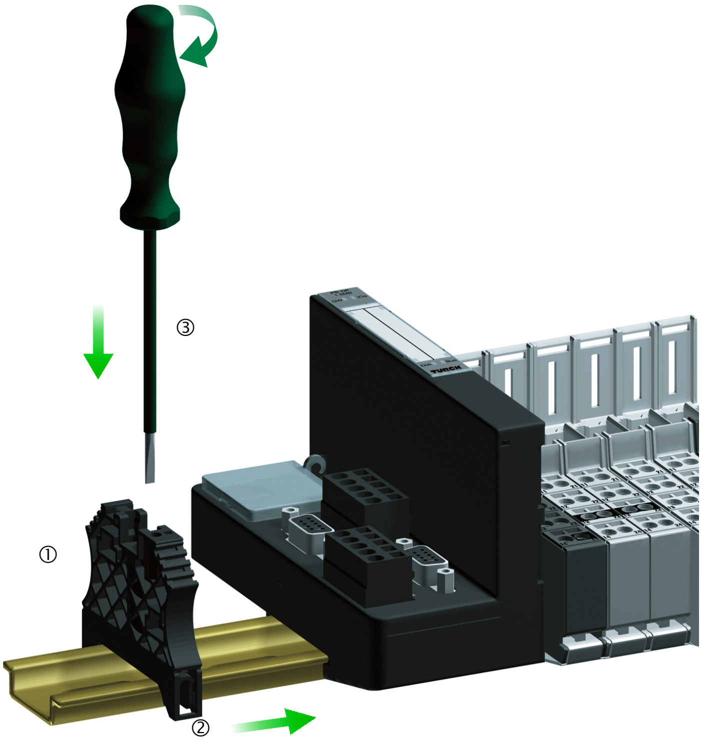

Fig. 309: Mounting end brackets

Please observe:

- BL20 stations must be fixed securely onto the mounting rail using two end brackets (BL20-WEW-35/2-SW). The first end bracket is mounted to the left of the gateway, the second is mounted together with the end plate at the end of the station.

Method:

- ➤ The first end bracket is mounted to the left of the gateway onto the mounting rail ①. Clip the end bracket onto the mounting rail until you hear an audible click ?If necessary, loosen the screw beforehand.
- ➤ Slide the end bracket up to the gateway ②, and tighten the screw ③:

End plate

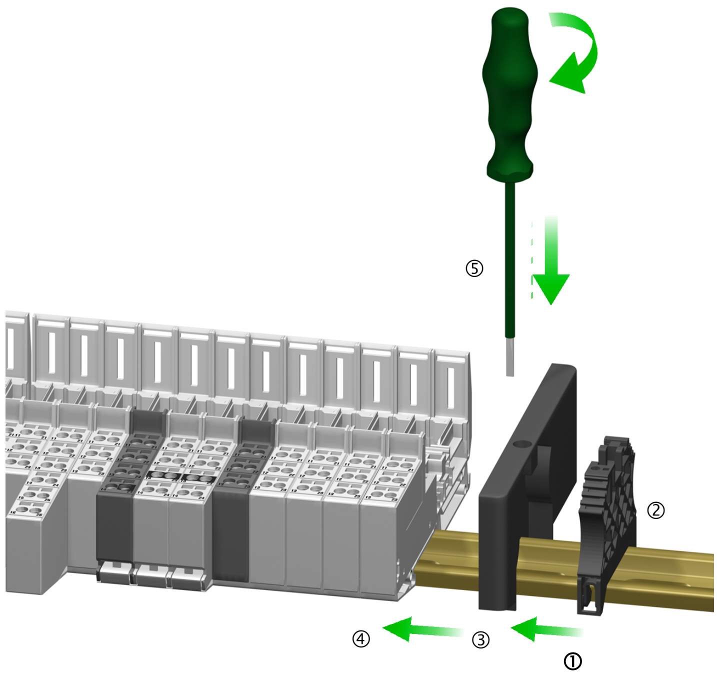

Fig. 310: Mounting of end plate and end bracket

Procedure:

- Insert the end bracket into the recess provided in the end plate ①.
- The end bracket and end plate should be held so that the connectors on the end plate are facing the last module of the BL20 station.
- Press the end plate onto the mounting rail until you hear an audible click ② (if necessary, loosen the screw beforehand). Then slide the end bracket and end plate up to the last module of the BL20 station ②.
- Press the end plate with the end bracket firmly up to the last module of the BL20 station. The end plate's connectors must lock firmly into the locating holes provided in the module ④.
- To secure the end bracket, insert a screwdriver into the hole provided in the end plate and tighten the screw ⑤.

14.1.7 Wiring with tension clamp connections

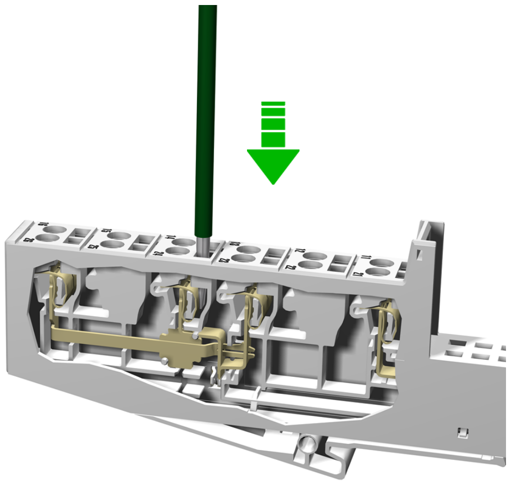

Fig. 311: Tension clamp connections

Method:

- Place the screwdriver in the rectangular opening of a connection level on the base module. When you feel a slight resistance, push the screwdriver into the opening until it comes up against a stop. This opens a tension clamp on the inside of the connection level.
- Insert the wiring into the round opening located directly below the rectangular opening, until the wire comes up against a stop.
- Remove the screwdriver; the tension clamp closes and secures the wire.

14.1.8 Wiring with screw connections

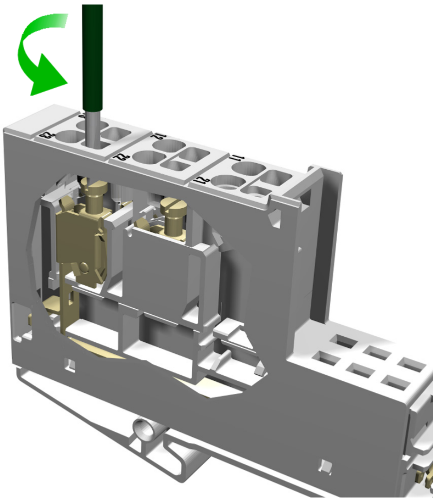

Fig. 312: Screw connection

Method:

- Place the screwdriver in the rectangular opening of a connection level on the base module. Turn the screw ant-clockwise as far as possible, without fully removing it.
- Insert the wire in to the round opening, located directly below the rectangular opening, until it comes up against a stop.
- Turn the screw clockwise until the wire is fully secured, and cannot be pulled out.

14.1.9 Mounting the electronics modules

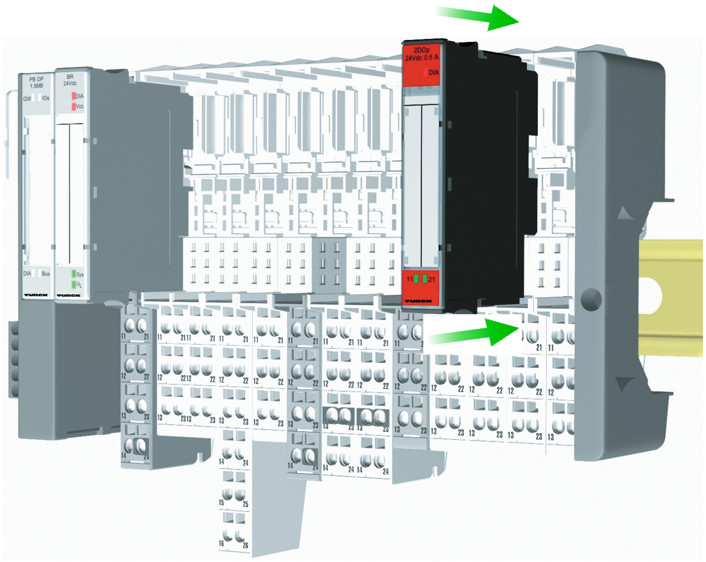

Fig. 313: Plugging the electronic modules

Please observe:

- The correct base module must have been previously mounted onto the mounting rail.
- Electronics modules are fitted onto the previously mounted and wired base modules.

NOTE

Before plugging the electronics modules, it is advisable to blow-clean the station with compressed air. This prevents dust and grains of dirt from contaminating the contacts, which can negatively influence the communication on the station.

Method:

➤ Press the electronics module squarely onto the base module, until you hear it lock into place at the front and back.

14.1.10 Prevention of false mounting

A mechanical coding element prevents an electronics module from being mounted onto the wrong base module – for example, following a defect in an electronics module. The coding element consists of two pieces and is supplied with every electronics module.

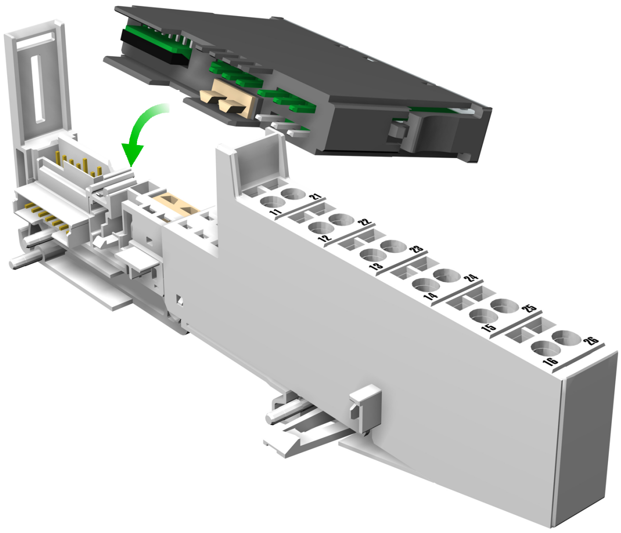

Fig. 314: Coding of electronics and base module

The complete coding element is mounted on the underside of each electronics module. When mounting the electronics module for the first time, the lower part of the coding element is automatically inserted into the recess provided in the base module.

NOTE

When plugging electronics modules for the first time, an initial resistance must be overcome. This is because the lower part of the coding element has to be pressed into the base module.

