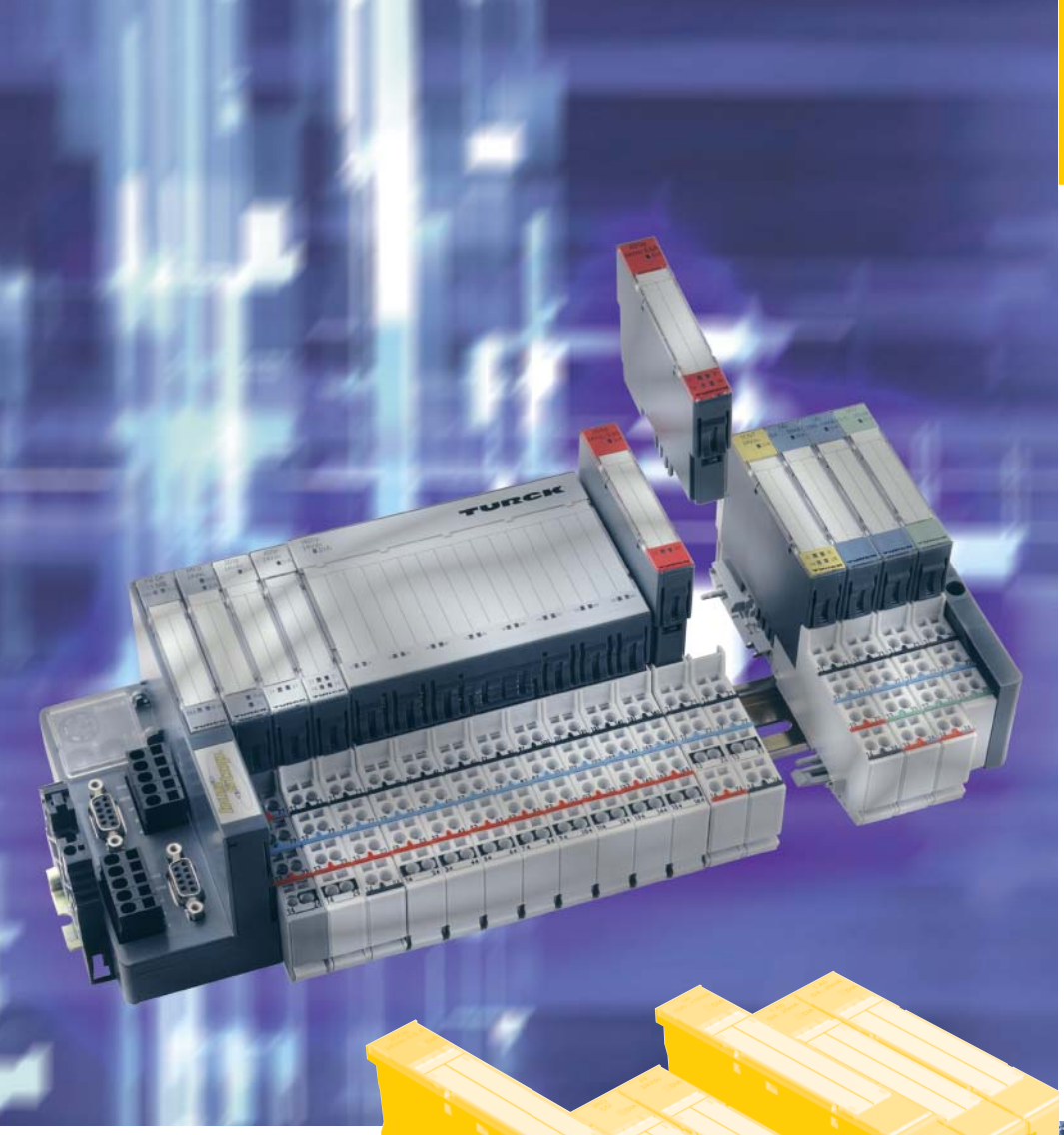
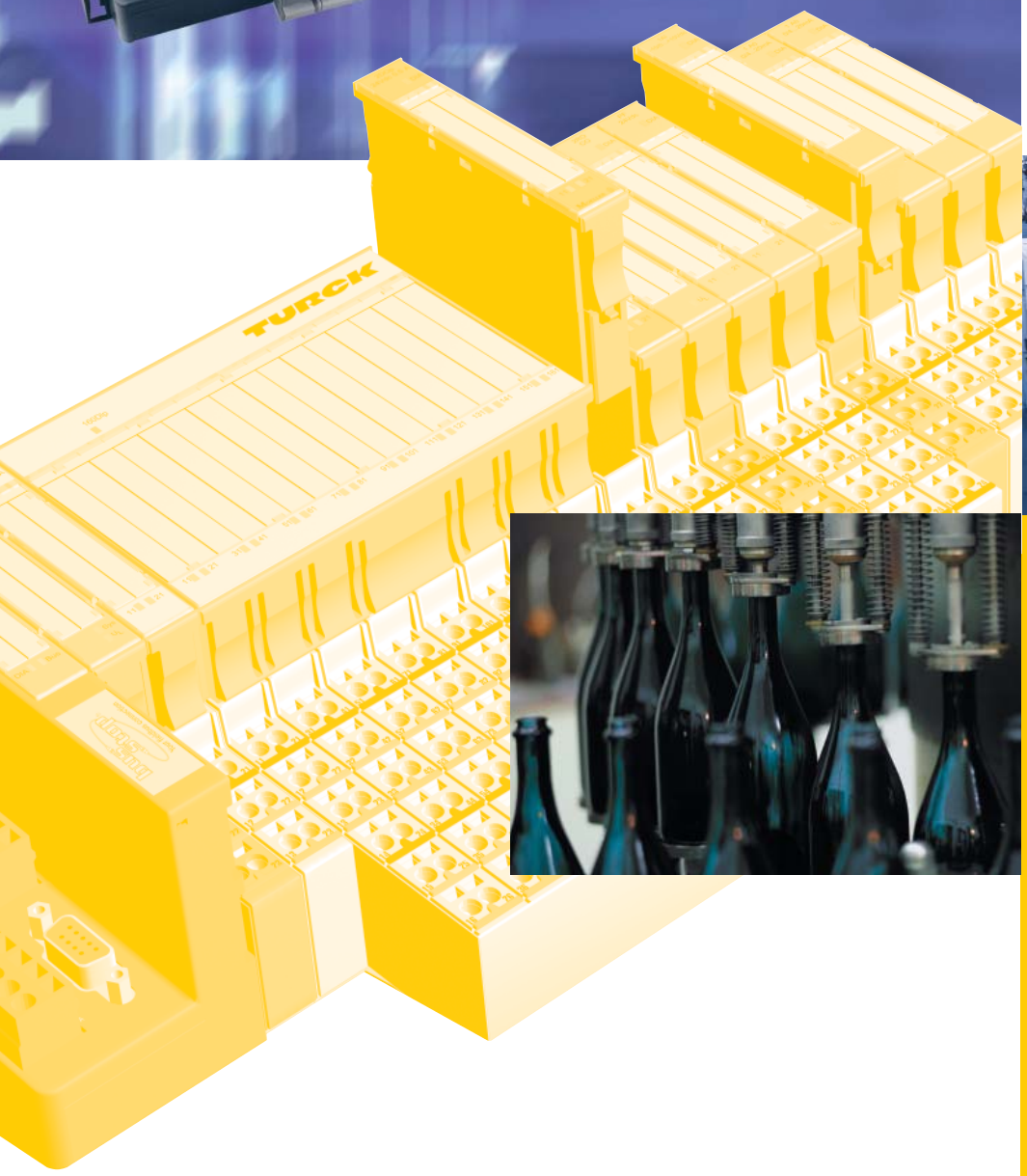
TURCK

Industrial
Automation

BL20 –

USER MANUAL FOR PROFINET





Edition 12/2011

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1 About this manual

1.1 Documentation concept

This manual contains all information about the PROFINET-gateway of the BL20 product series BL20 (BL20-GW-EN-PN).

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

The bus-independent I/O-modules for BL20 as well as all further fieldbus-independent chapters like mounting, labelling etc. are described in a separate manual.

- BL20 I/O-modules (TURCK-Documentation-No.: English D300717)

Furthermore, the manual mentioned above contains a short description of the project planning and diagnostics software for TURCK I/O-systems, the engineering software I/O-ASSISTANT.

1.2 Description of symbols used

Danger

This sign can be found next to all notes that indicate a source of hazards. This can refer to danger to personnel or damage to the system (hardware and software) and to the facility.

This sign means for the operator: work with extreme caution.

Attention

This sign can be found next to all notes that indicate a potential hazard.

This can refer to possible danger to personnel and damages to the system (hardware and software) and to the facility.

Note

This sign can be found next to all general notes that supply important information about one or more operating steps.
These specific notes are intended to make operation easier and avoid unnecessary work due to incorrect operation.

1.3 Overview

Attention

Please read this section carefully. Safety aspects cannot be left to chance when dealing with electrical equipment.

This manual includes all information necessary for the prescribed use of BL20-GW-EN-PN. It has been specially conceived for personnel with the necessary qualifications.

1.3.1 Prescribed use

Danger

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.

1.3.2 Notes concerning planning /installation of this product

Danger

All respective safety measures and accident protection guidelines must be considered carefully and without exception.

1.4 List of revisions

In comparison to the previous manual edition, the following changes/ revisions have been made:

Table 1-1: List of revisions

Chapter	Subject/ description	new	changed
Chap. 9	BL20-Approvals for Zone 2/ Division 2 → separate manual D301255	X	

Note

The publication of this manual renders all previous editions invalid.

2 BL20 philosophy

2.1 The Basic concept

BL20 is a modular IP20 I/O-system for use in industrial automation. It connects the sensors and actuators in the field to the higher-level master.

BL20 offers modules for practically all applications:

- Digital input and output modules
- Analog input and output modules
- Technology modules (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 realized 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.

2.1.1 Flexibility

A BL20 station can contain modules in any combination, which means it is possible to adapt the system to practically all applications in automated industries.

2.1.2 Convenient handling

All BL20 modules, with the exception of the gateway, consist of a base module and an electronic module.

The gateway and the base modules are either snapped onto a mounting rail or are directly mounted onto the machine frame. The electronic modules are plugged onto the appropriate base modules.

After disconnection of the load, the electronic modules 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.

2.2 BL20 components

2.2.1 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 software tool I/O-ASSISTANT.

ECO-gateways

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

Further advantages of the BL20-ECO gateways:

- Low required space: width 34 mm/ 1.34 inch
- Integrated power supply
- Can be combined with all existing standard modules (with tension clamp connection technology) and ECO modules
- Simple wiring with „Push-in" tension clamp terminals
- Setting of fieldbus address and bus terminating resistor via DIP-switches
- Service interface for commissioning with I/O-ASSISTANT (without PLC)

Figure 2-1: Gateway BL20-E-GW-DP

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-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 power supply

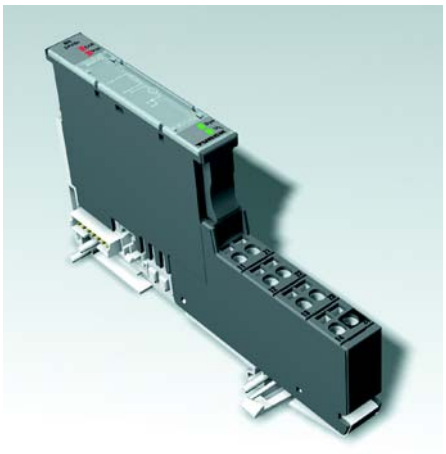
Note

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.

2.2.2 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.

Figure 2-2: Power distribution module



2.2.3 Electronic modules

Electronic modules contain the functions of the BL20 modules (power distribution modules, digital and analog input/output modules, and technology modules).

Electronic modules are plugged onto the base modules and are not directly connected to the wiring. The assignment table in the Section "Ordering Information" of the "Appendix" shows the possible combinations of electronic and base modules. They 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.

Figure 2-3: Electronic module in slice design

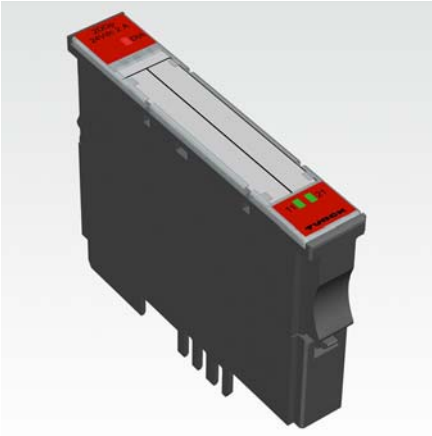
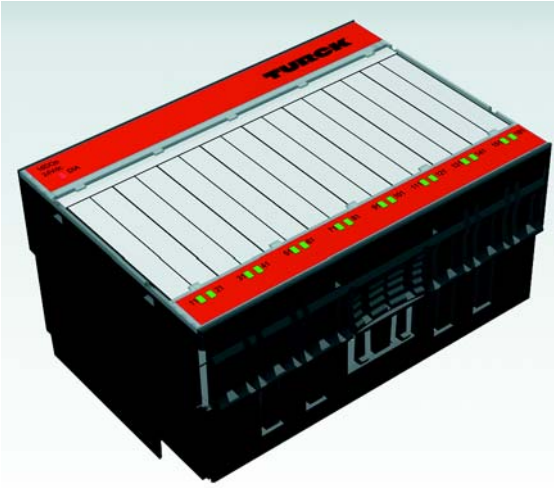


Figure 2-4: Electronic module in block design



2.2.4 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).

The assignment table in the Section "Ordering Information" of the "Appendix" shows the possible combinations of electronic and base modules.