Should the electronics module be pulled, one half of the coding element remains in the base module, the other half remains in the electronics module. It is now possible to mount a new electronics module only when its coding matches that of the base module.

When replacing an electronics module (plugging a new electronics module), remove and dispose of the lower part of the coding element (that part destined for the base module). The original lower part of the coding element, which remains in the base module, cannot be removed.

NOTE

When all modules are mounted, the supply to the module bus should be applied to check if the station communication functions correctly (no false mounting, no empty slots, etc). The field voltage should be applied only when the correct functioning of the station has been established.

14.1.11 Switchgear cabinet layout

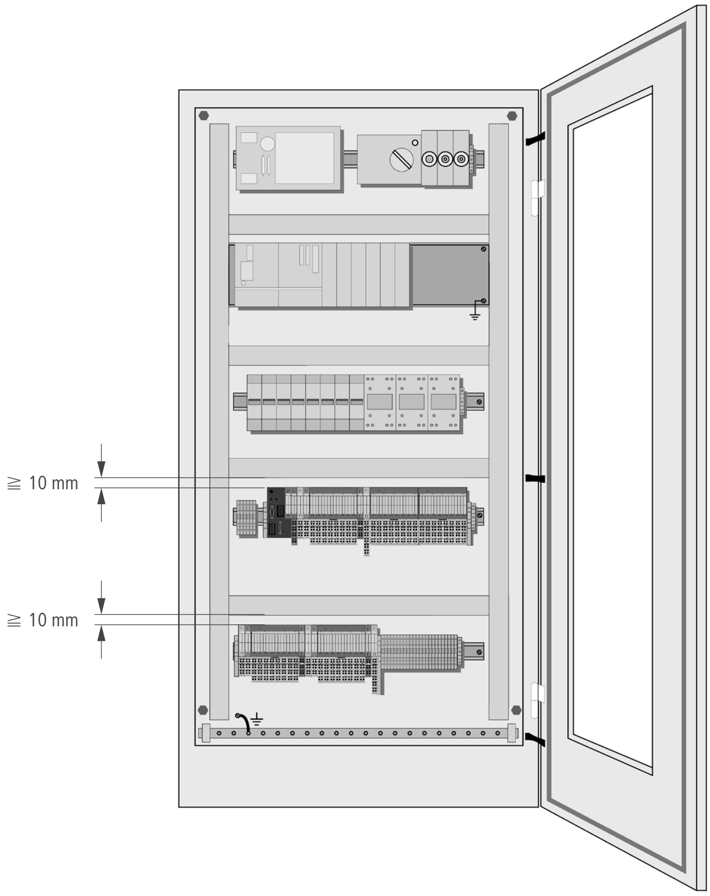

Fig. 315: Switchgear cabinet layout

BL20 modules are suitable for installation and operation in confined spaces. The minimum distance to any passive components should be 10 mm/0.39 inch. Should the adjoining component be an active element (for example load-current supply, transformers), then a minimum distance of 75 mm/2.95 inch must be kept, to comply with EMC regulations and to prevent overheating. If necessary, provide for an appropriate air conditioning/cooling of the temperature.

You should in every case, take into consideration the values for ambient temperature given in chapter 5.

14.2 Dismounting from the mounting rail

Please observe the following basic rules when dismounting:

14.2.1 Dismounting of a single component

DANGER

Dangerous electric voltage at modules with 120/230 VAC

Acute danger to life due to electric shock!

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

- **Base modules** and **gateways** can only be dismounted after the end plate has been disconnected from the last base module on the mounting rail. To do this, the end bracket mounted together with the end plate must be loosened.
- The **gateway** can only be dismounted from a station after all the base modules located on its right are separated and moved away to the right along the mounting rail. Furthermore, all connections from the gateway to the fieldbus must be disconnected. All wires must be disconnected and the fieldbus must be switched off.
- Individual base modules can only be removed from a station when all base modules located to its right have been moved away to the right along the mounting rail. A minimum distance of 30 mm/1.18 inch is required between the base module to be replaced and the previously adjoining base modules.

Dismounting an entire BL20 station in chronological order

- Switch off the power to the distribution modules (Bus Refreshing and Power Feeding)
- Pull the electronics modules
- Disconnect wiring
- Loosen/remove end bracket and end plate
- Dismount base modules
- Dismount gateway

Dismounting electronics modules

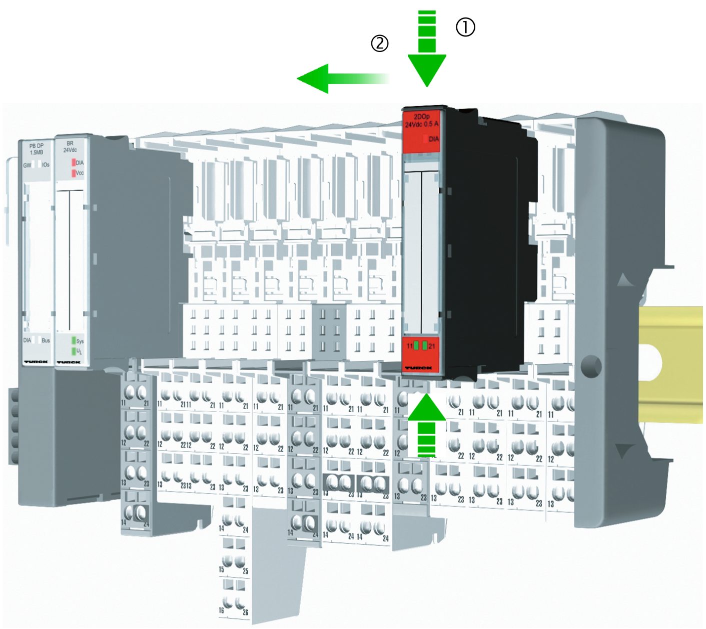

Fig. 316: Dismounting electronics modules

Please observe:

- Tools are not usually required to dismount electronics modules.

Method:

➤ Squeeze both locating hooks towards one another①; these are located at either end of the electronics modules and pull the module away from the base module②.

Dismounting end brackets and end plates

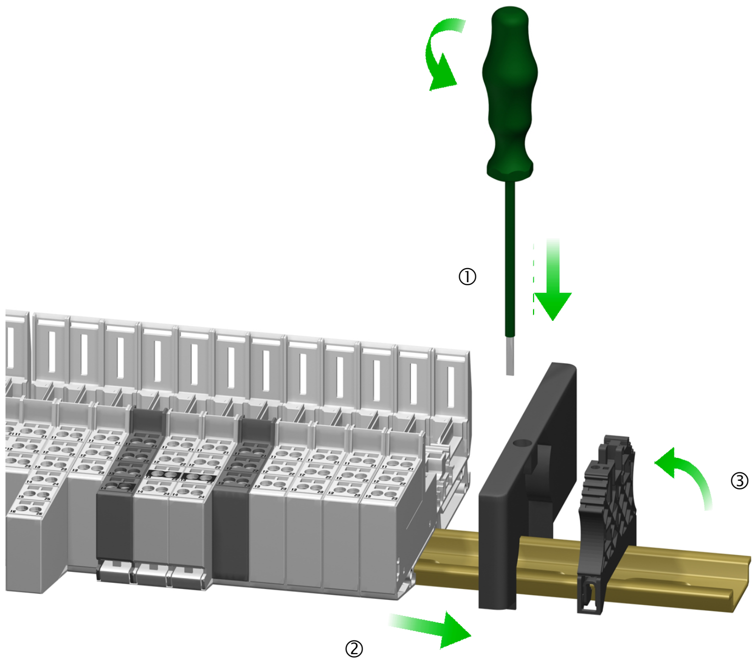

Fig. 317: Dismounting the end plate

Procedure:

➤ Insert the screwdriver into the hole in the end plate and loosen the screw in the end bracket ①.

➤ Slide the end plate and end bracket to the right, away from the last base module. If necessary, use a screwdriver; CAUTION However take care not to break the end plate connectors which are locked into the locating holes of the base module ②

➤ Loosen the screw in the end bracket to remove the end bracket and end plate from the mounting rail ③.

14.2.2 Dismounting the base modules

WARNING

Dangerous electrical voltage

Acute danger to life due to electric shock!

➤ Switch off all connected voltage supplies!

Please observe:

- Base modules can only be dismounted from the right.
- The end plate must already be dismounted.
- The electronics module must be pulled.

Method for dismounting base modules in slice design:

➤ Disconnect the wiring from the base module.

NOTE

If you are dismounting a base module for a relay, then any mounted jumpers must be removed from the front of the module before commencing with dismounting.

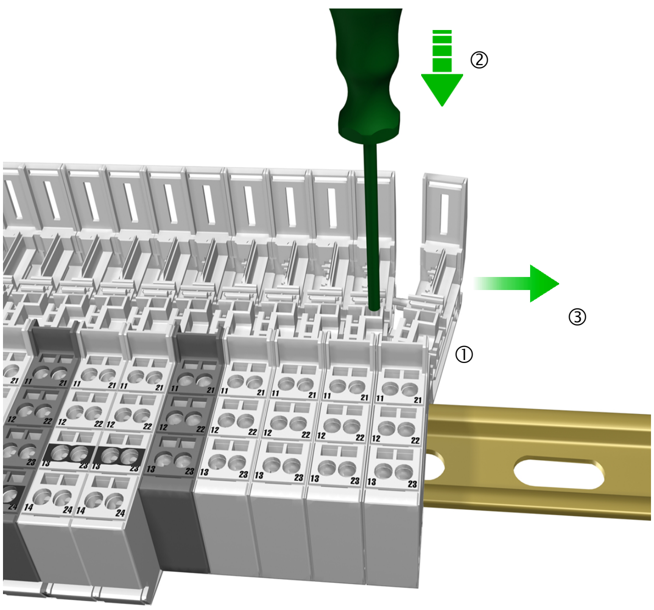

Fig. 318: Dismounting base modules in slice design

➤ Insert a screwdriver into the rectangular opening in the mounting slot of the base module ①.

➤ Press the screwdriver into the opening ②; thereby disengaging the connection between the base module to be dismounted and the adjoining module to its left. Pull the module away to the right until the rear locating hook disengages. Remove the screwdriver

- Pull the modules apart at the rear by hand (the module to be dismounted and the adjoining module) ③. This "drawing apart" motion automatically disengages the locating hook which connects both modules at the front.

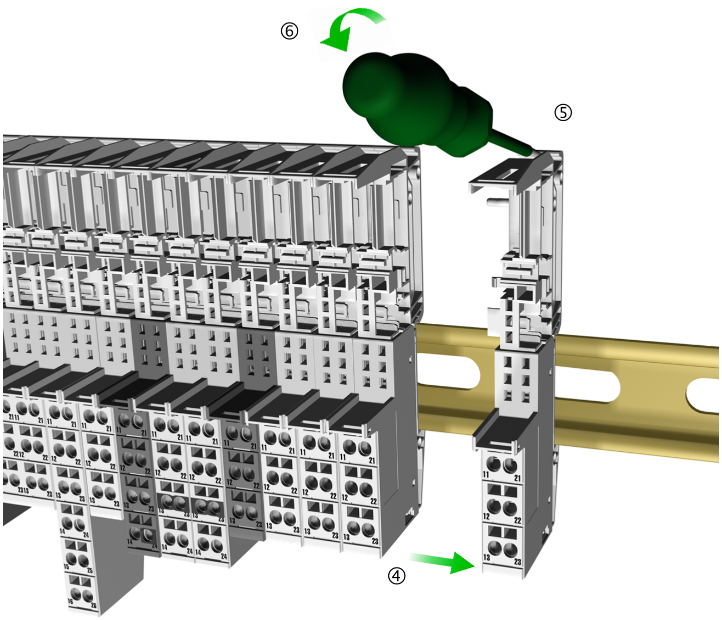

Fig. 319: Dismounting base modules from the mounting rail

- When both locating hooks are disengaged, slide the base module to be dismounted to the right ④.
- Insert the screwdriver into the slot provided in the locking mechanism ⑤ and lever the base module up and towards you, thereby releasing it from the mounting rail ⑥.

Method for dismounting base modules in block design:

- Disconnect the wiring from the base module.
- Carry out the steps indicated in **Fig. 318: Dismounting base modules in slice design (Seite 482)** and **Fig. 319: Dismounting base modules from the mounting rail (Seite 483)**. The method is identical at this point for both slice and block base modules.

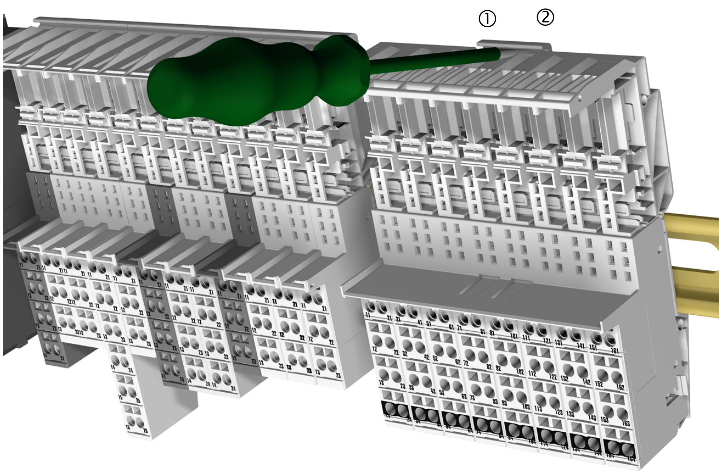

Fig. 320: Removing a base module in block design from the mounting rail

- There are two locking mechanisms in the middle of the block base module. These must be unlocked in two steps. Insert the screwdriver into the slot provided in the **left-hand** locking mechanism?① and lever the handle of the screwdriver downwards thereby moving the locking mechanism up until it disengages from the mounting rail.
- Insert the screwdriver into the slot of the provided in the **right-hand** locking mechanism ② and lever the handle of the screwdriver downwards thereby moving the second mounting foot up until it disengages from the mounting rail. Remove the base module from the mounting rail.

14.2.3 Dismounting the gateway

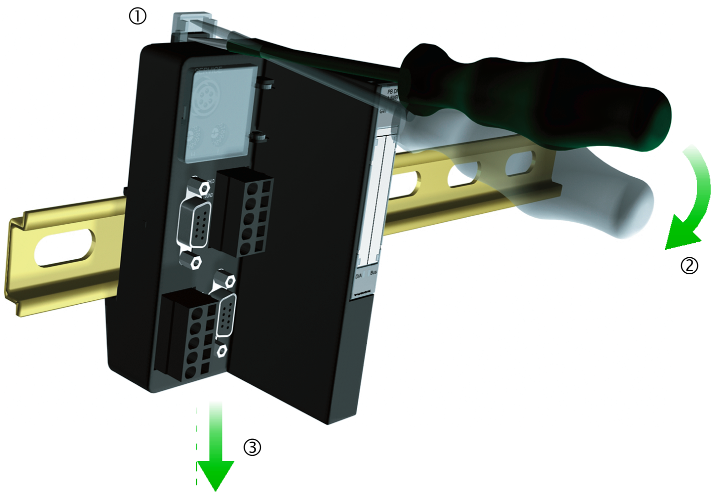

Fig. 321: Dismounting gateway

VORSICHT

Electric voltage (24 V)

Danger of injury due to electric shock!

- Switch off all connected voltage supplies!

ATTENTION

Field bus node missing

Field bus communication disturbed

- Separate the station from the field bus.

Please observe:

- All base modules on the mounting rail must be either moved away sufficiently to the right or dismounted.

Method:

- Disconnect the connection between the fieldbus and the gateway.
- Insert a screwdriver into the opening provided in the locking mechanism ①– on the top of the gateway – ?then carefully pull the screwdriver downwards as far as it will go ②. The spring loaded locking mechanism is levered upwards and disengages.
- Tilt the top end of the gateway with the screwdriver towards you and away from the mounting rail ③.

14.3 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

ATTENTION
Interruption of the module bus communication
Non-defined states of in- and outputs
➤ Do not plug or pull modules under load.

14.4 Handling the BL20 economy modules

The BL20 Economy modules use direct push-in contacts different from the BL20 base modules which use tension clamp contacts. The handling of these direct push-in contacts is described in the following:

14.4.1 Insertion of the conductor

The conductor is simply pushed into the corresponding contact.

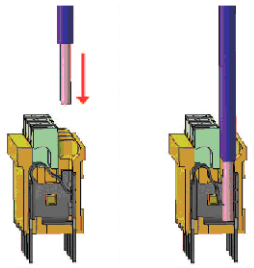

Fig. 322: Insertion of the conductor

14.4.2 Removal of the conductor

The conductor can be removed from the contact by pressing the release mechanism, e. g. with a screw driver.

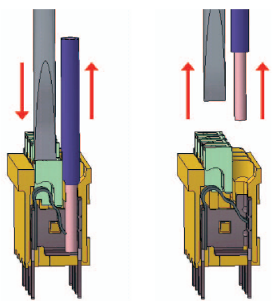

Fig. 323: Removal of the conductor

NOTE

The BL20 Economy modules can be easily combined with the base modules with tension clamp connection technology (BL20-B-…T-…). A combination with base modules using the screw connection technology (BL20-B-…S-…) is not possible.

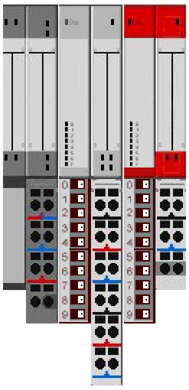

Fig. 324: BL20 Economy modules combined with tension clamp modules

15 Module Labeling

All electrical and electronics components for BL20 stations are supplied with labels to guarantee clear identification. In addition, Turck offers marking and labeling materials which enable individual and application specific labeling of each component. Fundamentally, the differences are as follows.

15.0.1 Colors

Each electronics module can be recognized immediately by the colored lid imprint (top and bottom).

Module	Color
Gateway (GW)	dusty grey
Power Feeding module 24 VDC (PF)	dusty grey
Power Feeding module 120/230 VAC (PF)	orange brown
Bus Refreshing (BR)	dusty grey
Digital input modules (DI)	light grey (white)
Analog input modules (AI)	pigeon blue
Digital output modules (DO)	strawberry red
Analog output modules (AO)	pale green
Relay modules (R)	pastel orange
Technology modules (CNT)	zinc yellow

15.0.2 Designations/catalog numbers

The designation is imprinted on the top of the electronics modules. Each module is clearly identified by a catalog number. The catalog number as well as further module-specific details can be found on a label attached to the side of the respective module.

The module's wiring diagram is printed on the lid of every electronics module. Example:

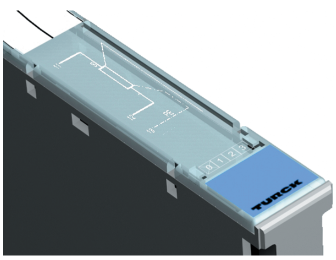

Fig. 325: Wiring diagram

15.1 Base modules

Base module connections are numbered consecutively channel by channel.

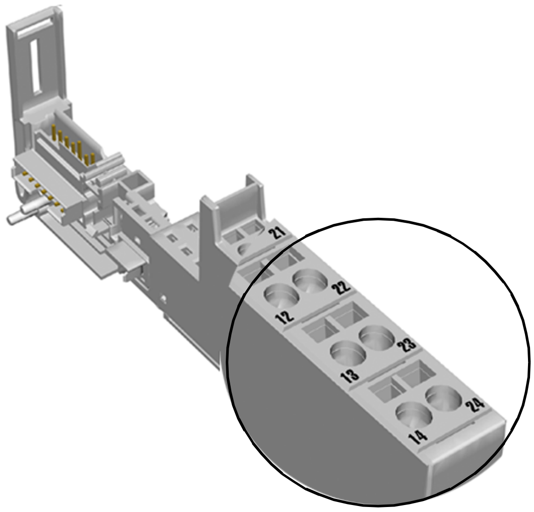

Fig. 326: Channel numbering

The colored markers are used to label the different base module connection levels and can be used to denote specific applications. They are available as accessories in the following colors: blue, red, green, black, brown, red/blue and yellow/green.

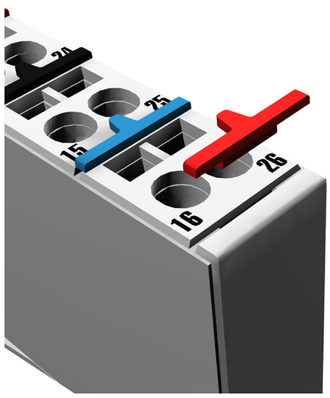

Fig. 327: Color-coding of the connection levels

NOTE
The individual colored markers assigned to the connection levels should be chosen in accordance with the electronics modules used.

Dekafix connection markers can be used to label the mounting slots for the electronics modules. Insert the connection into the mounting slots to the rear of the base module.