Figure 2-5: Base module with tension clamp connection

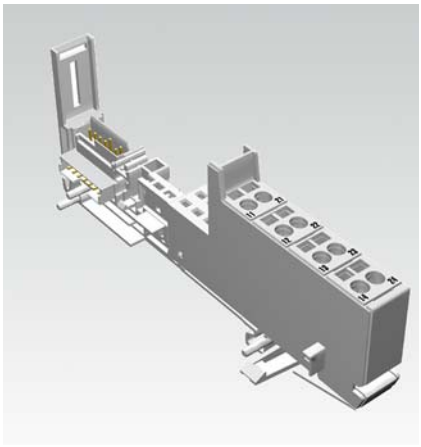


Figure 2-6: Base module with screw connection

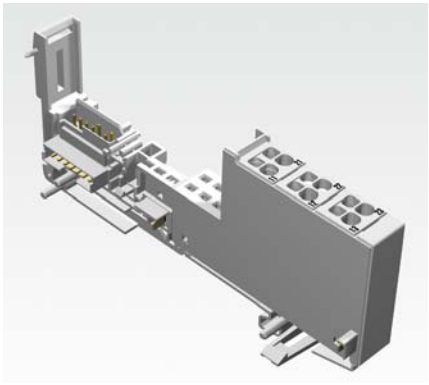
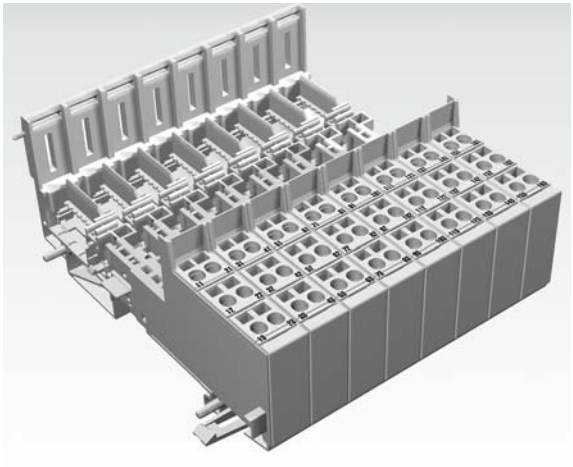


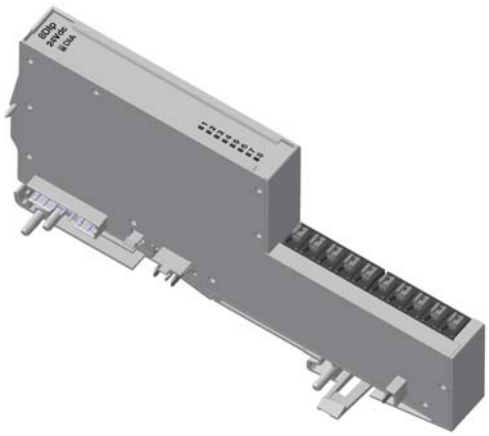
Figure 2-7: Base module in block design



2.2.5 BL20 economy

With the BL20 Economy modules the electronic and connection technology is integrated into a single housing. Thus, the selection of a base module is unnecessary. Within a station the Economy modules can be combined with the modules with separate electronic/connection technology, provided that the base modules feature tension spring connections.

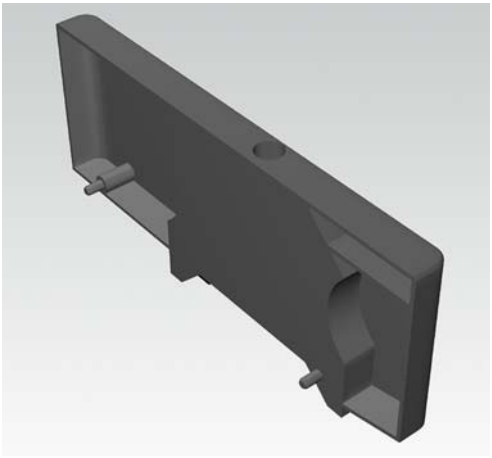
Figure 2-8:
BL20 Economy



2.2.6 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.

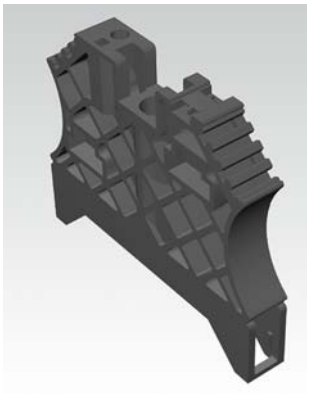
Figure 2-9:
End plate



2.2.7 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.

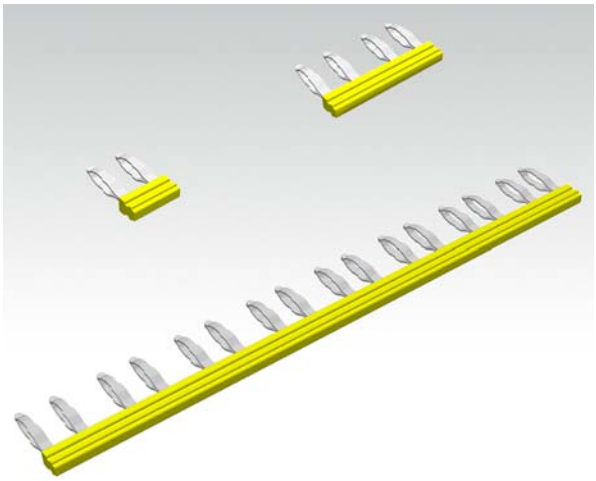
Figure 2-10: End bracket



2.2.8 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.

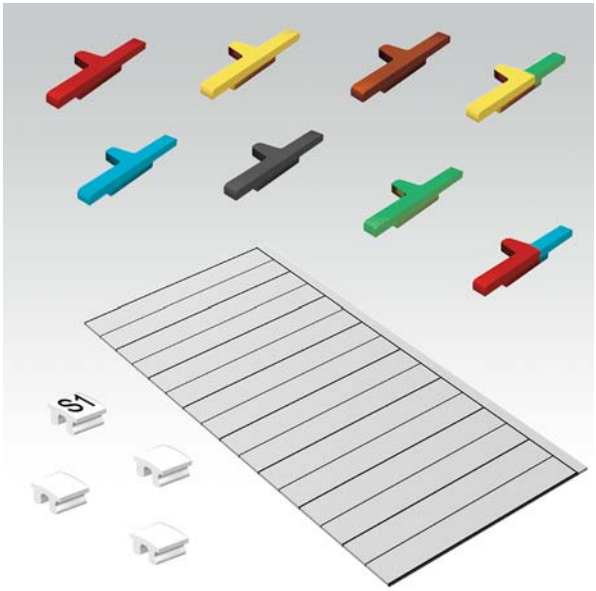
Figure 2-11: Jumpers



2.2.9 Marking material

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

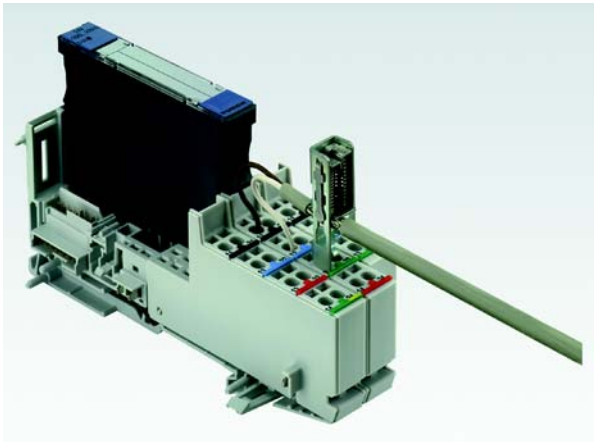
Figure 2-12: Marking material



2.2.10 Shield connection, 2-pole for analog modules

The 2-pole shield connection can be used to connect signal-cable shielding to the base modules of analog input and output modules. A special tension-clamp operating tool (BL20-ZBW5-2) is required to mount the shield connection onto the base module.

Figure 2-13: Shield connection



3 PROFINET IO

3.1 PROFINET

PROFINET is the innovative open standard for the implementation of end-to-end integrated automation solutions based on Industrial Ethernet. With PROFINET, simple distributed I/O and time-critical applications can be integrated into Ethernet communication just as well as distributed automation system on an automation component basis.

3.1.1 Distributed I/O with PROFINET IO

Distributed I/O is connected into communication through PROFINET IO. Here, the familiar I/O view of PROFIBUS is retained, in which the peripheral data from the field devices are periodically transmitted into the process model of the control system.

Device Model

PROFINET IO describes a device model oriented to the PROFIBUS framework, consisting of places of insertion (slots) and groups of
I/O channels (subslots). The technical characteristics of the field devices are described by the so-called GSD (General Station Description) on an XML basis.

3.1.2 Field bus integration

PROFINET offers a model for integration of existing field buses like PROFIBUS, AS-Interface, and INTERBUS.

This allows the construction of arbitrarily mixed systems consisting of fieldbus- and Ethernet-based segments. Thus a smooth technology transition is possible from fieldbus-based systems to PROFINET. The large number of existing fieldbus systems makes it necessary to support their simple integration into PROFINET for reasons of investment protection.

The integration is done with so-called "proxies". A proxy is a device which connects an underlying fieldbus with PROFINET. The proxy concept allows the device manufacturer, the plant and machine builder as well as the end user a high degree of investment protection.

Communications in PROFINET contain different levels of performance:

- The non-time-critical transmission of parameters, configuration data, and switching information occurs in PROFINET in the standard channel based on UDP and IP. This establishes the basis for the connection of the automation level with other networks (MES, ERP).
- For the transmission of time critical process data within the production facility, there is a Real-Time channel (RT) available. For particularly challenging tasks, the hardware based communication channel Isochronous Real-Time (IRT) can be used for example in case of Motion Control Applications and high performance applications in factory automation.

UDP/IP communication

For non-time-critical processes, PROFINET uses communications with the standard Ethernet mechanisms over UDP/IP which follow the international standard IEEE 802.3.

Similar to standard Ethernet, PROFINET field devices are addressed using a MAC and an IP address. In UDP/IP communications, different networks are recognized based on the IP address. Within a network, the MAC address is a unique criterion for the addressing of the target device. PROFINET field devices can be connected to the IT world without limitations. A prerequisite for this is that the corresponding services, for instance file transfer, must be implemented in the field device involved. This can differ from manufacturer to manufacturer.

Real-time communication (RT)

A data communication over the UDP/IP channel is provided with a certain amount of administrative and control information for addressing and flow control, all of which slows data traffic.

To enable Real-Time capability for cyclical data exchange, PROFINET abandons partially IP addressing and flow control over UDP for RT communications. The communication mechanisms of the Ethernet (Layer 2 of the ISO/OSI model) are very suitable for this. RT communications can always run in parallel with NRT communications.

The services of PROFINET IO

- Cyclic data exchange
  For the cyclic exchange of process signals and high-priority alarms, PROFINET IO uses the RT channel.
- Acyclic data exchange (record data)
  The reading and writing of information (read/write services) can be performed acyclically by the user. The following services run acyclically in PROFINET IO:
  - parameterization of individual submodules during system boot
  - reading of diagnostic information
  - reading of identification information according to the "Identification and Maintenance (I&M) functions"
  - reading of I/O data

3.1.3 Address assignment

In IP-based communications, all field devices are addressed by an IP address.

PROFINET uses the Discovery and Configuration Protocol (DCP) for IP assignment.

In the factory configuration, each field device has, among other things, a MAC address and a symbolic name stored. These information are enough to assign each field device a unique name (appropriate to the installation).

Address assignment is performed in two steps:

1. Assignment of a unique plant specific name to the field device.
2. Assignment of the IP address by the IO-Controller before system boot based on the plant specific (unique) name.

Both steps occur through the integrated standard DCP protocol.

3.1.4 Ethernet MAC address

The Ethernet MAC address is a 6-byte-value which serves to definitely identify an Ethernet device. The MAC address is determined for each device by the IEEE (Institute of Electrical and Electronics Engineers, New York).

The first 3 bytes of the MAC address contain a manufacturer identifier (Turck: 00:07:46:xx:xx:xx). The last 3 bytes can be chosen freely by the manufacturer for each device and contain a definite serial number.

The MAC address can be read out using the software tool I/O-ASSISTANT.

Note

The antecedent description contains a short overview about the properties and the functions of the PROFINET field bus system.

It has been taken from the brochure of the PROFIBUS user organization e.V. (version 2006).

A detailed system description can be found in the standards IEC 61158 and IEC 61784 and in the PROFIBUS-guidelines and -profiles (www.profibus.com).

4 Technical features

4.1 Function

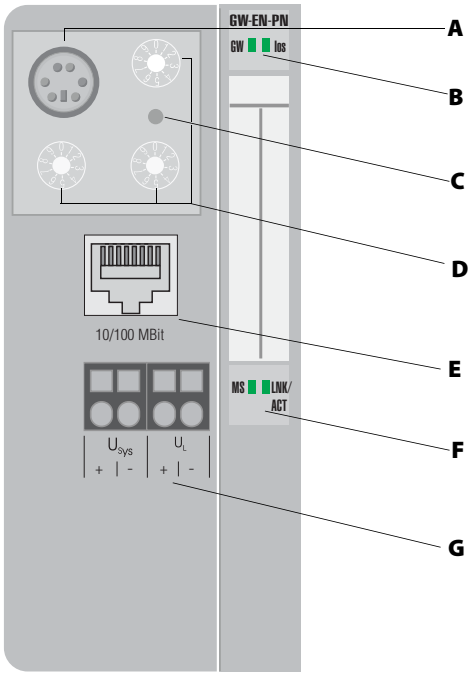
BL20-gateways for PROFINET are used tio connect BL20 IO modules with the field bus system PROFINET.