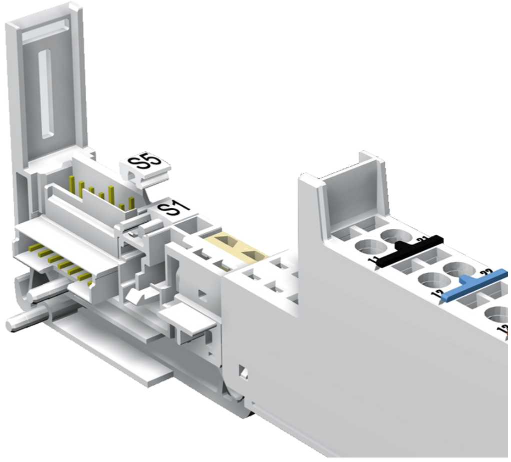

Fig. 328: Slot identification with Dekafix

15.2 Labels

Each electronics module is supplied with a label to enable application-specific identification. Labels are available as accessories (see **Anhang**).

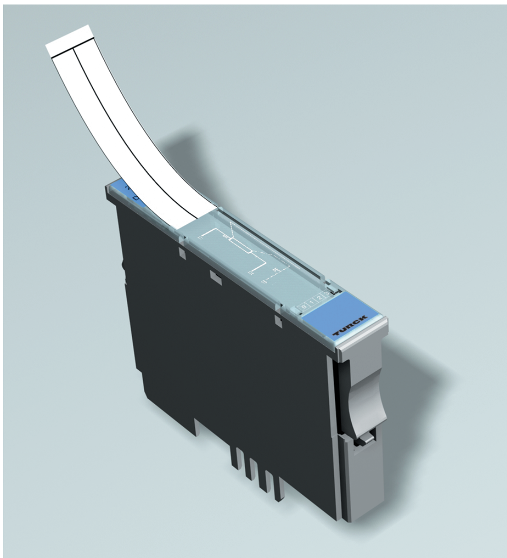

Fig. 329: Label

16 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**.

17 Appendix

17.1 Analog value representation (analog input modules)

The analog values can either be represented with16 bit or 12 bit. The two's-complement representation allow the representation of positive as well as negative values. The bits marked with an ”X” are not relevant for the analog value representation.

16-bit representation

The 16-bit-representation is realized as a **two's-complement**: 2 byte of process data are completely occupied:

analog value	16 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	+ -	measurement value														

Fig. 330: 16-bit representation

12-bit representation

In the voltage measurement/ output and in the temperature measurement, the value is represented as a two's-complement. In the current measurement/ output and in the resistance measurement, the value is represented as a **number**. The 12 bit value is **left-justified** and occupies bit 15 to 4 of the process data:

analog value	12 bit representation															
byte	byte 1								byte 0							
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
meaning	measurement value (without sign)												diagnostic data			

Fig. 331: 12-bit representation

The diagnostic data is integrated in the process input data and occupies 4 bit (right-justified).

The figure shows a 5-digit binary code in the outer circuit. The inner circuit shows the respective dual number, if the binary code is interpreted as binary number (positive numerical values) and as two’s complement.

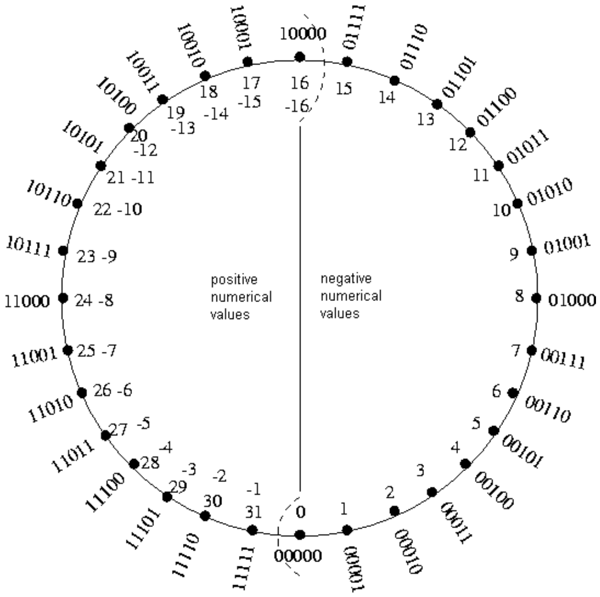

Fig. 332: Dual number and two's complement

17.1.1 Equations for 16-bit representation

Current values from 0 to 20 mA

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The value range:

0…20 mA

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two’s complement.

The current value can now be calculated by means of the following equation:

$$\text{current value} = \frac{\text{decimal value}}{1638.35}\,\text{mA} = 6.1 \cdot 10^{-4}\,\text{mA} \times \text{decimal value}$$

Current values from 4…20 mA

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The value range:

4…20 mA

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two’s complement.

The current value can now be calculated by means of the following equation:

$\text{current value} = 4.88 \times 10^{-4}\ \text{mA} \times \text{decimal value} + 4\ \text{mA}$

Temperature- and resistance values (BL20-2AI-PT/NI-2/3)

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two’s complement.

All numerical values from $00000_{hex...}$ $7FFF_{hex}$ represent **positive** values when coded as two’s complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is ”0”.

All numerical values from 8000_{hex} to $FFFF_{hex}$ represent **negative** values when coded as two’s complement. This is also relevant for binary numbers in which the most significant bit (bit 16) is ”1”. The conversion into a decimal number is shown in the following:

Example of the conversion of negative numerical value

The following parameterization is used in the example:

"Pt100, -200…150°C"

The temperature is thus calculated with the factor 0.01 (see below).

The example explains the general procedure to convert a hexadecimal or binary number coded as two's complement to a decimal number.

The hexadecimal value should be "**B344**".

1 The binary value is:

   B344 ↔ **1011.0011.0100.0100**

2 Invert the binary number:

   1011.0011.0100.0100 → **0100.1100.1011.1011**

3 Add a "1"to the inverted binary number:

   0100.1100.1011.1011
   0000.0000.0000.0001
   0100.1100.1011.1100

4 Convert the binary number into a decimal number:

   0100110010111100 ↔ **19644**

5 The temperature value is calculated as follows:

   temperature value = 0.01 °C × decimal value = 0.01 °C (-19644) = -196.44 °C

The temperature values can now be calculated according to the parameterization.

- For the parameterization
  "Pt100, -200…850°C"
  "Ni100, -60…250°C"
  "Pt200, -200…850°C"
  "Pt500, -200…850°C"
  "Pt1000, -200…850°C"
  "Ni1000, -60…250°C"

  use the equation:

  temperature value = 0.1 °C × decimal value

The value range:

-200 °C…-0,1°C

is displayed as follows:

F830$_{hex}$…FFFF$_{hex}$ (decimal: -2000…-1)

The value range:

0 °C…850°C

is displayed as follows:

0000$_{hex}$…2134$_{hex}$ (decimal: 0…8500)

- For the parameterization
  "Pt100, -200…150°C"
  "Ni100, -60…150°C"
  "Pt200, -200…150°C"
  "Pt500, -200…150°C"
  "Pt1000, -200…150°C"
  "Ni1000, -60…150°C"

  use the equation:

  temperature value = 0.1 °C × decimal value

The value range:

-200 °C…-0,01°C

is displayed as follows:

B1E0$_{\mathbf{hex}}$…**FFFF**$_{\mathbf{hex}}$ (decimal: -20000…-1)

The value range:

0 °C…150°C

is displayed as follows:

0000$_{\mathbf{hex}}$…**3A98**$_{\mathbf{hex}}$ (decimal: 0…15000)

For representation of resistance values only positive numbers (hexadecimal/binary) are used. The positive values can easily be converted into decimal ones.

The value range:

0…100 Ω; 0…200 Ω; 0…200 Ω; 0…1000 Ω

is displayed as follows:

0000$_{\mathbf{hex}}$…**7FFF**$_{\mathbf{hex}}$ (decimal: 0…32767)

The resistance values can now be calculated according to the parameterization.

The following equations are valid:

"Resistance, 0…100 Ohm":

resistance value = 0.00305 Ω × decimal value

"Resistance, 0…200 Ohm":

resistance value = 0.00610 Ω × decimal value

"Resistance, 0…400 Ohm":

resistance value = 0.01221 Ω × decimal value

"Resistance, 0…1000 Ohm":

resistance value = 0.03052 Ω × decimal value

Temperature- and voltage values (BL20-2AI-THERMO-PI)

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement.

All numerical values from 00000_{hex}… $7FFF_{hex}$ represent positive values when coded as two's complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is "0".

All numerical values from 8000_{hex}…$FFFF_{hex}$ represent negative values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (bit 16) is "1". Please see → **Example of the conversion of negative numerical value**, s. **S. 496**.

resistance value = 0.00305 Ω × decimal value

The temperature and voltage values can now be calculated according to the parameterization.

- For the parameterization
  "Typ K, -270…1370°C"
  "Typ B, +100…1820°C"
  "Typ E, -270…1000°C"
  "Typ J, -210…1200°C"
  "Typ N, -270…1300°C"
  "Typ R, -50…1760°C"
  "Typ S, -50…1540°C"
  "Typ T, -270…400°C"

  use the equation:

Temperature value = 0.01 °C × decimal value

The value range:

-270 °C…-0,1°C

is displayed as follows:

$F574_{hex}$…$FFFF_{hex}$ (decimal: -2700…-1)The value range:

0 °C…1820°C

is displayed as follows:

0000_{hex}…4718_{hex} (decimal: 0…18200)

The value range:

-50 mV…-0,002 mV;
-100 mV…-0,003 mV;
-500 mV…-0,015 mV;
-1000 mV…-0.031 mV

is displayed as follows:

8000_{hex}…$FFFF_{hex}$ (deimal: -32768…-1)

The value range:

0 mV…50 mV;
0 mV…100 mV;
0 mV…500 mV;
0 mV…1000 mV;

is displayed as follows:

0000_{hex} to $7FFF_{hex}$ (decimal: 0…32767)

For the parameterization "±50mV":

voltage value = 0.001526 mV x decimal value

For the parameterization "±100mV":

voltage value = 0.003052 mV x decimal value

For the parameterization "±500mV":

voltage value = 0.015259 mV x decimal value

For the parameterization "±1000mV":

voltage value = 0.030519 mV x decimal value

Voltages from 0…10 VDC

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two’s complement.

The value range:

0…10 VDC

is displayed as follows:

0000_{hex}…$7FFF_{hex (decimal:}$ 0…32767)

The voltage value can now be calculated by means of the following equation:

voltage value = 0.001526 mV x decimal value

Voltage values from -10 bis 10 V DC

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two’s complement.

All numerical values from 00000_{hex}… $7FFF_{hex}$ represent **positive** values when coded as two’s complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is ”0”.

All numerical values from 8000_{hex}…$FFFF_{hex}$ represent negative values when coded as two’s complement. This is also relevant for binary numbers in which the most significant bit (bit 16) is ”1”. Please see → **Example of the conversion of negative numerical value**, s. **S. 496**.

voltage value = 4.88×10^{-3} mV × decimal value

The value range:

-10 V…-3.052 10^{-4} V

is displayed as follows:

8000_{hex}…$FFFF_{hex}$ (decimal:-32768…-1)

The value range:

0 V…10 V

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

voltage value = 0.001526 mV × decimal value

17.1.2 Equations for 12-bit representation

The 12-bit-representation is "left-justified". The value is transmitted with 16 bit. The last 4 digits of the binary number or respectively the last digit position of the hexadecimal value are used as diagnostic bits!

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value. The value is contained in the 3 more significant digit positions of the hexadecimal number or in the 12 more significant bits of the binary number.

In the 12-bit-representation only the 3 more significant digit positions of the hexadecimal number or the 12 more significant bits of the binary number are used for the calculation of the decimal value.

Current values from 0…20 mA

The value range:

0…20 mA

is displayed as follows:

000_{hex}…$7FFF_{hex}$ (decimal: 0…4095)

The hexadecimal/binary value can easily be changed into a decimal value.

The current value can now be calculated by means of the following equation:

voltage value = 4.88×10^{-3} mA × decimal value

Current values from 4 bis 20 20 mA

The value range:

4…20 mA

is displayed as follows:

000_{hex}…$7FFF_{hex}$ (decimal: 0…4095)

The hexadecimal/binary value can easily be changed into a decimal value.

The current value can now be calculated by means of the following equation:

current value = 3.91×10^{-3} × decimal value

Temperature- and resistance values (BL20-2AI-PT/NI-2/3)

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement.

All numerical values from 000_{hex} … $7FF_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is "0".

All numerical values from 800_{hex}…$FFFF_{hex}$ represent negative values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (bit 12) is "1".

The conversion into a decimal number is shown in the following:
→ **Example of the conversion of negative numerical value**, s. **S. 496**.

The temperature values can now be calculated according to the parameterization.

- The first equation is for the parameterization:
  "Pt100, -200…850°C"
  "Ni100, -60…250°C"
  "Pt200, -200…850°C"
  "Pt500, -200…850°C"
  "Pt1000, -200…850°C"
  "Ni1000, -60…250°C"

Temperature value = 0.5 °C × decimal value

The value range:

-200 °C…-0,5°C

is displayed as follows:

$E70_{hex}$…FFF_{hex} (decimal: -400…-1)

The value range:

0 °C…850°C

is displayed as follows:

000_{hex}…$6A4_{hex}$ (decimal: 0…1700)

- The second equation is for the parameterization:
  "Pt100, -200…150°C"
  "Ni100, -60…150°C"
  "Pt200, -200…150°C"
  "Pt500, -200…150°C"
  "Pt1000, -200…150°C"
  "Ni1000, -60…150°C"

Temperature value = 0.1 °C × decimal value

The value range:

-200 °C…-0.1°C

is displayed as follows:

830_{hex}…FFF_{hex} (decimal: -2000…-1)

The value range:

0 °C…150°C

is displayed as follows:

000_{hex}…$5DC_{hex}$ (decimal: 0…1500)

For representation of **resistance values** only positive numbers (hexadecimal/binary) are used. The positive values can easily be converted into decimal ones.

The resistance values can now be calculated according to the parameterization.

The value range:

0 Ω to100 Ω;
0 Ω to 200 Ω;
0 Ω to 400 Ω;
0 Ω to 1000 Ω;

is displayed as follows:

000_{hex}…FFF_{hex} (decimal: 0 to 4095).

The following equations are valid:

"Resistance, 0…100 Ohm":

Resistance value = 0.02442 Ω × decimal value

"Resistance, 0…200 Ohm":

Resistance value = 0.04884 Ω × decimal value

"Resistance, 0…200 Ohm":

Resistance value = 0.09768 Ω × decimal value

"Resistance, 0…1000 Ohm":

Resistance value = 0.24420 Ω × decimal value

Temperature- and voltage values (BL20-2AI-THERMO-PI)

Before using the equation below, the hexadecimal or binary value has to be converted into a decimal value. The value is contained in the 3 more significant digit positions of the hexadecimal number or in the 12 more significant bits of the binary number.

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement.

All numerical values from 000_{hex} … $7FF_{hex}$ represent positive values when coded as two's complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 16) is "0".

All numerical values from 800_{hex}…$FFFF_{hex}$ represent negative values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (bit 12) is "1".

The conversion into a decimal number is shown in the following:
→ s. S. 496.

The temperature and voltage values can now be calculated according to the parameterization.

For the parameterization

- "Type K, -270…1370°C"
- "Type B, +100…1820°C"
- "Type E, -270…1000°C"
- "Type J, -210…1200°C"
- "Type N, -270…1300°C"
- "Type R, -50…1760°C"
- "Type S, -50…1540°C"
- "Type T, -270…400°C"

use the equation:

Temperature value = 1 °C × decimal value

The value range:

-270 °C…1820°C

is displayed as follows:

$EF2_{hex}$…$71C_{hex}$ (decimal: -270…1820)

For the parameterization "±50mV":

voltage value = 0.02443 mV x decimal value

For the parameterization "±100mV":

voltage value = 0.04885 mV x decimal value

For the parameterization "±500mV":

voltage value = 0.24426 mV x decimal value

For the parameterization "±1000mV":

voltage value = 0.488523 mV x decimal value

The value range:

-50 mV…-0,024 mV;

-100 mV…-0,049mV;

-500 mV…-0,244mV;

-1000 mV…-0,489mV;

is displayed as follows:

800$_{hex}$…7FFF$_{hex}$ (decimal: -2048…-1)

The value range:

0 mV…50 mV;

0 mV…100 mV;

0 mV…500 mV;

0 mV…1000 mV;

is displayed as follows:

000$_{hex}$…7FF$_{hex}$ (decimal: 0…2047)

Voltages from 0…10 VDC

The hexadecimal/binary value can easily be converted into a decimal value, because all numbers belong to the positive range of the two's complement.

The voltage value can now be calculated by means of the following equation:

voltage value = 0.002442 V x decimal value

The value range:

0 V…10 V

is displayed as follows:

000$_{hex}$…7FFF$_{hex}$ (decimal: 0…4095)

Voltages from -10…10 VDC

The hexadecimal/binary values for the negative value range cannot easily be converted into decimal values, because the values are coded as two's complement.

All numerical values from 000_{hex} … $7FF_{hex}$ represent **positive** values when coded as two's complement. Values in this range can easily be converted into decimal values. This is also relevant for binary numbers in which the most significant bit (bit 12) is "0".

All numerical values from 800_{hex}…$FFFF_{hex}$ represent negative values when coded as two's complement. This is also relevant for binary numbers in which the most significant bit (bit 12) is "1". Please see → **Example of the conversion of negative numerical value**, s. **S. 496**.

The voltage value can now be calculated by means of the following equation:

For **positive** values 0 …10 VDC:

voltage value = 0.004885 V × decimal value

The value range:

0 V…10 V

is displayed as follows:

000_{hex}…$7FF_{hex}$ (decimal: 0…2047)

For **negative** voltage values -10 …10 VDC:

voltage value = 0.004883 V × decimal value

The value range:

-10 V…-0.0049 V

is displayed as follows:

800_{hex}…$7FFF_{hex}$ (decimal: -2048…-1)

17.2 Analog value representation (analog output modules)

17.2.1 Resolution of analog value representations

In the bipolar mode the digitalized analog values are represented as a two's complement. The 16 bit or the 12-bit-representation (left justified) can be chosen by setting the respective module parameter.

17.2.2 Equations for 16-bit representation

Current values from 0 bis 20 20 mA

The decimal values for the current values from 0…20 mA can be calculated by means of the following equation:

$$\text{decimal value} = 2047.9375\ 1/\text{mA} \times \text{current value} - 8191.75$$

The value range:

0…20 mA

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The decimal value can easily be converted into a hexadecimal value, because all numbers belong to the positive range of the two's complement.

Current values from 4…20 mA

The decimal values for the current values from 4…20 mA can be calculated by means of the following equation:

$$\text{decimal value} = 2047.9375\ 1/\text{mA} \times \text{current value} - 8191.75$$

The value range:

4…20 mA

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The decimal value can easily be converted into a hexadecimal value, because all numbers belong to the positive range of the two's complement.

Voltages from 0…10 VDC

The decimal values for the current values from 0…10 VDC can be calculated by means of the following equation:

decimal value = 3276.7 /1V × voltage value

The decimal value can easily be converted into a hexadecimal value, because all numbers belong to the positive range of the two's complement.

Voltage values in the range of -10 … 10 V DC

The decimal values for the current values from -10…10 VDC can be calculated by means of the following equation:

For **positive** values 0 …10 VDC:

decimal value = 3276.7 /1V × voltage value

The value range:

0 V…10 V

is displayed as follows:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

For **negative** voltage values -10 …0 VDC:

decimal value = 3276.8 /1V × voltage value

The value range:

-10 V…-3.052 10^{-4} V

is displayed as follows:

8000_{hex}…$FFFF_{hex}$ (decimal:-32768…-1)

Conversion of the decimal values into hexadecimal/ binary values

The decimal value can easily be converted into hexadecimal value. The two's complement for the 16 bit values corresponds to the dual numbers in the positive range.

The conversion of negative decimal values into hexadecimal values is more complicated, because the values have to be coded as a two's complement. The following example explains the method of conversion:

The 4-digit hexadecimal number for the voltage value **-6 V** is searched:

decimal value = 3276.8 1/V× (-6 v) = -19660.8

Some calculators can be used to convert negative decimal values directly in a hexadecimal value coded as two's complement.

Without such a calculator, convert the value as follows:

1 Convert the amount of the negative decimal value to a binary number:

|-19660,8| = 19660,8 ⇔ 100.1100.1100.1100

2 Fill the 16 bit of the binary number with "0":

100.1100.1100.1100 ⇔ 0100.1100.1100.1100

3 Invert the 16-digit binary number:

0100.1100.1100.1100 ⇒ 1011.0011.0011.0011

4 Add "1" to this inverted number:

1011.0011.0011.0011
0000.0000.0000.0001
1011.0011.0011.0100

5 The number is now coded as a two's complement and can be converted into a hexadecimal number.

1011.0011.0011.0100 ⇒ B334

6 The result is:

19660.8 ⇒ B334

17.2.3 Equations for 12-bit representation

The 12-bit-representation is ”left-justified”. The value is transmitted with 16 bit. The last 4 digits of the binary number or respectively the last digit position of the hexadecimal value are always ”0”!