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

4.2 Technical data

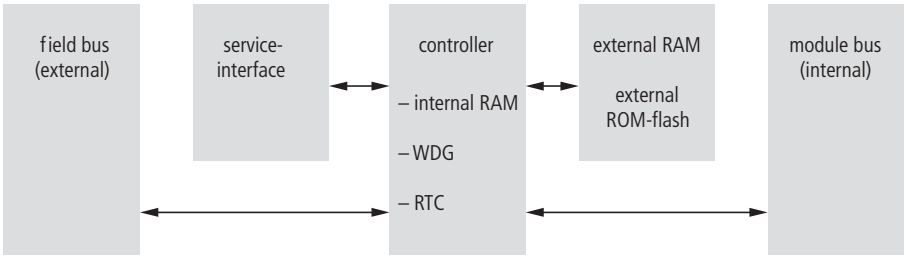
Figure 4-1: BL20-GW-EN-PN

A*service-interface*
B*module bus LEDs*
C*SET-button*
D*rotary coding switches*
E*Ethernet*
F*Ethernet LEDs*
G*power supply*



4.2.1 Gateway structure

Figure 4-2: Structure of a BL20-GW-EN-PN



4.2.2 General technical data of a station

Attention

The auxiliary power supply must comply with the stipulations of SELV (Safety Extra Low Voltage) according to IEC 364-4-41.

Table 4-1: Technical data

Supply voltage	
field supply	
U_L nominal value (permissible range)	24 VDC (18 to 30 VDC)
I_L max. field current	10 A
System	24 VDC
U_{sys} nominal value (permissible range)	24 VDC (18 to 30 VDC)
I_{sys}	max. 500 mA
I_{MB} (supply of the module bus nodes)	max. 1,5 A
Physical interfaces	
field bus	
transmission rate	10/100 Mbit/s
passive LWL can be connected	current consumption max. 100 mA
field bus connection technology	RJ45 female connector
field bus shielding connection	via Ethernet cable
Address setting	3 decimal rotary coding switches
Service interface	PS/2 female connector
Isolation voltages	
U_{RS} (Ethernet/ service interface)	500 V AC
U_{EN} (Ethernet/ module bus)	500 V DC
U_{sys} (U_L to U_{sys})	1000 V DC
Ambient conditions	
Ambient temperature	
– $t_{Ambient}$	0 to +55 °C / 32 to 131 °F
– t_{Store}	-25 to +85 °C / 13 to 185 °F
Relative humidity	according to IEC 61 131-2/ EN 50 178
Noxious gas	– SO_2: 10 ppm (rel. humidity < 75 %, non-condensing) – H_2S: 1.0 ppm (rel. humidity < 75 %, non-condensing)

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	1 000 shocks, half-sinus 25 g peak value/6 ms, in each case in ± direction per space coordinate
Topple and fall according to IEC 68-2-31 and free fall according to IEC 68-2-32	
Weight	< 10 kg
Height of fall	1.0 m / 39.37 inch
Weight	10 to 40 kg
Height of fall	0.5 m / 19.69 inch
Test runs	7
Device with packaging, electrically tested printed-circuit board	
Electromagnetic compatibility (EMC) according to EN 50 082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61 000-4-6	10 V
Fast transients (Burst) according to EN 61 000-4-4	
Emitted interference according to EN 50 081-2 (Industry)	according to EN 55 011 Class A, Group 1

Danger

This device can cause radio disturbances in residential areas and in small industrial areas (residential, business and trading). In this case, the operator can be required to take appropriate measures to suppress the disturbance at his own cost.

Approvals and tests

Table 4-2: Approvals and tests

Description	
Approvals	
UL CSA	in preparation
Tests (EN 61131-2)	
Cold	DIN IEC 68-2-1, temperature -25 °C / -13 °F, duration 96 h; not in use
Dry heat	DIN IEC 68-2-2, Temperature +85 °C / 185 °F, duration 96 h; device not in use
Damp heat, cyclic	DIN IEC 68-2-30, temperature +55 °C / 131 °F, duration 2 cycles every 12 h; device in use
Operational life MTBF	120 000 h
Pollution severity according to IEC 664 (EN 61 131-2)	2
Protection class according to IEC 529	IP20

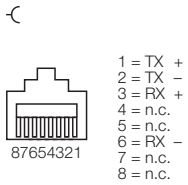
4.3 Connection possibilities

4.3.1 Field bus connection

Ethernet-connection

The connection to Ethernet is realized via female RJ45 connector:

Figure 4-3: female RJ45 connector



4.3.2 Power Supply via terminal block with screw connection

The power supply is realized via terminal block with screw connection technology.

Table 4-3: Pin assignment the terminal blocks

Signal	Description
U_{SYS} +	System supply (Gateway, module bus)
U_{SYS} -	
U_L+	Field supply (max. 10 A)
U_L-	

4.3.3 Service interface connection (female PS/2 connector)

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

Note

All BL××-Ethernet™ gateways offer the possibility to directly access the I/O-ASSISTANT via Ethernet.

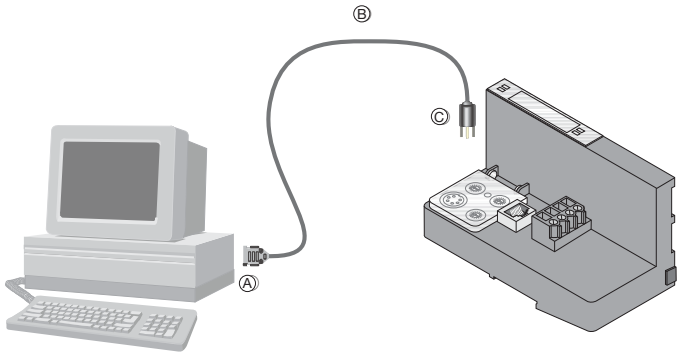
The service interface is designed as a 6 pole PS/2-connection.

Two types of cables can be used to connect the service interface to a PC.

- special I/O-ASSISTANT-connection cable from TURCK (IOASSISTANT-ADAPTERKABEL-BL20/BL67; Ident-no.: 6827133)
- Commercially available PS/2 cable with adapter cable SUB-D/ PS/2

Connection with I/O-ASSISTANT-connection cable

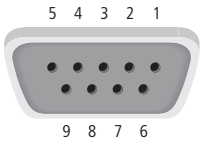
Figure 4-4: BL20-gateway connected to PC via special cable



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

Figure 4-5: PS/2 male connector on the connection cable to the gateway (top view)

Figure 4-6: 9-pole SUB-D female connector on the cable for connecting to PC (top view)



4.4 Usage of the software I/O-ASSISTANT

The software tool I/O-ASSISTANT should only be connected in Force Mode during the initial operation.

Note

A permanent connection between I/O-ASSISTANT and PROFINET gateway during the active process data trafic may lead to disturbances in the PROFINET communication.

4.5 Address setting

Achtung

In PROFINET IO, the connected device is not identified by it's IP address, but recognized and addressed by it's device name.

The selection of a device name for a special IO device can thus be compared to the setting of the PROFIBUS address for a DP slave.

The device name can be freely chosen.

Note

It is not necessary to address the station's internal module bus.

4.6 PROFINET-operation mode

The gateway BL20-GW-EN-PN is set to the PROFINET-operation mode (switch position "700") when delivered.

This mode assures a PROFINET-compliant operation of the gateway.

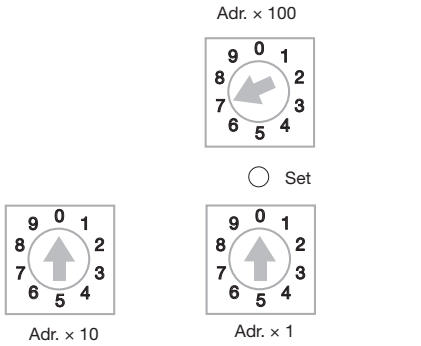


Figure 4-7: Decimal rotary coding switches for address setting

000 : 192.168.1.254
1-254 : Static rotary
300 : BootP
400 : DHCP
500 : PGM
600 : PGM-DHCP
700 : PROFINET

Note

To be able to communicate via the I/O-ASSITANT with a gateway in PROFINET-mode - the rotary coding switches are set to “700“-, it is first of all necessary to assign a valid IP address to the gateway. This can be done for example by using the HW-Config or the Primary Setup Tool from Siemens).

Additionally, the I/O-ASSISTANT can only access the gateway via ForceMode if the connection between gateway and PROFINET is cut off.

4.6.1 Rotary coding switch setting “000“

With the setting “000“ of the rotary coding switches, the gateway is set to address 192.168.1.254 for IP-based services. In this mode, for example the I/O-ASSISTANT can communicate with the gateway. A PROFINET-communication is not possible in this mode.

4.7 GSDML-file

You can download the actual GSDML file for the gateway BL20-GW-EN-PN “GSDML-V××-Turck-BL20-×××.xml“ from our Home-page www.turck.com.

4.8 SET button

Pressing the SET-button under the cover on the gateway for about 10 seconds is used to store the factory default values to the gateway.

This function is only available in the „PROFINET-operation mode“.

Default-values:

IP address:	0.0.0.0
Subnet mask:	0.0.0.0
Device name:	TURCK-BL20-default

Attention

When storing the device name or the IP address or when resetting the gateway to the default values, the GW-LED switches to orange.

During this time, the gateway’s voltage supply must not be interrupted. In case of a power failure, faulty data will be stored in the gateway.

Note

Resetting the gateway is only possible when the station is not connected to the fieldbus (no AR active).

4.9 Parameterization

4.9.1 Gateway-parameters

The BL20 gateways for PROFINET use 5 bytes of parameters, of which byte 3 and 4 contain the user-specific parameter data.

Description of the gateway-parameters

The texts in the columns parameter name and value correspond to those defined in the general station description files (GSDML-files).

Table 4-4: Gateway parameters

Byte/ parameter name	Value	Meaning
Byte 3:		
bit 0 and 1: outputs module sequence deviation		
00	output 0 **A**	The gateway switches the outputs of modules to "0". No error information is transmitted.
01	output substitute value	The gateway switches the outputs of all modules to "0" (with the exception of analog output modules . Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".
10	hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or maintain the original values. The non-configured analog output modules maintain their current output settings.
11	exchange process data	The gateway carries on exchanging process data with the other module bus stations. No error information is transmitted.
bit 2 and 3: outputs module sequence error		
00	output 0 **A**	The gateway switches the outputs of modules to "0". No error information is transmitted.
01	output substitute value	The gateway switches the outputs of all modules (with the exception of analog output modules) to "0". Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or to maintain the original values. The non-configured analog output modules set their outputs to "0".

A*default-settings*

Table 4-4: Gateway parameters

Byte/ parameter name	Value	Meaning
10	hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or maintain the original values. The non-configured analog output modules maintain their current output settings.
11	exchange process data	The gateway carries on exchanging process data with the other module bus stations. No error information is transmitted.
bit 4 and 5: outputs fieldbus error		
00	output 0 **A**	The gateway switches the outputs of the modules to "0". No error information is transmitted.
01	output substitute value	The gateway switches the outputs of all modules (with the exception of analog output modules) to "0". Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or maintain the original values. The non-configured analog output modules set their outputs to "0".
11	Hold current value	The gateway maintains the actual output settings of all modules (with the exception of analog output modules). Error information is transmitted to the analog output modules. Depending on their configuration, these modules set their outputs either to "0" or to a default value, or maintain the original values. The non-configured analog output modules maintain their current output settings.
Byte 4:		
bit 1: Diagnostic from modules		
0	activate **A**	Diagnostic messages and alarms are generated.
1	deactivate	Diagnostic messages and alarms are disabled.
– **Bit 2:** V_O diagnostics		
0	activate **A**	The monitoring function for the field supply V_O (from gateway and power feeding modules) is activated. If this parameter is set but the parameter "Diagnostics from modules" (see bit 1) deactivated, then only the voltage supply at the gateway is monitored. A monitoring of the voltage supply at the power feeding module is not realized.
1	deactivate	
– **Bit 3 to 5**: reserved		

A*default-settings*

Table 4-4: Gateway parameters

A*default-settings*

Byte/ parameter name	Value	Meaning
– **Bit 6**: Static configuration		
0	activate **A**	Changes in the station configuration are stored in the gateway following a power-on reset.
1	deactivate	If the static configuration is deactivated, a dynamic configuration take-over is realized directly following station configuration changes (important for acyclic parameterization).
– **Bit 7**: reserved		

4.9.2 Parameter "module parameterization"

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

Note

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

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

- **"module parameterization" activated**
  The module receives its parameter settings from the controller, IO-supervisor, I/O-ASSISTANT or similar.
  In this case, parameter changes which were done in the meantime for example by a configuration tool or similar will be overwritten with the valid parameter data set.
- **"module parameterization" deactivated**
  Changes in the parameter settings are ignored for the respective module. The stored parameter data will be used.

Note

If the "module parameterization" is activated and a module is replaced by a new one, the gateway has to be operated with active VI , in order to keep the module's parameter-settings for the new module.
Vo has to be switched-off and the station has to be separated from the field bus.

Now, the gateway sends the parameters defined for the old module, into the new module.
This parameter extension is always necessaray, even if the module is parameterized via an IO-supervisor.