Current values from 0…20 mA

The decimal values for the current values from 0…20 mA can be calculated by means of the following equation:

decimal value = 204.75 1/mA × current value

The value range:

0…20 mA

is displayed as follows:

000_{hex}…$7FFF_{hex}$ (decimal: 0…4095)

The decimal value can easily be changed into a hexadecimal value.

As the numbers are represented left-justified, a ”0” has to be added to the 3-digit hexadecimal value or the number has to move one digit to the left.

$XXX_{hex} \Rightarrow XXX0_{hex}$

The 12-digit binary number has to be filled with 4 digits of ”0” or has to move 4 digits to the left:

XXXX.XXXX.XXXX ⇒ XXXX.XXXX.XXXX.0000

Current values from 4 to 20 20 mA

The decimal values for the current values from 4…20 mA can be calculated by means of the following equation:

decimal value = 255.9375 1/mA × current value-1023.75

The value range:

4…20 mA

is displayed as follows:

000_{hex}…$7FFF_{hex}$ (decimal: 0…4095)

The decimal value can easily be changed into a hexadecimal value (see s. S. 510).

Voltage values from 0…10 VDC

The decimal values for the current values from 0…10 VDC can be calculated by means of the following equation:

decimal value = 409.5 1/V ÷ voltage value

The value range:

0 V…10 V

is displayed as follows:

000_{hex}…$7FFF_{hex}$ (decimal: 0…4095)

The decimal value can easily be changed into a hexadecimal value (see s. S. 510).

Voltage values from -10…10 VDC

The decimal values for the current values from -10…10 VDC can be calculated by means of the following equation:

For **positive** values 0 …10 VDC:

decimal value = 204.7 1/V × voltage value

The value range:

0 V…10 V

is displayed as follows:

000_{hex}…$7FF_{hex}$ (decimal: 0…2047)

For **negative** voltage values -10 …0 VDC:

decimal value = 204.8 1/V × voltage value

The value range:

-10 V…-0.0049 V

is displayed as follows:

800_{hex}…FFF_{hex} (decimal: -2048…-1)

The decimal value can easily be converted into hexadecimal value. The two’s complement for the 12 bit values corresponds to the dual numbers in the positive range.

As the numbers are represented left-justified, a ”0” has to be added to the 3-digit hexadecimal value or the number has to move one digit to the left s. S. 510.

Conversion of the decimal values into hexadecimal/ binary values

The conversion of negative decimal values into hexadecimal values is more complicated, because the values have to be coded as a two's complement. The following example explains the method of conversion:

The 4-digit hexadecimal number for the voltage value -6 V is searched:

decimal value = 204.75 1/V × (- 6 V) = -1228.8

Some calculators can be used to convert negative decimal values directly in a hexadecimal value coded as two's complement.

Without such a calculator, convert the value as follows:

1 Convert the amount of the negative decimal value to a binary number:

|-1228,8| = 1228,8 ⇔ 100.1100.1100

2 Fill the 12 bit of the binary number with "0":

100.1100.1100 ⇒ 0100.1100.1100

3 Invert the 12-digit binary number:

0100.1100.1100 ⇒ 1011.0011.0011

4 Add "1" to this inverted number:

1011.0011.0011
0000.0000.0001
1011.0011.0100

5 The number is now coded as a two's complement and can be converted into a hexadecimal number.

1011.0011.0100 ⇒ B34

6 As the number is represented as 16 bit left-justified, the hexadecimal value has to be completed with a "0" and the binary value with 4 "0".

B34 ⇒ B340
(1011.0011.0100 ⇒ 1011.0011.0100.0000)

7 The result is:

-1228,8 ⇒ B340

17.3 Ident codes the BL20-modules

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

Module	ident code
Digital input modules	
BL20-2DI-24VDC-P	0×210020××
BL20-2DI-24VDC-N	0×220020××
BL20-2DI-120/230VAC	0×230020××
BL20-4DI-24VDC-P	0×410030××
BL20-4DI-24VDC-N	0×420030××
BL20-4DI-NAMUR	0×015640××
BL20-E-8DI-24VDC-P	0×610040××
BL20-16DI-24VDC-P	0×810050××
BL20-E-16DI-24VDC-P	0×820050××
BL20-32DI-24VDC-P	0×A10070××
Analog input modules	
BL20-1AI-I(0/4..20MA)	0×012350××
BL20-2AI-I(0/4..20MA)	0×225570××
BL20-1AI-U(-10/0..+10VDC)	0×011350××
BL20-2AI-U(-10/0..+10VDC)	0×235570××
BL20-2AI-PT/NI-2/3	0×215770××
BL20-2AI-THERMO-PI	0×215570××
BL20-4AI-U/I	0×417790××
BL20-E-8AI-U/I-4PT/NI	0×6199B0××
BL20-2AIH-I	0x2179C0××
BL20-E-4AI-TC	0×427790××
Digital output modules	
BL20-2DO-24VDC-0.5A-P	0×212002××
BL20-2DO-24VDC-0.5A-N	0×222002××
BL20-2DO-24VDC-2A-P	0×232002××
BL20-2DO-120/230VAC-0.5A	0×250002××
BL20-4DO-24VDC-0.5A-P	0×013003××
BL20-E-8DO-24VDC-0.5A-P	0×610004××
BL20-16DO-24VDC-0.5A-P	0×413005××
BL20-E-16DO-24VDC-0.5A-P	0×820005××

Module	ident code
BL20-32DO-24VDC-0.5A-P	0×614007××
Analog output modules	
BL20-1AO-I(0/4..20MA)	0×010605××
BL20-2AO-I(0/4..20MA)	0×220807××
BL20-2AO-U(-10/0..+10VDC)	0×210807××
BL20-E-4AO-U/I	0×417A09××
BL20-2AOH-I	0×217AB7××
Relay modules	
BL20-2DO-R-NC	0×230002××
BL20-2DO-R-NO	0×220002××
BL20-2DO-R-CO	0×210002××
Technology modules	
BL20-1CNT-24VDC	0×014B99××
BL20-E-2CNT-2PWM	0×017BCC××
BL20-1RS232	0×014799××
BL20-1RS485/422	0×024799××
BL20-1SSI	0×044799××
BL20-E-1SWIRE	0×169C99××
BL20-2RFID-x	0×242224××
Power distribution modules	
BL20-BR-24VDC-D	0×013000××
BL20-PF-24VDC-D	0×023000××
BL20-PF-120/230VAC-D	0×053000××

17.4 Nominal current consumption and power loss

17.4.1 Nominal current consumption of BL20-modules from the supply terminal I_L

Module	Power supply	Nominal current consumption
gateway		–
BL20-BR-24VDC-D	10 A	
BL20-PF-24VDC-D	10 A	
BL20-PF-120/230VAC-D	10 A	
BL20-2DI-24VDC-P		≤ 20 mA
BL20-2DI-24VDC-N		≤ 20 mA
BL20-2DI-120/230VAC		≤ 20 mA
BL20-4DI-24VDC-P		≤ 40 mA
BL20-4DI-24VDC-N		≤ 40 mA
BL20-4DI-NAMUR		≤ 30 mA
BL20-16DI-24VDC-P		≤ 40 mA
BL20-32DI-24VDC-P		≤ 30 mA
BL20-1AI-I(0/4..20MA)		≤ 50 mA
BL20-2AI-I(0/4..20MA)		≤ 12 mA
BL20-1AI-U(-10/0..+10VDC)		≤ 50 mA
BL20-2AI-U(-10/0..+10VDC)		≤ 12 mA
BL20-2AI-PT/NI-2/3		< 30 mA
BL20-2AI-THERMO-PI		< 30 mA
BL20-4AI-U/I		< 20 mA
BL20-E-8AI-U/I-4PT/NI		50 mA
BL20-2AIH-I		typ. 35 mA (without measurement signal)
BL20-E-4AI-TC		< 30 mA
BL20-2DO-24VDC-0.5A-P		20 mA (load current= 0)
BL20-2DO-24VDC-0.5A-N		20 mA (load current= 0)
BL20-2DO-24VDC-2A-P		50 mA (load current= 0)
BL20-4DO-24VDC-0.5A-P		≤ 25 mA (load current = 0)
BL20-16DO-24VDC-0.5A-P		< 30 mA
BL20-32DO-24VDC-0.5A-P		< 50 mA
BL20-2DO-120/230VAC-0.5A		20 mA (load current= 0)
BL20-1AO-I(0/4..20MA)		≤ 50 mA

Module	Power supply	Nominal current consumption
BL20-2AO-I(0/4..20MA)		≤ 50 mA
BL20-2AO-U(-10/0..+10VDC)		≤ 50 mA
BL20-2AOH-I		< 20 mA (without signal output)
BL20-E-4AO-U/I		< 40 mA (without signal output)
BL20-2DO-R-NC		< 20 mA
BL20-2DO-R-NO		< 20 mA
BL20-2DO-R-CO		< 20 mA
BL20-1CNT-24VDC		50 mA (load current= 0)
BL20-E-2CNT-2PWM		Typ. 35 mA (all in- and outputs = 0)
BL20-1RS232		-
BL20-1RS485/422		< 25 mA
BL20-1SSI		< 25 mA
BL20-2RFID-x		≤ 100 mA

17.4.2 Nominal current from module bus I_{MB}

Module	Power supply	Nominal current consumption
gateway		≤ 430 mA
BL20-BR-24VDC-D	1500 mA	
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
BL20-16DI-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

Module	Power supply	Nominal current consumption
BL20-2AI-PT/NI-2/3		≤ 45 mA
BL20-2AI-THERMO-PI		≤ 45 mA
BL20-4AI-U/I		≤ 50 mA
BL20-E-8AI-U/I-4PT/NI		< 50 mA
BL20-2AIH-I		≤ 30 mA
BL20-E-4AI-TC		≤ 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
BL20-4DO-24VDC-0.5A-P		≤ 30 mA
BL20-16DO-24VDC-0.5A-P		≤ 45 mA
BL20-32DO-24VDC-0.5A-P		≤ 30 mA
BL20-2DO-120/230VAC-0.5A		≤ 35 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
BL20-2AOH-I		≤ 30 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
BL20-1CNT-24VDC		≤ 40 mA
BL20-E-2CNT-2PWM		≤ 30 mA
BL20-1RS232		≤ 140 mA
BL20-1RS485/422		≤ 60 mA
BL20-1SSI		≤ 50 mA
BL20-E-1SWIRE		≤ 60 mA
BL20-2RFID-x		≤ 30 mA

17.4.3 Power loss of the modules

Modules	Power loss (typical)
gateway	–
BL20-BR-24VDC-D	–

Modules	Power loss (typical)
BL20-PF-24VDC-D	–
BL20-PF-120/230VAC-D	–
BL20-2DI-24VDC-P	< 0.7 W
BL20-2DI-24VDC-N	< 0.7 W
BL20-2DI-120/230VAC	< 1 W
BL20-4DI-24VDC-P	< 1 W
BL20-4DI-24VDC-N	< 1 W
BL20-16DI-24VDC-P	< 2.5 W
BL20-32DI-24VDC-P	< 4.2 W
BL20-1AI-I(0/4..20MA)	< 1 W
BL20-2AI-I(0/4..20MA)	< 1 W
BL20-1AI-U(-10/0..+10VDC)	< 1 W
BL20-2AI-U(-10/0..+10VDC)	< 1 W
BL20-2AI-PT/NI-2/3	< 1 W
BL20-2AI-THERMO-PI	< 1 W
BL20-4-AI-U/I	< 1W
BL20-E-4AI-TC	< 1W
BL20-E-8AI-U/I-4PT/NI	< 1.5 W
BL20-2AIH-I	< 1W
BL20-2DO-24VDC-0.5A-P	< 1 W
BL20-2DO-24VDC-0.5A-N	< 1 W
BL20-2DO-24VDC-2A-P	< 1 W
BL20-4DO-24VDC-0.5A-P	< 1 W
BL20-16DO-24VDC-0.5A-P	< 4 W
BL20-32DO-24VDC-0.5A-P	< 4 W
BL20-2DO-120/230VAC-0.5A	< 1 W
BL20-1AO-I(0/4..20MA)	< 1 W
BL20-2AO-I(0/4..20MA)	< 1 W
BL20-2AO-U(-10/0..+10VDC)	< 1 W
BL20-E-4AO-U/I	< 1.5 W
BL20-2AOH-I	< 1W
BL20-2DO-R-NC	< 1 W
BL20-2DO-R-NO	< 1 W
BL20-2DO-R-CO	< 1 W

Modules	Power loss (typical)
BL20-1CNT-24VDC	< 1.3 W
BL20-E-2CNT-2PWM	< 2 W
BL20-1RS232	< 1 W
BL20-1RS485/422	< 1 W
BL20-1SSI	< 1 W
BL20-E-1SWIRE	< 1 W
BL20-2RFID-x	< 1 W

17.5 Abbreviations

Abbrev.	Designation	Example
ABPL	End plate for right-sided termination of a BL20 station	BL20-**ABPL**
AI	Analog input module	BL20-1**AI**-…
AO	Analog output module	BL20-1**AO**-…
B	Designation for base module in block design	BL20-**B**3S-SBB
B	engl. Bridge connector: bridged connections on the same connection level in a base module, for applying potentials	BL20-S3T-S**BB**
B	Added to designation of base modules for those Bus Refreshing modules used within a BL20 station but do not supply the gateway with power.	BL20-P4T-SBBC-**B**
BR	Bus Refreshing module	BL20-**BR**-24VDC-D
C	Designation of a connection level with cross connection to a C-rail and can, among other things, be used as a PE (only possible with certain base modules).	BL20-S4T-SBB**C**
CJ	Base module for BL20-2AI-THERMO-PI with integrated PT1000 for cold junction compensation	BL20-S4T-SBBS-**CJ**
CNT	engl. counter module	BL20-1**CNT**-24VDC
CO	engl. change over change over contact	BL20-2DO-R-**CO**
D	Diagnostics	BL20-BR-24VDC-**D**
DI	Digital input module	BL20-2**DI**-24VDC-P
DO	Digital output module	BL20-2**DO**-24VDC-2A-P
GW	gateway	BL20-**GW**-PBDP-1.5MB
KLBU	Terminal clip, shielded connection for analog input modules	BL20-**KLBU**/T
KO	Coding element for coding electronics and base module	BL20-**KO**/2
MB	MBaud (Mbps); Transmission rate	BL20-GW-PBDP-1.5**MB**

Abbrev.	Designation	Example
N	Negative switching (sourcing)	BL20-2DI-24VDC-**N**
NC	engl. normally closed normally closed contact	BL20-2DO-R-**NC**
NI	For connecting resistance thermometers with sensors Ni100 and NI1000 in 2- or 3-wire measurement type	BL20-2AI-PT/**NI**-2/3
NO	engl. normally open normally open contact	BL20-2DO-R-**NO**
P	Positive switching	BL20-2DI-24VDC-**P**
P	Designation of the base module for Power Feeding and Bus Refreshing modules	BL20-**P**3T-SBB
PBDP	BL20 gateway for PROFIBUS-DP	BL20-GW-**PBDP**-1.5MB
PF	Power Feeding module	BL20-**PF**-24VDC-D
PT	Analog input module for connecting resistance thermometers with sensors PT100, PT200, PT500 and PT1000 in 2- or 3-wire measurement type	BL20-2AI-**PT**/NI-2/3
QV	Jumper for relay modules	BL20-**QV**/1
R	Relay module	BL20-2DO-**R**-NC
S	Designation for base module in slice design	BL20-**S**3T-SBB
S	engl. screw Designation for base module with screw connection	BL20-S3**S**-SBB
S	engl. screw Designation for gateway with screw connection	BL20-GW-PBDB-1.5MB-**S**
S	engl. single connector: non-bridged connections on the same connection level in a base module, used for connecting the signal	BL20-S3T-**S**BB
T	engl. tension clamp Designation for base module with tension clamp connection	BL20-S3**T**-SBB
x	Partly for ”S” or ”T” in the designations of base modules with screw or tension clamp connection	BL20-S3×-SBB

17.6 Assignment electronic and base modules

Electronic module	Base module	BL20-S3x-SBB	BL20-S3x-SBC	BL20-S4x-SBBC	BL20-S4x-SBBS	BL20-S4x-SBCS	BL20-S4x-SBBS-CJ	BL20-S6x-SBBSBB	BL20-S6x-SBCSBC	BL20-B3x-SBB	BL20-B3x-SBC	BL20-B4x-SBBC	BL20-B6x-SBBSBB	BL20-P3x-SBB	BL20-P3x-SBB-B	BL20-P4x-SBBC	BL20-P4x-SBBC-B
Digital input																	
BL20-2DI-24VDC-P		X		X													
BL20-2DI-24VDC-N		X		X													
BL20-2DI-120/230VAC		X		X													
BL20-4DI-24VDC-P					X			X									
BL20-4DI-24VDC-N					X			X									
BL20-16DI-24VDC-P										X		X					
BL20-32DI-24VDC-P													X				
BL20-4DI-NAMUR					X												
Analog input																	
BL20-1AI-I(0/4…20MA)		X			X												
BL20-2AI-I(0/4…20MA)		X			X												
BL20-1AI-U(-10/0...+10VDC)		X			X												
BL20-2AI-U(-10/0...+10VDC)		X			X												
BL20-2AI-PT/NI-2/3		X			X												
BL20-2AI-THERMO-PI							X										
BL20-4AI-U/I									X								
BL20-2AIH-I					X												
Digital output																	
BL20-2DO-24VDC-2A-P			X			X											
BL20-2DO-24VDC-0.5A-P			X			X											
BL20-2DO-24VDC-0.5A-N			X			X											
BL20-4DO-24VDC-0.5A-P						X			X								
BL20-16DO-24VDC-0.5A-P											X						
BL20-32DO-24VDC-0.5A-P												X					
BL20-2DO-120/230VAC-0.5A			X			X											
Analog output																	
BL20-1AO-I(0/4…20MA)		X															
BL20-2AO-I(0/4…20MA)		X															
BL20-2AO-U(-10/0…+10VDC)		X															
BL20-2AOH-I					X												

Electronic module	Base module	BL20-S3×-SBB	BL20-S3×-SBC	BL20-S4×-SBBC	BL20-S4×-SBBS	BL20-S4×-SBCS	BL20-S4×-SBBS-CJ	BL20-S6×-SBBSBB	BL20-S6×-SBCSBC	BL20-B3×-SBB	BL20-B3×-SBC	BL20-B4×-SBBC	BL20-B6×-SBBSBB	BL20-P3×-SBB	BL20-P3×-SBB-B	BL20-P4×-SBBC	BL20-P4×-SBBC-B
Relay modules																	
BL20-2DO-R-NC					X	X											
BL20-2DO-R-NO					X	X											
BL20-2DO-R-CO					X												
Technology modules																	
BL20-1CNT-24VDC					X												
BL20-1RS232					X												
BL20-1RS485/422					X												
BL20-1SSI					X												
Power distribution modules																	
BL20-BR-24VDC-D														X 1)	X 2)	X 1)	X 2)
BL20-PF-24VDC-D														X		X	
BL20-PF-120/230VAC-D														X		X	

1) base modules for gateway supply

2) base modules for the bus refreshing wihtin a station

17.7 Cross reference list parameters

NOTE
Due to a product actualization, the parameter texts of the Turck I/O-products have been revised.
The actual configuration files (GSD-, GSDML-, EDS-files) with the new parameters can be found under www.turck.com.
Please use the following cross reference list if you work with old configuration files with old parameter texts (release date before April 2014).