4.9.3 Module parameters

Table 4-5: Module parameters

A*default-setting*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-4DI-NAMUR					
0 to 3	0 to 3	0	Input filter x	0 1	– deactivated (input filter 0,25 ms) **A** – activated (input filter 2,5 ms)
		1	Digital input x	0 1	– normal **A** – inverted
		2	Short-circuit monitoring x	0 1	– deactivate **A** – activate
		3	Short circuit diagnosis x	0 1	– deactivate **A** – activate
		4	Open circuit monitoring x		– deactivate **A** – activate
		5	Open circuit diagnosis x		– deactivate **A** – activate
		6	Input on diagnostic x		– output substitute value **A** – hold current value
		7	Substitute value on diag x		– off **A** – on
BL20-1AI-I(0/4...20MA)					
0	0	0	Current mode	0 1	– 0...20 mA **A** – 4...20 mA
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic	0 1	– release **A** – block
BL20-2AI-I(0/4...20MA)					
0/1	0/1	0	Current mode	0 1	– 0...20 mA **A** – 4...20 mA
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic	0 1	– release **A** – block
		3	Channel K1	0 1	– activate **A** – deactivate

Table 4-5: Module parameters

A*Default-setting*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1AI-U(-10/0...+10VDC)					
0	0	0	Voltage mode	0 1	– 0...10 V **A** – -10...+10 V
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic	0 1	– release **A** – block
BL20-2AI-U(-10/0...+10VDC)					
0/1	0/1	0	Voltage mode	0 1	– 0...10 V **A** – -10...+10 V
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic	0 1	– release **A** – block
		3	Channel K1	0 1	– activate **A** – deactivate
BL20-2AI-PT/NI-2/3					
0	0	0	Mains suppression K1	0 1	– 50 Hz **A** – 60 Hz
		1	Value representation K1	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic K1	0 1	– release **A** – block
		3	Channel K1	0 1	– activate **A** – deactivate
		4 - 7	Element K1	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1001 1100 1101 1110 1111	– Pt100, -200..850 °C **A** – Pt100, -200..150 °C – Ni100, -60..250 °C – Ni100, -60..150 °C – Pt200, -200..850 °C – Pt200, -200..150 °C – Pt500, -200..850 °C – Pt500, -200..150 °C – Pt1000, -200..850 °C – Pt1000, -200..150 °C – Ni1000, -60..250 °C – Ni1000, -60..150 °C – Resistance, 0..100 Ω – Resistance, 0..200 Ω – Resistance, 0..400 Ω – Resistance, 0..1000 Ω

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
0	1	0	Measurement Mode K1	0 1	– 2-wire **A** – 3-wire
1	1 3	0	Mains suppression K2	0 1	– 50 Hz **A** – 60 Hz
		1	Value representation K2	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic K2	0 1	– release **A** – block
		3	Channel K2	0 1	– activate **A** – deactivate
		4 - 7	Element K2	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1001 1100 1101 1110 1111	– Pt100, -200..850 °C **A** – Pt100, -200..150 °C – Ni100, -60..250 °C – Ni100, -60..150 °C – Pt200, -200..850 °C – Pt200, -200..150 °C – Pt500, -200..850 °C – Pt500, -200..150 °C – Pt1000, -200..850 °C – Pt1000, -200..150 °C – Ni1000, -60..250 °C – Ni1000, -60..150 °C – Resistance, 0..100 Ω – Resistance, 0..200 Ω – Resistance, 0..400 Ω – Resistance, 0..1000 Ω
		0	Measurement Mode K2	0 1	– 2-wire **A** – 3-wire
BL20-2AI-THERMO-PI					
0	0	0	Mains suppression K1	0 1	– 50 Hz **A** – 60 Hz
		1	Value representation K1	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic K1	0 1	– release **A** – block
		3	Channel K1	0 1	– activate **A** – deactivate

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
0	0	4 - 7	Element K1	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011	– type K, -270..1370 °C **A** – 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 – ±50 mV – ±100 mV – ±500 mV – ±1000 mV
1	1	0	Mains suppression K2	0 1	– 50 Hz **A** – 60 Hz
		1	Value representation K2	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic K2	0 1	– release **A** – block
		3	Channel K2	0 1	– activate **A** – deactivate
	1	4 - 7	Element K2	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011	– type K, -270..1370 °C **A** – 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 – ±50 mV – ±100 mV – ±500 mV – ±1000 mV
BL20-4AI-U/I					
0 to 3	0 to 3	0	range x	0 1	– 0...10V/ 0...20 mA **A** – -10...10V/ 4...20 mA
		1	value representation x	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		2	Diagnostic x	0 1	– release **A** – block
		3	Channel x	0 1	– activate **A** – deactivate
		4	Operation mode x	0 1	– voltage **A** – current

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1AO-I(0/4...20MA)					
0	0	0	Current mode	0 1	– 0...20 mA **A** – 4...20 mA
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
	1 to 2		Substitute value A1		The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.
BL20-2AO-I(0/4...20MA)					
0	0	0	Current mode	0 1	– 0...20 mA **A** – 4...20 mA
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		3	Channel K1	0 1	– activate **A** – deactivate
	1 to 2		Substitute value A1		The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.
1	3	0	Current mode	0 1	– 0...20 mA **A** – 4...20 mA
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
		3	Channel K2	0 1	– activate **A** – deactivate
	4 to 5		Substitute value A2		The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.

Table 4-5: Module parameters

A*Default-setting*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-2AO-U(-10/0...+10VDC)					
0	0	0	Voltage mode	0 1	– 0...10 V **A** – -10...+10 V
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
	1 to 2		Substitute value A1		The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.
1	3	0	Voltage mode	0 1	– 0...10 V **A** – -10...+10 V
		1	Value representation	0 1	– Integer (15 bit + sign) **A** – 12 bit (left-justified)
	4 to 5		Substitute value A2		The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.
BL20-1CNT-24VDC, counter mode					
0	0	0 -5	Counter mode	100000 100001 100010	– continuous count **A** – single-action count – periodical count
	1	0	Gate function	0 1	– abort count procedure **A** – interrupt count procedure
		1	Digital input DI	0 1	– normal **A** – inverted
		2/ 3	Function DI	00 01 10 11	– input **A** – HW gate – Latch-Retrigger when edge pos. – synchronisation when edge pos.
		4	Synchronisation	0 1	– single-action **A** – periodical
		5/ 6	Main count direction	00 01 10	– none **A** – up – down
0	2 to 5		Lower count limit	-2 147 483 648 (-2^{31}) to 0	
			Lower count limit (HWORD)	-32768 **A** to 0 (Signed16)	
			Lower count limit (LWORD)	-32 768 to 32 767 (Signed16); 0 **A**	

Table 4-5: Module parameters

A*Default-setting*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
	6 to 9		Upper count limit	0 to + 2 147 483 647 (2^{31}-1)	
			Upper count limit (HWORD)	0 to 32767 **A** (Unsigned16)	
			Upper count limit (LWORD)	0 to 65535 **A** (Unsigned16)	
	10		Hysteresis	0 **A** to 255 (Unsigned8)	
	11	0/ 7	Pulse duration DO1, DO2 [n*2ms]	0 **A** to 255 (Unsigned8)	
	12	0	Substitute value DO	0 1	0 **A** 1
		1	Diagnostic DO1	0 1	on **A** off
		2/ 3	Function DO1	00 01 10 11	– output **A** – on when cnt value >= ref. value – on when cnt value <= ref. value – pulse when cnt val. = ref. value
		5/ 6	Function DO2	00 01 10 11	– output **A** – on when cnt value >= ref. value – on when cnt value <= ref. value – pulse when cnt val. = ref. value
BL20-1CNT-24VDC, counter mode					
0	13	0/ 1	Signal evaluation (A,B)	00 01 10 11	pulse and direction **A** rotary sensor: single rotary sensor: double rotary sensor: fourfold
		2	Sensor/input filter (A)	0 1	2,5 µs (200 kHz) **A** 25 µs (20 kHz)
		3	Sensor/input filter (B)	0 1	2,5 µs (200 kHz) **A** 25 µs (20 kHz)
		4	Sensor/input filter (DI)	0 1	2,5 µs (200 kHz) **A** 25 µs (20 kHz)
		5	Sensor (A)	0 1	– normal **A** – inverted
		7	Direction input (B)	0 1	– normal **A** – inverted

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
–	14	0	Group diagnostics	0 1	– release **A** – block
		4/ 5	Behaviour CPU/ master STOP	00 01 10 11	– turn off DO1 **A** – proceed with operating mode – DO1 switch to substitute value – DO1 hold last value
BL20-1CNT-24VDC, measurement mode					
0	0	0 -5	Measurement mode	100000 100001 100010	– frequency measurement **A** – revolutions measurement – period duration measurement
	1	1	Digital input DI	0 1	– normal **A** – inverted
		2	Function DI	0 1	– input **A** – HW gate
	2 to 4		Lower limit	0 to 16 777 214 x 10^{-3}	
			Lower limit (HWORD)	0 **A** to 255 (Unsigned8)	
			Lower limit (LWORD)	0 **A** to 65535	
	5 to 7		Upper limit	1 to 16 777 215 x 10^{-3}	
			Upper limit (HWORD)	0 **A** to 255 (Unsigned8)	
			Upper limit (LWORD)	0 **A** to 65535	
	8 to 9		Integration time [n*10ms]	1 to 1 000; 10 **A**	
	10 to 11		Sensor pulse per revolution	1**A** to 65535	
	12	0	Substitute value DO1	0 1	0 **A** 1
		1	Diagnostic DO1	0 1	– on **A** – off
		2 -4	Function DO1	00 01 10 11	– output **A** – outside of limit – below lower limit – above upper limit

Table 4-5: Module parameters

Assigment			**Parameter**	**Value**	**Meaning**
Ch.	**Byte**	**Bit**			
0	13	0 - 1	Signal evaluation (A,B)	00 01	– pulse and direction **A** – rotary sensor: single
		2	Sensor/input filter (A)	0 1	– 2,5 µs (200 kHz) **A** – 25 µs (20 kHz)
		3	Sensor/input filter (B)	0 1	– 2,5 µs (200 kHz) **A** – 25 µs (20 kHz)
		4	Sensor/input filter (DI)	0 1	– 2,5 µs (200 kHz) **A** – 25 µs (20 kHz)
		5	Sensor (A)	0 1	– normal **A** – inverted
		7	Direction input (B)	0 1	– normal **A** – inverted
	14	0	Group diagnostics	0 1	– release **A** – block
		4 -5	Behaviour CPU/ master STOP	00 01 10 11	– turn off DO1 **A** – proceed with operating mode – DO1 switch to substitute value – DO1 hold last value

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS232					
0	0	0 -4	Bit transfer rate	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	– reserved – 300 bit/s – 600 bit/s – 1200 bit/s – 2400 bit/s – 4800 bit/s – 9600 bit/s – 14400 bit/s – 19200 bit/s – 28800 bit/s – 38400 bit/s – 57600 bit/s – 115200 bit/s – reserved – reserved – reserved
		6	Disable ReducedCtrl	1	Constant setting: The diagnostic messages are shown in Byte 6 of the process input data (independently from “Diagnosis"). Byte 6 of the process output data contains 2 bits, with which the receive or transmit buffer can be cleared.Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.
		7	Diagnostics	0 1	– Enable **A** – Inhibit: Diagnosis activated/diagnosis deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnosis embedded in the process input data.

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS232					
0	1	0	Stop bits	0 1	– 1 stop bit – 2 stop bits **A**
		1 to 2	Parity	0 1 2	– None – Odd: **A** The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd. – Even: The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is even.
		3	Data bits	0 1	– The number of data bits is 7. **A** – The number of data bits is 8.
		4 to 5	Flow control	0 1 2 3	– None:**A** Data flow control is switched off. – "XON/XOFF": Software handshake (XON/XOFF) is switched on. – "RTS/CTS" Hardware handshake (RTS/CTS) is switched on. – reserved
	2	0 to 7	XON character	0 – 255 (17 **A**)	– XON character: This character is used to start the transmission of data from the data terminal device if the software handshake is active.
	3	0 - 7	XOFF character	0 – 255 (19 **A**)	– XOFF character: This character is used to stop the transmission of data from the data terminal device if the software handshake is active.

Table 4-5: Module parameters

A*Default-setting*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS485/422					
0	0	0 to 4	Bit transfer rate	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	– reserved – 300 bit/s – 600 bit/s – 1200 bit/s – 2400 bit/s – 4800 bit/s – 9600 bit/s – 14400 bit/s – 19200 bit/s – 28800 bit/s – 38400 bit/s – 57600 bit/s – 115200 bit/s – reserved – reserved – reserved
		6	Disable ReducedCtrl	1	Constant setting: The diagnostic messages are shown in Byte 6 of the process input data (independently from “Diagnosis"). Byte 6 of the process output data contains 2 bits, with which the receive or transmit buffer can be cleared.Byte 7 contains the status or control byte. User data are represented in Bytes 0 - 5.
		7	Diagnostics	0 1	– Enable **A** – Inhibit: Diagnosis activated/diagnosis deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnosis embedded in the process input data.

Table 4-5: Module parameters

A*Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS485/422					
0	1	0	Stop bits	0 1	– 1 stop bit – 2 stop bits **A**
		1 -2	Parity	0 1 2	– None – Odd: **A** The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd. – Even: The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is even.
		3	Data bits	0 1	– The number of data bits is 7. **A** – The number of data bits is 8.
		4 to 5	Flow control	0 1 2 3	– None:**A** Data flow control is switched off. – "XON/XOFF": Software handshake (XON/XOFF) is switched on. – "RTS/CTS" Hardware handshake (RTS/CTS) is switched on. – reserved
	2	0 to 7	XON character	0 – 255 (17 **A**)	– XON character for RS422 operation: This character is used to start the transmission of data from the data terminal device if the software handshake is active.
	3	0 - 7	XOFF character	0 – 255 (19 **A**)	– XOFF character for RS422 operation: This character is used to stop the transmission of data from the data terminal device if the software handshake is active.
BL20-1SSI					
0	0	5	Sensor data cable test	0 1	– Activate: **A** Data cable is checked for ZERO. – Deactivate: After the last valid bit, there will be no check that the data cable is at ZERO.

Table 4-5: Module parameters

A *Default-settings*

Assigment			Parameter	Value	Meaning
Ch.	**Byte**	**Bit**			
	1	0 to 3	Number of invalid bits (LSB)	0 to 15	The number of invalid bits in the position value delivered by the SSI-encoder at the LSB end. The significant word length of the position value transmitted to the module bus master is thus: SSI_FRAME_LEN - INVALID_BITS_MSB- INVALID_BITS_LSB. The invalid bits at the LSB end are removed by shifting the position value to the right, starting with the LSB. (Default: 0 Bit = 0 x 0). Basically, INVALID_BITS_MSB + INVALID_BITS_LSB must be smaller than SSI_FRAME_LEN.
1	1	4 to 6	Number of invalid bits (MSB)	0 to 7	The number of invalid bits in the position value delivered by the SSI-encoder at the MSB end. The significant word length of the position value transmitted to the module bus master is thus: SSI_FRAME_LEN - INVALID_BITS_MSB- INVALID_BITS_LSB. The invalid bits at the MSB end are set to zero by masking the position value. Basically, INVALID_BITS_MSB + INVALID_BITS_LSB must be smaller than SSI_FRAME_LEN. Default: 0 = 0_{hex}
	2	0 to 3	Bit transmission rate	0 1 2 3 4 5 6 7 8 to 15	– 1000000 bit/s – 500000 bit/s – 250000 bit/s – 125000 bit/s – 100000 bit/s – 83000 bit/s – 71000 bit/s – 62500 bit/s – reserved
	3	0 to 5	Number of data frame bits	1 to 32	Number of bits in the SSI data frame. Basically, SSI_FRAME_LEN must be larger than INVALID_BITS. Default: 25 = 19hex
		7	Data format	0 1	Binary coded: **A** The SSI-encoder transmits data in binary code GRAY coded: The SSI-encoder transmits data in Gray code

Parameters BL20-E-1SWIRE

see chapter 6 Integration of technology modules, page 6-53

4.10 Status iIndicators/diagnostic messages gateway

Diagnostic messages are displayed in two different ways:

- via the LEDs
- via the respective configuration software

4.10.1 Diagnostic messages via LEDs

Every BL20 gateway displays the following statuses via LEDs:

- 2 LEDs for module bus communication (module bus LEDs): **GW** and **IOs**
- 2 LEDs for the Ethernet communication (fieldbus-LEDs): **LINK/ACT** and **MS**.

.LED displays

Table 4-6: LED-displays

LED	Status	Meaning	Remedy
GW	Off	CPU not supplied.	
	Green	Firmware active, gateway ready to operate and transmit	-
	Green, flashing, 1 Hz	Firmware not active.	If LED "**IOs**" red → Firmware download necessary
	Green, flashing, 4 Hz	Firmware active, gateway hardware defect.	Replace the gateway.
IOs	Off	CPU not supplied.	– Check the voltage supply at the gateway.
	Green	Module bus is running, the configured module bus station corresponds to the physically connected station, communication is active.	-
	Green, flashing 1 Hz	Station is in the I/O-ASSISTANT Force Mode.	– Deactivate the I/O-ASSISTANT Force Mode.
	Green, flashing 4 Hz	Maximum number of modules at the gateway is exceeded.	– Check the number of modules connected to the gateway, dismount modules
	Red	Controller is not ready, V_{CC} level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in – gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.

Table 4-6: LED-displays

LED	Status	Meaning	Remedy
IOs	Red flashing, 4 Hz	no module bus communication	– At least one module has to be plugged and has to be able to communicate with the gateway.
	Red/green flashing, 1 Hz	Adaptable modification of the physically connected station; data transfer possible	– Check the physical station for pulled or new but not planned modules.
LINK/ ACT	Off	No Ethernet link	– Check the Ethernet-connection
	Green	Link, 100 Mbit/s	
	Green flashing	Ethernet Traffic 100 Mbit/s	
	Yellow	Link, 10 Mbit/s	
	Yellow, flashing	Ethernet Traffic 10 Mbit/s	
MS	Green	Displays the logical connection PROFINET IO controller	
	Green, flashing	The gateway has received a identifica-tion command from configurator	
	Red	No connection to a PROFINETIO controller established	

4.10.2 Diagnostic messages via software

The diagnostic messages are displayed in the corresponding software of the PROFINET PLC as diagnostic error codes.

For the meaning of the individual error codes error codes, please refer to the following section.

Gateway diagnostic messages

Table 4-7: Gateway-Diagnostics

Value (dec.)	Diagnostics meaning for the gateway
Error codes (1 to 9 acc. the standards)	
2	Undervoltage: Undervoltage Channel 0: Undervoltage at U_{SYS} Undervoltage Channel 1: Undervoltage at U_L
Error codes (16 to 31, manufacturer specific)	
16	Parametrization error/ configuration error – **Station configuration changed** → The configuration is currently deviating from the reference list of modules. Process data can still be exchanged with the module bus stations which are at present connected to the module bus. The constellation of the module bus station that is set in the configuration software (CheckConfig-Cmd) of the corresponding controller serves as a reference. **– Master configuration error** – → Display: Configuration error/ Parameterizing error at **channel 1** → The actual list of modules has been altered in such a manner, that no process data can be exchanged with the module bus stations which are at present connected to the module bus. **– Station configuration error** – → Display: Configuration error/ Parameterizing error at **channel 0** → The gateway could not prepare the station's configuration to be read out.
22	Communication error – **Module bus error** → Communication with the module bus station on the module bus is not possible.

Channel-specific diagnostic messages of the modules

The channel-specific diagnostic messages are defined as follows:

Table 4-8: channel-spec. diagnostics

Value (dec.)	Diagnostics
Error-Codes (1 to 9 according to DP-spec.)	
1	short-circuit
2	Undervoltage at channel Exception for BL20-BR-24VDC Undervoltage channel 0: Undervoltage at U_{SYS} Undervoltage channel 1: Undervoltage at U_L Exception for BL20-PF-24VDC Undervoltage channel 1: Undervoltage at U_L
4	overload
5	overtemperature
6	wire-break
7	upper limit value exceeded
8	lower limit value exceeded
9	error
Error-Codes (16 to 28, manufacturer-specific)	
16	Parameterization error After a validity check, the parameter data are (partially) rejected by the module. Check the context of parameters.
21	Hardware failure The module detected a hardware failure. Exchange the module.
22	Communication failure The module detected a communication problem at its ports, e. g. RS232/485/422, SSI or other interface. Check the connection or the function of the attached devices.
23	Direction error The direction is detected to be wrong. Check the parameterization or the control interface versus use case.
24	User software error The module detected an user application software error. Check the interoperability of the user application software revisions. Reinitialize user the application software of the module.
25	Cold-junction compensation error The module detected a defect or missing cold-junction compensation.
26	Sensor supply load dump The module detected a load dump at the sensor supply.

Table 4-8: channel-spec. diagnostics

Value (dec.)	Diagnostics
28	Common Error The module detected an error. Refer to the I/O-module manuals for a more detailed description of possible errors. Error types can depend on the operation mode and the parameterization.

4.11 Description of user data for acyclic services

The acyclic data exchange is done via Record Data CRs (CR-> Communication Relation).

Via these Record Data CRs the reading and writing of the following services is realized:

- Writing of AR data
- Writing of configuration data
- Reading and writing of device data
- Reading of diagnostic data
- Reading of I/O data
- Reading of Identification Data Objects (I&M functions)
- Reading of differences between the expected and the actually plugged modules

4.11.1 Description of the acyclic gateway user data

Table 4-9: Gateway User Data

Index (dec.)	Name	Data type	r/w	Remark
1	Gateway-Parameter	DWORD	r	Parameter data the gateway
2	Gateway designation	STRING	r	Productname of the gateway
3	Gateway revision	STRING	r	Firmware-revision of the gateway
4	Vendor ID	WORD	r	Ident number for TURCK
5	Gateway name	STRING	r	Name assigned to the gateway
6	Gateway type	STRING	r	Device type of the gateway
7	Device ID	WORD	r	Ident number of the gateway
8 to 23	reserved			
24	Gateway diagnosis	WORD	r	Diagnosis data of the gateway
25 o 31	reserved			
32	Module input list	Array of BYTE	r	List of all input channels in the station
33	Module output list	Array of BYTE	r	List of all output channels in the station
34	Modul diag. list	Array of BYTE	r	List of all module diagnosis messages
35	Module parameter list	Array of BYTE	r	List of all module parameters
36 to 45039	reserved			

Table 4-9: Gateway User Data

Index (dec.)	Name	Data type	r/w	Remark
45040	I&M functions		r/w	Identification & Maintaining-services
45041 to 45055	I&M1 to IM15 functions			Actually not supported

4.11.2 Description of the acyclic module user data

Table 4-10: Module User Data

Index (dec.)	Name	Data type	r/w	Remark
1	Modul parameters	DWORD	r	Parameter rof the module
2	Modul type	ENUM UINT8	r	Module type
3	Modul version	UINT8	r	Firmware-Revision of the module
4	Module ID	DWORD	r	Ident number of the module
5 to 18	reserved			tp
19	Input data	specific	r	Input data of the respective module
20 to 22	reserved			
23	Output data	specific	r/w	Output data of the respective module
24 to 31	reserved			
32 to 255	Profile-specific	These indices are reserved for the data of several module profiles (e. g. RFID). The definitions of the profile indices can be found in the respective module descriptions.		

5 Connection of the PROFINET IO gateway to a Siemens PLC S7

5.1 Application example

In order to configure the connection of a BL20-gateway with a Siemens PLC S7, the software package „SIMATIC Manager“, version 5.4 with Service Pack 3 from Siemens is used.

Note

A correct representation of BL××-parameter texts can only be guaranteed using Step7-version V 5.4, SP3, HF1 or higher.

Hardware:

- Siemens-PLC S7, CPU 315-2-PN/DP, 6ES7 315-2EG10-0AB0, firmware V2.3:2
- BL20-station with a gateway BL20-GW-EN-PN for the connection to PROFINET IO with the following BL20 example station:

Table 5-1: Example station

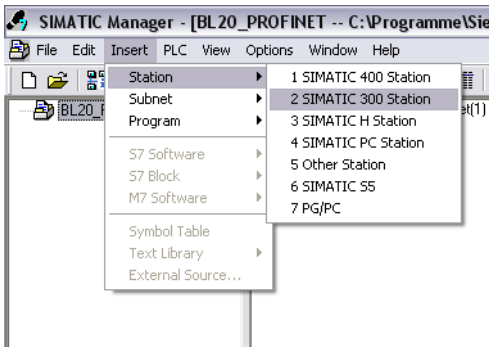
Module		**Data width**		
		Process input	**Process output**	**Alignment**
GW	BL20-GW-EN-PN			
0	BL20-2AI-I(0/4...20MA)	2 word	-	word by word
1	BL20-4DI-24VDC-P	4 bit	-	bit by bit
2	BL20-E-8DI-24VDC-P	8 bit	-	bit by bit
3	BL20-1RS232	4 word	4 word	word by word
5	BL20-4DI-24VDC-P	4 bit	-	bit by bit
6	BL20-2AI-I(0/4...20MA)	2 word	-	word by word
7	BL20-2AI-THERMO-PI	2 word	-	word by word

5.1.1 New project in Simatic Manager

Create a new project in the Simatic Manager using the "File → new" command.

Add a Simatic Station to the project with "Insert → Station...". In this example, a "Simatic 300-Station" is used.

Figure 5-1: Adding a Simatic Station to the project



The configuration of the PROFINET IO-network is done subsequently in the hardware configuration (HW config) of the software.

5.1.2 Setting the PG/ PC interface

In order to be able to build up the communication between the PLC an your PG/ PC via Ethernet, the respective interface/ network interface of the PG/ PC has to be activated.

The configuration of the interface is done via the dialog " Set PG/PC Interface" command.

Open this dialog in the Simatic software for example via the "Options → Set PG/PC Interface..." command or directly in the Windows Control Panel for your PG/PC.