Parameters OLD	Parameters NEW
Digital modules	
Activate output	
0 = no 1 = yes	
Invert digital input	
0 = no 1 = yes	
Wire break diagnostics	Activate wire break diagnostics
0 = deactivate 1 = activate	0 = no 1 = yes
Wire break monitoring	Activate wire break monitoring
0 = deactivate 1 = activate	0 = no 1 = yes
Input on diagnostic	
0 = output substitute value 1 = keep last value	0 = substitute value 1 = current value
Activate input filter	
0 = no 1 = yes	
Substitute value	
0 = off 1 = 1	
Short-circuit diagnosis	Activate overcurrent diagnostics
0 = deactivate 1 = activate	0 = no 1 = yes
Short-circuit monitoring	Activate overcurrent monitoring
0 = deactivate 1 = activate	0 = no 1 = yes
Output on overcurrent	Manual output reset after overcurrent

Parameters OLD	Parameters NEW
0 = automatic recovery 1 = yes	0 = no 1 = yes
Analog modules	
range	Measurement range
0 = 0…10V/0…20 mA 1 = -10…10V/4…20 mA	
Mode – BL20-2AIH-I – BL20-2AOH-I	
0 = 0…20mA 1 = 4…20mA 2 = 4…20mA HART active	
Mode – BL20-4AI-U/I	
0 = voltage 1 = current	
Mode – BL20-E-4AO-U/I	
0000 = voltage -10…10 V standard 0001 = voltage 0…10 V standard 0010 = voltage -10…10 V NE43 0011 = voltage 0…10 V NE43 0100 = voltage -10…10 V ext. range 0101 = voltage 0…10 V ext. range 1000 = current 0…20 mA standard 1001 = current 4…20 mA standard 1010 = current 0…20 mA NE43 1011 = current 4…20 mA NE43 1100 = current 0…20 mA ext. range 1101 = current 4…20 mA ext. range	

Parameters OLD	Parameters NEW
Mode – BL20-E-8AI-U/I-4PT/NI	
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 V DC extended range 000101 = voltage 0…10 V DC extended range 001000 = current 0…20 mA standard 001001 = current 4…20 mA standard 001010 = current 0…20 mA PA (NE 43) 001011 = current 4…20 mA DC PA (NE 43) 001100 = current 0…20 mA extended range 001101 = current 4…20 mA extended range 010000 = Pt100,-200 °C…850 °C, 2 wire 010001 = Pt100,-200 °C…150 °C, 2 wire 010010 = Pt200,-200 °C…850 °C, 2 wire 010011 = Pt200,-200 °C…150 °C, 2 wire 010100 = Pt500 -200 °C…850 °C, 2 wire 010101 = Pt500 -200 °C…150 °C, 2 wire 010110 = Pt1000 -200 °C…850 °C, 2 wire 010111 = Pt1000 -200 °C…150 °C, 2 wire	
011000 = Pt100,-200 °C…850 °C, 3 wire 011001 = Pt100,-200 °C…150 °C, 3 wire 011010 = Pt200,-200 °C…850 °C, 3 wire 011011 = Pt200,-200 °C…150 °C, 3 wire 011100 = Pt500 -200 °C…850 °C, 3 wire 011101 = Pt500 -200 °C…150 °C, 3 wire 011110 = Pt1000 -200 °C…850 °C, 3 wire 011111 = Pt1000 -200 °C…150 °C, 3 wire 100000 = Ni100, -60 °C…250 °C, 2 wire 100001 = Ni100, -60 °C…150 °C, 2 wire 100010 = Ni1000, -60 °C…250 °C, 2 wire 100011 = Ni1000,-60 °C…150 °C, 2-wire 100100 = Ni1000TK5000, -60 °C…250 °C, 2 wire 101000 = Ni100, -60 °C…250 °C, 3 wire 101001 = Ni100, -60 °C…150 °C, 3 wire 101010 = Ni1000, -60 °C…250 °C, 3 wire 101011 = Ni1000,-60 °C…150 °C, 3-wire 101100 = Ni1000TK5000, -60 °C…250 °C, 3 wire 110000 = resistance, 0…400 Ω 110001 = resistance, 0…800 Ω 110011 = resistance, 0…2000 Ω 110100 = resistance, 0…4000 Ω	
Diagnostics	Deactivate all diagnostics
0 = activate 1 = deactivate	0 = no 1 = yes
Wire break diagnostics	Activate wire break diagnostics
0 = block 1 = release	0 = no 1 = yes
Element – BL20-2AI-PT/NI-2/3	RTD type

Parameters OLD	Parameters NEW
0000 = Pt100, -200…850 °C 0001 = Pt100, -200…150 °C 0010 = Ni1000, -60...250 °C 0011 = Ni1000, -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	
Element – BL20-2AI-THERMO-PI	Thermocouple type
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	
Element – BL20-E-4AI-TC	Thermocouple type
0000 = Type K, -270…1370 °C 0001 = Type B, +100…1820 °C 0010 = Type E, -270…1000 °C 0011 = Type J, -210…1200 °C 0100 = Type N, -270…1300 °C 0101 = Type R, -50…1760 °C 0110 = Type S, -50…1540 °C 0111 = Type T, -270…400 °C 1000 = ±50 mV 1001 = ±100 mV 1010 = ±500 mV 1011 = ±1000 mV 1100 = Type K, -454…2498 °F 1101 = Type J, -346…2192 °F 1110 = Type C 0… 2320 °C 1111 = Type G 0… 2320 °C	

Parameters OLD	Parameters NEW
HART-Diagnostics	Activate HART diagnostics
0 = release 1 = block	0 = no 1 = yes
Mapped channel	Mapped channel VA
0 = channel 1 1 = channel 2	
Mapped variable	Mapped variable VA
00 = PV (1. HART variable) 01= SV (2nd HART variable) 10 = TV (3rd HART variable) 11 = QV (4th HART variable)	
Channel	Deactivate channel
0 = activate 1 = deactivate	0 = no 1 = yes
Short-circuit diagnosis	Activate overcurrent diagnostics
0 = block 1 = release	0 = no 1 = yes
Mains suppression	
0 = 50 Hz 1 = 60 Hz	
Voltage mode (AI)	Measurement range
0 = 0…10V 1 = -10…+10V	
Voltage mode (AO)	Output range
0 = 0…10 V 1 = -10…+10 V	
Current range	Measurement range
0 = 0…20 mA 1 = 4…20 mA	
Current range	Output range
0 = 0…20 mA 1 = 4…20 mA	
Value representation	Data format
0 = integer (15 bit + sign) 1 = 12 bit (left justified)	0 = 15 bit + sign 1 = 12 bit (left justified)

Parameters OLD	Parameters NEW
Value representation – BL20-2AIH-I – BL20-2AOH-I	Data representation
00 = 15 bit + sign 01 = NE43 10 = extended range	
Value representation – BL20-2AIH-I – BL20-2AOH-I	Data representation
Technology modules **– BL20-1RS232/BL20-1RS485/422**	
transmission 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	
Data bits	
0 = 7 1 + 8	
Diagnostics	Deactivate all diagnostics
0 = release 1 = block	0 = no 1 = yes
Data flow control – BL20-1RS232	Data flow control
00 = none 01 = XON/XOFF 10 = RTS/CTS	
Data flow control – BL20-1RS485/422	Data flow control
00 = none 01 = XON/XOFF	
Parity	
00 = none 01 = odd 10 = even	

Parameters OLD	Parameters NEW
Reduced control mode	Extended status/control mode
0 = 01:07 1 = 2:06 AM	0 = no 1 = yes
RS422 / RS485	
0 = RS422 1 = RS485	
Stop bits	
0 = 1 bit 1 = 2 bit	
XOFF character	
0 – 255	
XON character	
0 – 255	
Technology modules – BL20-1SSI	
Data frame bits	
00000…100000	
Invalid bits (LSB)	
0000…1111	
Invalid bits (MSB)	
0000…1111	
transmission 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	
Data format	
0 = binary coded 1 = GRAY coded	
Sensor idle data cable test	
0 = activate 1 = deactivate	

Parameters OLD	Parameters NEW
Technology modules – BL20-E-1SWIRE	
Automatic configuration SWIRE	
0 = deactivate 1 = activate	
Error message - Uaux	
0 = activate 1 = deactivate	
Configuration error field	
0 = activate 1 = deactivate	
Array - PKZ error	
0 = activate 1 = deactivate	
Array - slave error	
0 = activate 1 = deactivate	
Common error - config error	Group configuration error field
0 = activate 1 = deactivate	
Common error - PKZ error	Group PKZ error field
0 = activate 1 = deactivate	
Common error - slave error	
0 = activate 1 = deactivate	
Configuration check	
0 = line orientated 1 = slave oriented	
MC (Moeller Conformance)	
0 = deactivate 1 = activate	
PLC configuration check	
0 = activate 1 = deactivate	

Parameters OLD	Parameters NEW
Technology modules – BL20-1CNT-24VDC	
Diagnostic DO1	
0 = 1 1 = off	
Digital input DI	
0 = normal 1 = inverted	
Substitute value DO	
0 = 0 1 = 1	
Function DI (count mode)	
00 = input 01 = HW gate 10 = Latch-Retrigger when edge pos. 11 = Synchronization when edge pos.	
Function DI (measurement mode)	
0 = input 1 = HW gate	
Function DO (count mode)	
00 = output 01 = on when cnt value >= ref. value 10 = on when cnt value <= ref. value 11 = pulse when cnt value = ref. value	
Function DO (measurement mode)	
00 = output 01 = outside of limit 10 = below lower limit 11 = above upper limit	
Sensor pulse per revolution	
1…65535	
Main count direction	
00 = none 01 = up 10 = down	
Hysteresis	
0…255 (Unsigned8)	
Pulse duration DO1, DO2 [n*2ms]	
0…255 (Unsigned8)	

Parameters OLD	Parameters NEW
Integration time [n*10ms]	
1…1 000	
wiring type	
100000 = frequency measurement 100001 = revolutions measurement 100010 = period duration measurement	
upper limit	
1…16 777 215 $\times$ 10^{-3}	
Upper limit (HWORD)	
0…255 (Unsigned8)	
Upper limit (LWORD)	
0…65535	
Upper count limit	
0…2147483647 (2^{31}-1)	
Upper count limit (HWORD)	
0…^{32767} (Unsigned16)	
Upper count limit (LWORD)	
0…65535 (Unsigned16)	
Direction input (B)	
0 = normal 1 = inverted	
Group diagnostics	
0 = release 1 = block	
sensor (A)	
0 = normal 1 = inverted	
Sensor/ input filter (x)	
0 = 2.5 µs (200 kHz) 1 = 25 µs (20 kHz)	
Signal evaluation (A, B)	
00 = pulse and direction 01 = rotary sensor: single 10 = rotary sensor: double 11 = rotary sensor: fourfold	

Parameters OLD	Parameters NEW
synchronization	
0 = single-action 1 = periodical	
Gate function	
0 = abort count procedure 1 = interrupt count procedure	
Lower limit	
0…16 777 214 × 10^{-3}	
Lower limit (HWORD)	
0…255 (Unsigned8)	
Lower limit (LWORD)	
0…65535	
Lower count limit	
-2 147 483 648 (-2^{31})…0	
Lower count limit (HWORD)	
-32 768…32 767 (Signed16)	
Lower count limit (LWORD)	
--32768…0 (Signed16)	
behavior CPU/ master stop	
00 = turn off DO1 01 = proceed with operating mode 10 = DO1 switch to substitute value 11 = DO1 hold last value	
Counter mode	
100000 = continuous count 100001 = single-action count 100010 = periodical count	

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