Figure 5-2: Command "Set PG/PC Interface"

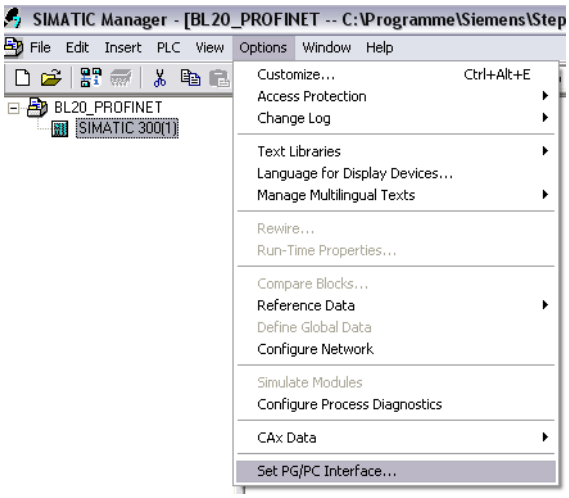
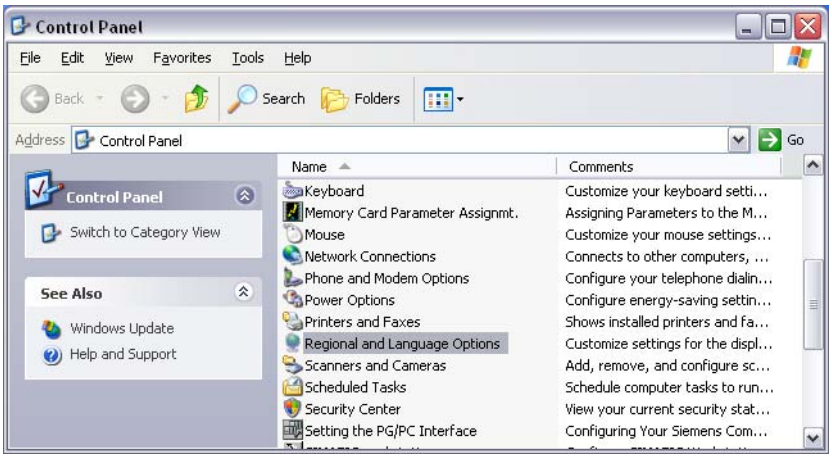
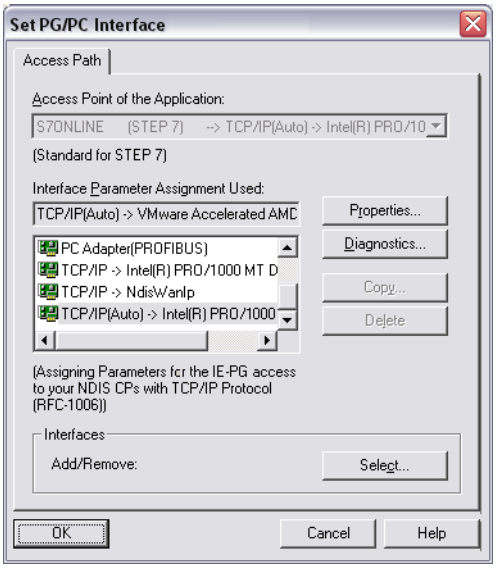


Figure 5-3: "Set PG/PC interface" in the Control Panel



Select your interface for the connection between S7 PLC and Ethernet-network and confirm the settings.

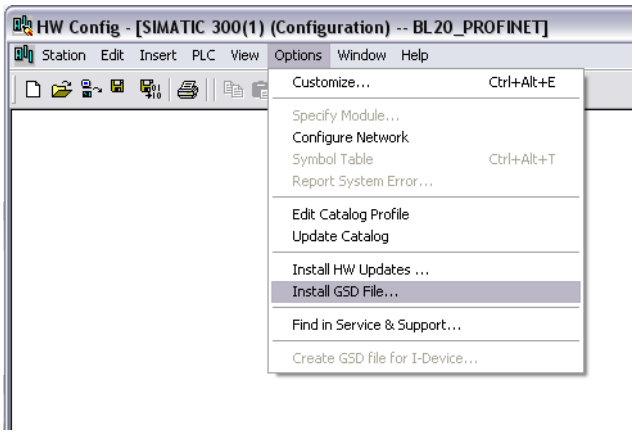
Figure 5-4: Select PG/PC interface



5.1.3 Installation of the GSDML-files

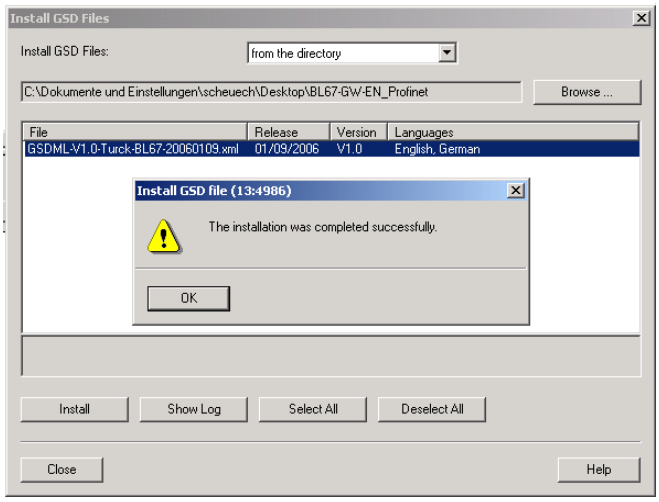
In the hardware configuration "HW config", open the "Options → Install GSD file" command in order to install new GSD-files.

Figure 5-5: Install GSD-files



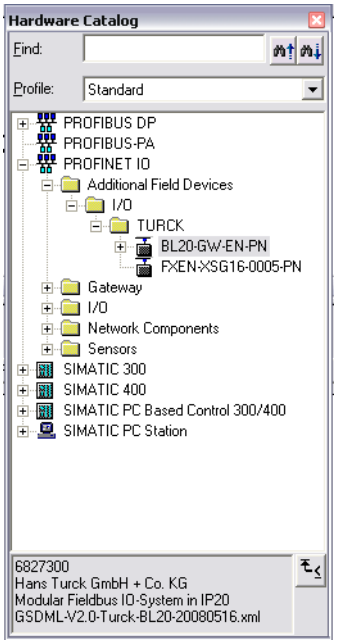
Define the directory for the TURCK GSDML-files by browsing the directories and add the BL20 PROFINET IO gateway to the hardware catalog.

Figure 5-6: Install GSDML-file



The BL20 gateway can now be found under "PROFINET IO → Additional Field Devices → I/O → TURCK".

Figure 5-7: BL20 gateway in the hardware catalog

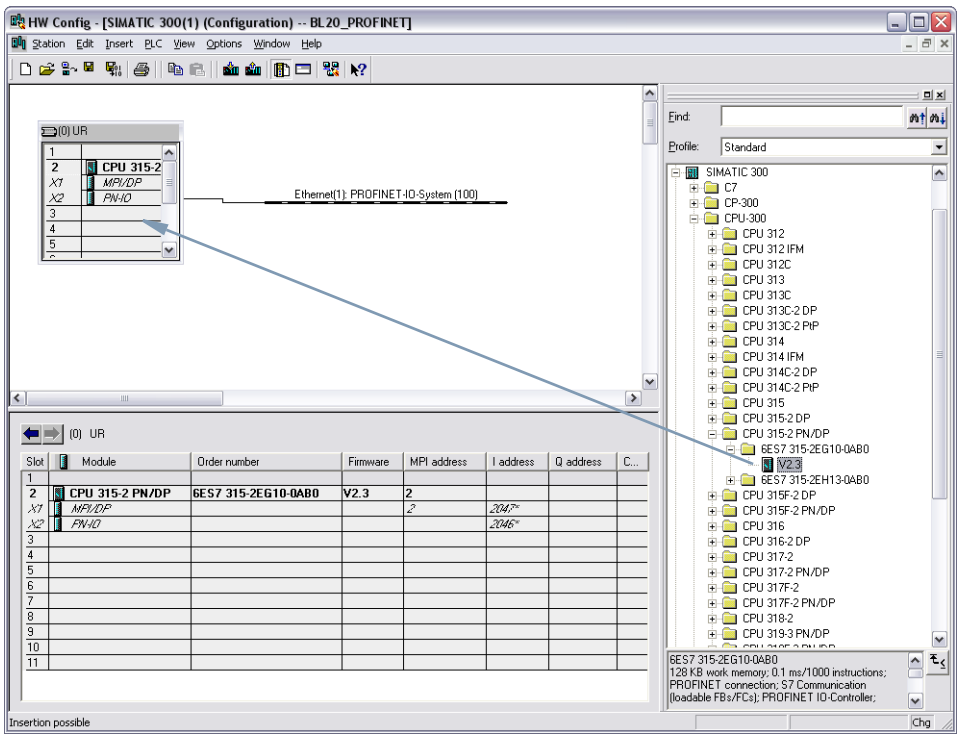


5.1.4 PLC configuration

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

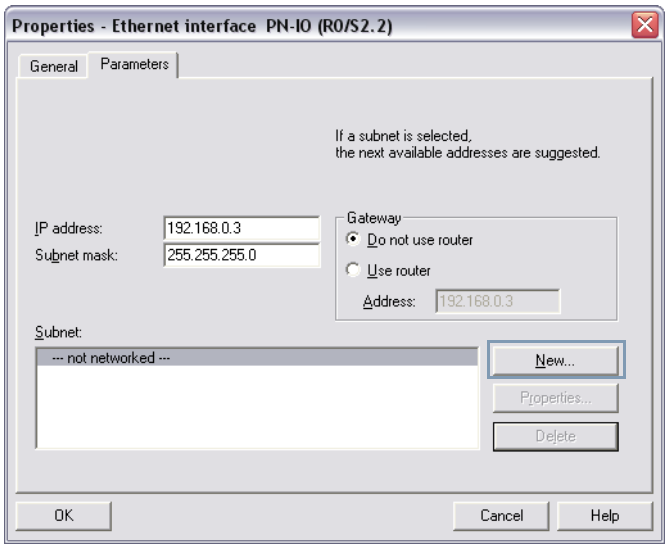
After this, select the Siemens CPU from the hardware catalog. In this example a CPU 315-2 PN/DP, version 6ES7 315-2EG10-0AB0 (V 2.3.2) is used.

Figure 5-8: Selecting the CPU



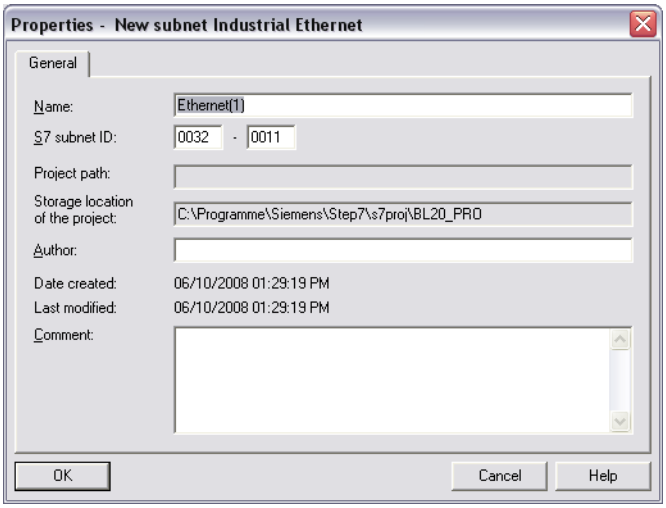
In the dialog "Properties Ethernet Interface", the IP address and the subnet mask for the S7 CPU are defined.

Figure 5-9: Properties Ethernet interface



The subnet is added using the "New..." button.

Figure 5-10: Add new Ethernet subnet

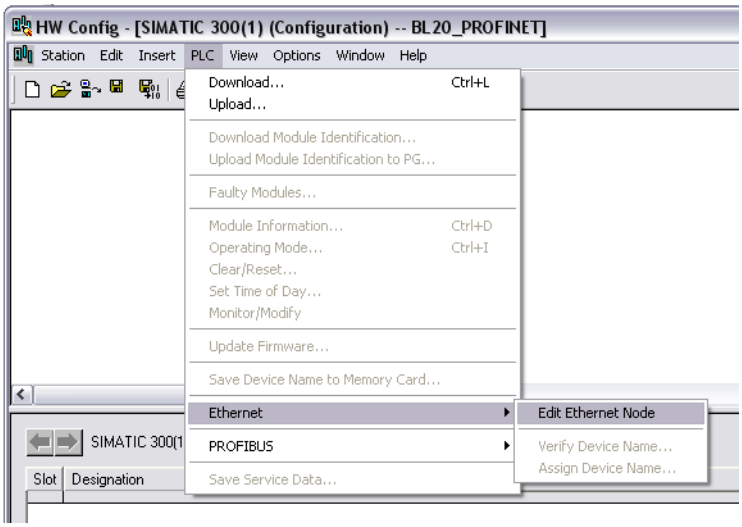


5.1.5 Scanning the network for PROFINET IO nodes

The Simatic hardware configuration offers the possibility to browse the PROFINET IO network using a broadcast command in order to find active PROFINET IO nodes. The active nodes are identified via their MAC address.

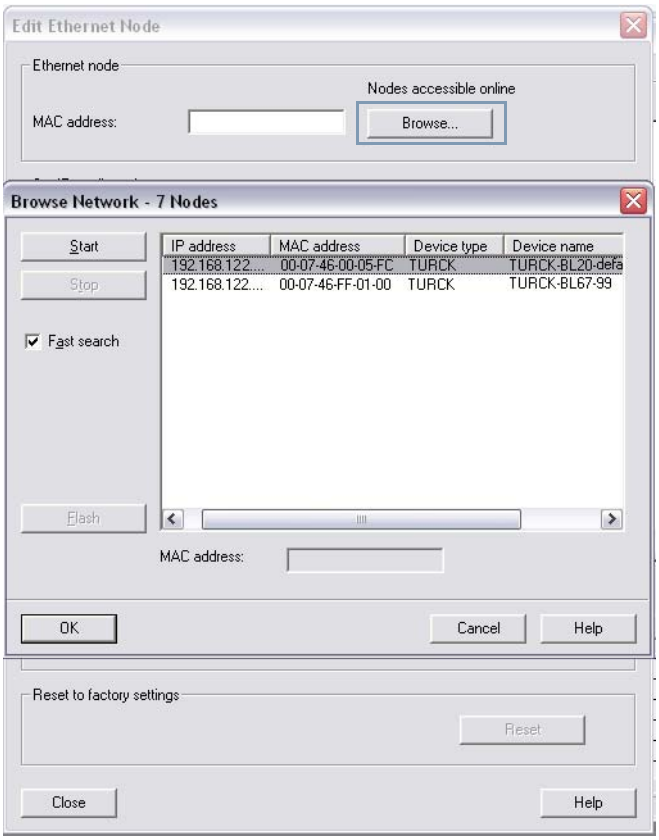
Open the respective dialog box by using "PLC → Ethernet → Edit Ethernet Node".

Figure 5-11: Configure Ethernet node



Browse the network for active network nodes identified by means of their MAC address, by using the button "Browse" in the field "Ethernet node".

Figure 5-12: Browse the network



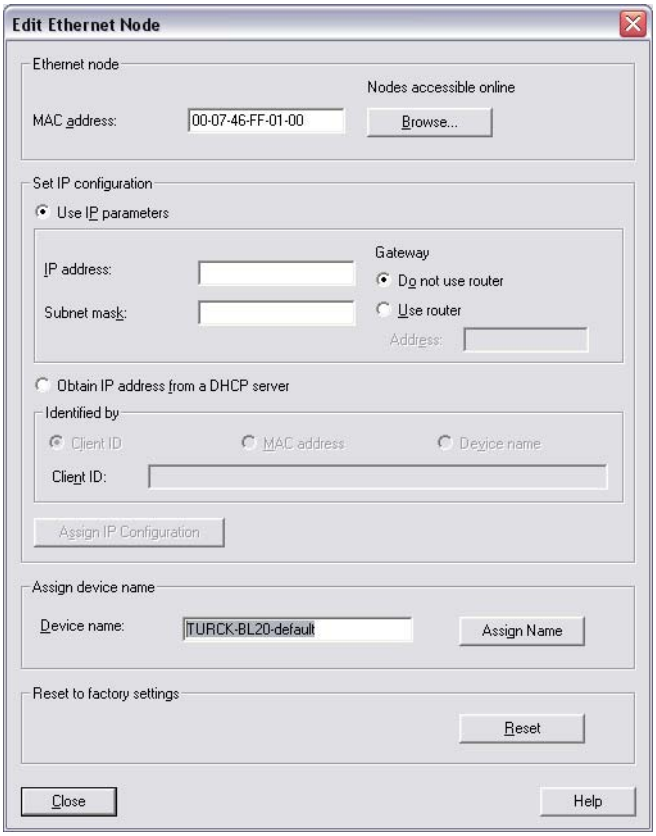
All PROFINET IO nodes found in the network answer the command sending their MAC address and their device name.

Select a node and close the dialog with "OK".

The features of the selected node are now shown in the in the dialog "Edit Ethernet Node".

In this dialog, the node's IP configuration or device name can be adapted, if necessary for the application.

Figure 5-13: Adaptation of the Ethernet node configuration



Attention

Here, you can also assign an application specific device name to the devices which were found.

Please observe, that the device name assigned here has to be similar to the device name assigned to the node in the properties dialog box (see Figure 28: "Dialog box: Properties TURCK").

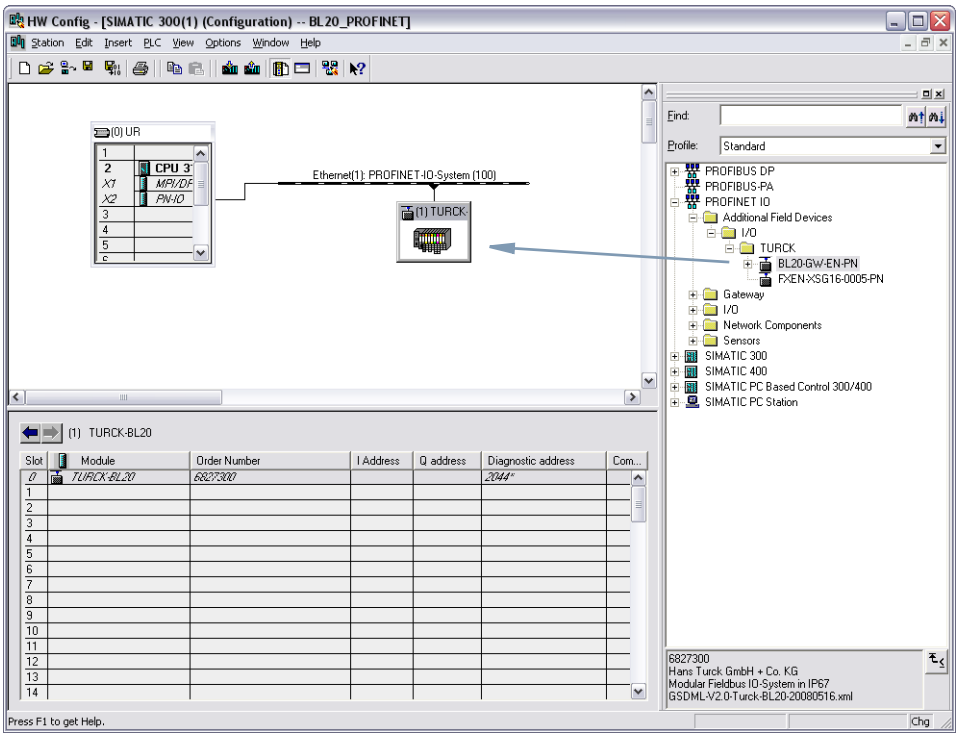
If this is not guaranteed, the PLC will not be able to clearly identify the node!

5.1.6 Configuration of the BL20 station

Now, the BL20 gateway is chosen from the hardware catalog and added to the configuration.

Select the gateway under "PROFINET IO → Additional Field Devices → I/O → TURCK" and add it to the Ethernet-network.

Figure 5-14: Select BL20 gateway

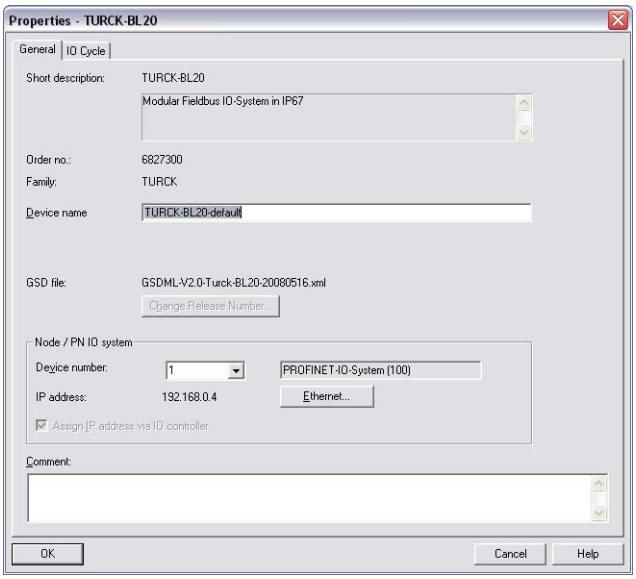


A double-click on the gateway-symbol opens the dialog "Properties TURCK". Enter the gateway's device name in this dialog.

Note

When being operated for the first time, the default-device name of the TURCK BL20 gateways for PROFINET is "TURCK-BL20-default". The IP-Address is 0.0.0.0.

Figure 5-15: Dialog box: Properties TURCK



Attention

In PROFINET IO, the connected device is not identified by it's IP address, but recognized and addressed by it's device name.

The selection of a device name for a special I/O device can thus be compared to the setting of the PROFIBUS address for a DP slave.

The device name can be freely chosen.

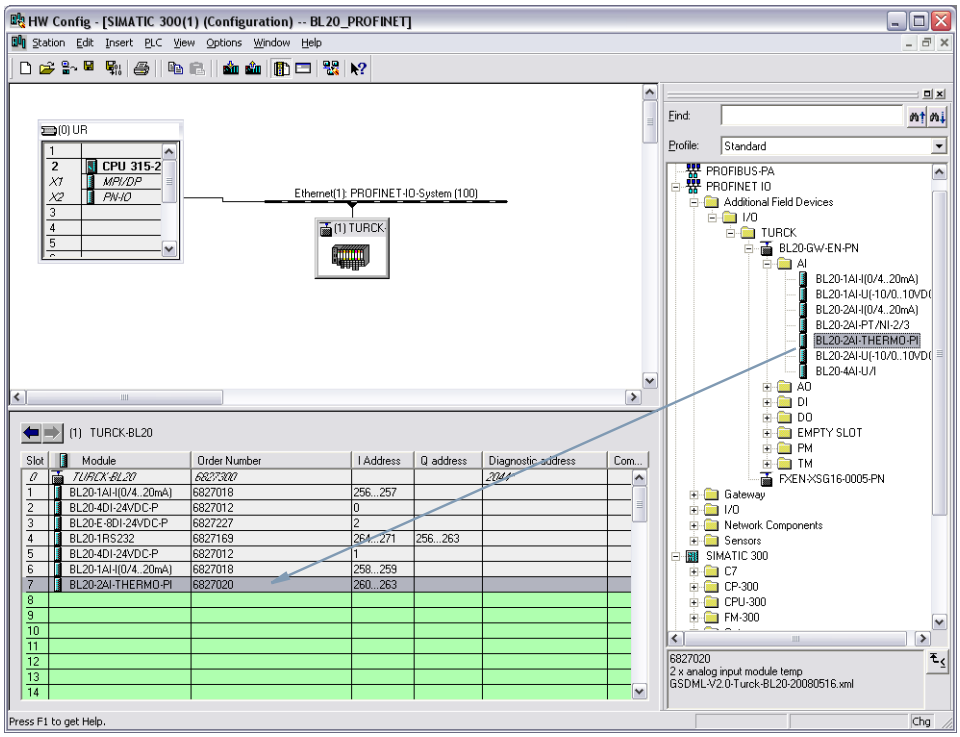
Attention

When storing the device name or the IP address or when resetting the gateway to the default values, the GW-LED switches to orange.

During this time, the gateway's voltage supply must not be interrupted. In case of a power failure, faulty data will be stored in the gateway.

After the assignment of the device name, the I/O modules, which are connected to the BL20 gateway, are added to the station configuration. They have to be selected from the Hardware Catalog in the same order as they appear physically in the station.

Figure 5-16: Add I/O-modules to the station



Save your hardware configuration via "Station → Save and Compile" and download it to the PLC via "PLC → Download...".

The hardware configuration is completed.

5.2 Diagnostic with Step 7

5.2.1 Diagnostic messages in the hardware configuration

The BL20 gateways for PROFINET show gateway diagnostics and channel-specific module diagnostics in the hardware configuration of the Step 7-software.

Furthermore a special help text, which clearly specifies the error, is given for each diagnostic message:

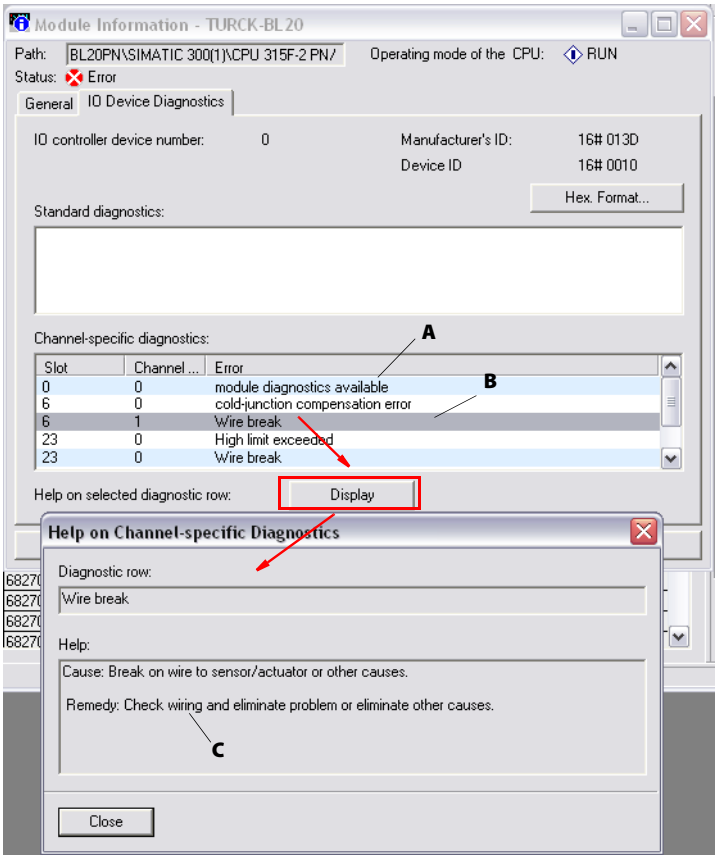


Figure 5-17: Diagnosis of the PROFINET gateways in the hardware config

A *gateway diagnosis*
B *channel-specific module diagnosis*
C *manufacturer-specific help texts*

5.2.2 Diagnostic evaluation in the application program

In PROFINET IO, a vendor-independent structure for data records with diagnostic information has been defined. Diagnostic information is generated only for disturbed channels.

The following pages show two possibilities for diagnosis evaluation within an application program.

Note

Please refer to the Step 7 online help or the respective Simatic documentation ("PROFINET IO - From PROFIBUS DP to PROFINET IO - Programming manual", document number A5E00298268-02) for all complete and actual information about the diagnosis evaluation.

Diagnose with SFB 52 in OB1

Using the SFB52, the diagnosis evaluation is done with every cycle of the application program.

In principle, SFB 52 can be called in any organization block.

Note

Please refer to the complete and actual description of SFB 52 in the software's online help.

Table 5-2: input data SFB 52

Parameter name	Meaning
REQ	REQ = 1, starts data transfer
ID	Logical address (HW config) of the BL20-I/O-module to be addressed. When addressing the gateway, the Diagnostic address given in HW config has to be entered. Note: If the module is an output module, bit 15 has to be set (example: for address 5: ID: = DW#16#8005). In combi-modules, the smaller of the two addresses should be specified.
INDEX	Data record number; in PROFINET specify the number of the PROFINET diagnosis data record for the reading of channel diagnosis (diagnosis data records: W#16#800A$_{hex}$ to W#16#E00A$_{hex,}$ according to PROFINET specification).
MLEN	Maximum length of the data to be read.

Table 5-3: output data SFB 52

Parameter name	Meaning
VALID	New data record has been received and is valid.
BUSY	BUSY = 1: The read operation is not yet complete.
ERROR	ERROR = 1: An error occurred during the read operation
STATUS	Error code of the function block (see Siemens online help for SFB54 "RALRAM")
LEN	Length of loaded data.
RECORD	Destination area for the read data record.

Diagnostic with SFB 54 in case of error/ alarm in the alarm OB

Signal and function modules with diagnosis function detect interrupts and generate a diagnosis alarm. A response to this alarm is done via alarm Organization Blocks.

Based on the OB number and start information for the interrupt event, you already have some first information about its cause and location.

Detailed information about the interrupt event in this error OB can be read using SFB 54 (Read supplementary interrupt information).

The interrupt evaluation is done as follows:

Diagnostic event:

→ **Alarm-OB** is called

→ **SFB 54** is called.

→ Diagnostic data is stored in the **AINFO** (header information and supplementary interrupt information) and **TINFO** (OB start information and housekeeping information) destination areas.

Note

Please refer to the Step 7 online help or the respective Simatic documentation ("PROFINET IO - From PROFIBUS DP to PROFINET IO - Programming manual", document number A5E00298268-02) for all complete and actual information about the diagnosis evaluation.

Table 5-4: input data SFB 54

Parameter name	Meaning
MODE	Operation mode
F_ID	Logical start address of the module from which interrupt information should be received.
MLEN	Maximum length of diagnosis information to be received in bytes.

Table 5-5: output data SFB 54

Parameter name	Meaning
NEW	A new interrupt has been received.
STATUS	Error code of SFB or IO controller.
ID	Start address of component (module) from which an interrupt was received Bit 15 contains the I/O identifier: "0" for an input address, "1" for an output address.
LEN	Length of the received interrupt information in bytes.
TINFO	(Task information) Destination area for OB start information and housekeeping information.
AINFO	(Alarm information) Destination area for header information and supplementary interrupt information.

Note

Please refer to the Step 7 online help or the respective Simatic documentation ("PROFINET IO - From PROFIBUS DP to PROFINET IO - Programming manual", document number A5E00298268-02) for all complete and actual information about the AINFO and TINFO.

6 Integration of technology modules

6.1 Integration of the Counter Module BL20-1CNT-24VDC

6.1.1 Count mode: data image

Process output data

The process output data is the data that is output from the PLC via the gateway to the BL20-1CNT-24VDC module.

The BL20 module allows some parameters to be modified during operation.

The other parameters must be changed prior to commissioning.

Note

The current count operation is stopped if parameters are changed during operation.

Note

The parameters modified via the process output data are not retentive. The commissioning after a power failure is based on the parameter data of the configuration tool or default configuration.

The data is transferred in 8 byte format:

- The first 2 bytes are not yet assigned.
- Two control bytes contain the control functions for transferring the parameter values, for starting/stopping the measurement, for acknowledging errors and for resetting the status bit.
- Four bytes provide the parameter values for "Load direct", "Load in preparation", "Reference value 1", "Reference value 2" or "Behaviour of the digital outputs".

Structure of the data bytes in PROFIBUS-DP with "Load value direct/in preparation", "Reference value 1" or "Reference value 2".

Table 6-1: PDOut with "Load value direct/ in preparation", "Reference value 1" or "Reference value 2"

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
0	X							
1	X							
2	X	X	X	LOAD_ DO_ PARAM	LOAD_ CMP_ VAL2	LOAD_ CMP_ VAL1	LOAD_ PREPARE	LOAD_ VAL
3	EXTF_ ACK	CTRL_ DO2	SET_ DO2	CTRL_ DO1	SET_ DO1	RES_ STS	CTRL_ SYN	SW_ GATE
4	Load value direct, Load value in preparation, Reference value 1 or Reference value 2							
5								
6								
7								

Structure of the data bytes in PROFIBUS-DP with "Function and behaviour of DO1/DO2":

Table 6-2: PDOut with "Function and behaviour of DO1/DO2"

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
0	X							
1	X							
2	X	X	X	LOAD_ DO_ PARAM	LOAD_C MP_ VAL2	LOAD_C MP_ VAL1	LOAD_ PREPARE	LOAD_ VAL
3	EXTF_ ACK	CTRL_ DO2	SET_ DO2	CTRL_ DO1	SET_ DO1	RES_ STS	CTRL_ SYN	SW_ GATE
4	X							
5	Pulse duration							
6	Hysteresis value							
7	X		MODE_DO2				MODE_DO1	

Table 6-3: Meaning of the data bits (process output)

Control bit	**Explanations**
MODE_DO2	Only valid if LOAD_DO_PARAM: "0" → "1". The virtual**A** 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.s

A *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.*

Table 6-3: Meaning of the data bits (process output)

Control bit	Explanations
MODE_DO1	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 to 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 to 255) unit: ms If the DO1/DO2 outputs are set to indicate counter status = reference value 1/2, a longer pulse is sometimes required to indicate equal values.
EXTF_ ACK	Error acknowledgement 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**A** output DO2 is blocked.
	1: The virtual**A** output DO2 is released.
SET_ DO2	If CTRL_DO2 = 1 and the virtual**A** 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.
CTRL_DO1	0: The output DO1 is blocked.
	1: The output DO1 is released.

Table 6-3: Meaning of the data bits (process output)

Control bit	Explanations
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 DO2 can also be set before commissioning via the separate parameter data. The default setting for DO1 is to display the value 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**A** DO2 output "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 to 3 is accepted as a reference value 2.
LOAD_ CMP_VAL1	Parameter definition of reference value 1 "0" → "1": The value in bytes 0 to 3 is accepted as a reference value 1.
LOAD_ PREPARE	Parameter definition of Load counter in preparation "0" → "1": The value in bytes 0 to 3 is accepted as the new load value.
LOAD_VAL	Parameter definition of Load counter direct "0" → "1": The value in bytes 0 to 3 is accepted directly as the new count value.

Process input data

Process input data is data from the connected field device that is transmitted via the BL20-1CNT-24VDC module to the PLC. This is transferred in an 8-byte format as follows:

- 2 bytes contain status information.
- 1 byte contains the diagnostics data.
- 4 bytes are used to represent the counter value.

Structure of the data bytes in PROFIBUS-DP

Table 6-4: PDIn

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
0	X							
1	STS_ND	STS_UFLW	STS_OFLW	STS_CMP2	STS_CMP1	x		STS_SYN
2 Status	STS_DN	STS_UP	X	STS_DO2	STS_DO1	X	STS_DI	STS_GATE
3 Diagn.	ERR_24Vdc	ERR_DO	ERR_PARA	X	X	RES_STS_A	ERR_LOAD	STS_LOAD
4	Count value							
5								
6								
7								

Table 6-5: Meaning of the data bits (process input)

Bits	**Explanations**
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 to 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.

Table 6-5: Meaning of the data bits (process input)

Bits	Explanations
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 Set if the Load function is running.
STS_DN	1: Status direction down.
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 DO2 SET_DO2 = 1 when the output is not released. This bit must be reset by the RES_STS control bit.

Table 6-5: Meaning of the data bits (process input)

Bits	Explanations
STS_CMP1	Status comparator 1 This status bit indicates a comparison result for comparator 1 if: – The output DO1 is released with CTRL_DO1 = 1. and – a comparison is run via MODE_DO1 = 01, 10 or 11. Otherwise STS_CMP1 simply indicates that the output is or was set. It must be acknowledged with RES_STS (process output). The bit is reset immediately if acknowledgement takes place when the output is still set. STS_CMP1 is also set if DO1 SET_DO1 = 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.

Parameters for count mode

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

Some parameters refer to the physical inputs/outputs A,B,DI,DO.

The parameters are stored in a non-volatile memory before being checked. The parameters that are not mode-dependent are evaluated and processed first of all. If some of the mode-dependent parameters have an error, the appropriate diagnostics message is initiated and the bits in the check-back interface/ process input are set.

(X = reserved)

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (15/16)	X	X	counter mode					
Byte 1 (14/15)	X	main count direction		synchro nization	function DI		digital input DI	gate function
Byte 2 (13/14) to Byte 5 (10/11)	lower count limit							
Byte 6 (9/ 10) to Byte 9 (6/ 7)	upper count limit							
Byte 10 (5/6)	hysteresis							
Byte 11 (4/5)	pulse duration							
Byte 12 (3/4)	function DO2			function DO1			diagnost ic DO1	substitut e value DO 1
Byte 13 (2/3)	direction input (B)	sensor (A)		sensor/ input filter (DI)	sensor/ input filter (B)	sensor/ input filter (A)	signal evaluation (A,B)	
Byte 14 (1/2)	X	X	behavior CPU/ master stop		X	X	X	group diagnost ics
Byte 15 (0/1)	X	X	X	X	X	X	X	X

The list parameters are set by means of a fieldbus configuration tool or the I/Oassistant software package. Some parameters cannot be modified online. These parameters must be defined before commissioning. Some parameters can also be modified via the process output after commissioning → Process output data.

Note
The current count operation is stopped if parameters are changed during operation.

Table 6-6: Parameters for count modes

A*default value*

Designation		**Description**
Value		
– Group diagnostics		
0 **A**	Release **A**	Separate diagnostics is released.
1	Block	Separate diagnostics is blocked.
– Behavior CPU/master stop		
00 **A**	turn off DO1 **A**	A failure of the higher-level PLC causes output DO1 to be switched off or held.
01	Proceed with operating mode	A failure of the higher-level PLC causes the module to continue operating without restriction.
10	DO1 switch substitute value	A failure of the higher-level PLC causes output DO1 to assume the value specified at Substitute value DO1.
11	DO1 hold last value	A failure of the higher-level PLC causes output DO1 to retain the status in the event of a failure
– Signal evaluation (A,B)		
00 **A**	Pulse and direction **A**	In this mode input B can control up and down counting.
01	rotary sensor: single	
10	rotary sensor: double	
11	rotary sensor: fourfold	
– Sensor/Input filter (A)		An input filter at inputs A,B and DI can suppress high-frequency interference and thus increase the accuracy of the counting. The limit frequency can be adapted to the application: 20 kHz or 200 kHz
0 **A** 1	2.5 ms (200 kHz) **A** 25 ms (20 kHz)	
– Sensor/Input filter (B)		
0 **A** 1	2.5 ms (200 kHz) **A** 25 ms (20 kHz)	
– Sensor/Input filter (DI)		
0 **A** 1	2.5 ms (200 kHz) **A** 25 ms (20 kHz)	

Table 6-6: Parameters for count modes

A*Default value*

Designation		**Description**
Value		
– sensor (A)		
00 **A** 01	Normal Inverted	
– direction input (B)		
0 **A** 1	Normal Inverted	
– function DO1		
00 **A**	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 **A**	Output	
01	On when cnt. value ≥ ref. value	
10	On when cnt. value ≤ ref. value	
11	Pulse when cnt. value = ref. value	
– substitute value DO1		
0 **A** 1	0 1	This value determines the state of output DO1 in the event of a failure if: behavior CPU/master stop = 10
– diagnostic DO1		
0 **A**	On	The Short-/open circuit DO diagnostic message is not blocked.
1	Off	The Short-/open circuit DO diagnostic message is blocked.
– hysteresis		
0 **A** to 255	0 to 255 (UINT)	
*– Pulse duration DO1, DO2 [n*2ms]*		
0 **A** to 255	0 to 255 (UINT)	
– count mode		

Table 6-6: Parameters for count modes

A*Default value*

Designation		**Description**
Value		
000000 **A**	continuous count	
000001	single-action count	
000010	periodical count	
000011 to 011111		Reserve
– gate function		
0 **A**	abort count procedure	If the counting operation is aborted, counting begins from the load value on restart.
1	interrupt count procedure	If the counting operation is interrupted, the counter continues on restart from the actual counter value.
– digital input DI		
0 **A** 1	Normal Inverted	
– function DI		
00 **A**	Input	
01	HW gate	Hardware release
10	latch retrigger function when edge pos.	
11	synchronization when edge pos.	
– Synchronization		
0 **A** 1	single-action periodical	
– main count direction		
00 **A** 01 10	None Up Down	

Table 6-6: Parameters for count modes

Designation		Description
Value		
– lower count limit (HWORD) **B**		
8000 0000 **A** to 0 ($_{hex}$)	-32768 1 to 0 (SUINT)	If the upper or lower count limit is reached, the count value jumps to the load value, the lower count limit or the upper count limit, depending on the count mode and the main count direction.
– lower count limit (LWORD) **B**		
8000 0000 **A** to 0 ($_{hex}$)	-32768 to 32767 (SINT) (0)	see above: „lower count limit"
– upper count limit (HWORD) **B**		
0 to 7FFF FFFF **A** ($_{hex}$)	0 to 32767 (SINT)	see above: „lower count limit"
– upper count limit (LWORD) **B**		
0 to 7FFF FFFF **A** ($_{hex}$)	0 to 65535 1 (SINT)	see above: „lower count limit"

A *In some PLCs the count limits (one double word each) consist of a High Word (HWORD) and Low Word (LWORD). The relevant ranges are stated.*

Diagnostics for count mode

The parameter setting for the PROFIBUS-DP gateway provides the Gateway Diagnostics parameter for selecting between two different diagnostics displays. Choose "Devices, ID, Channel Diagnostics" to select more detailed diagnostics indication. The diagnostics message will then consist of the following elements:

- 2 bytes of gateway diagnostics (device-related diagnostics)
- 64 bits of ID-specific diagnostics
- n x 3 bytes of channel-specific diagnostics (n: number of channels with active diagnostics)

With channel-specific diagnostics, the use of an error number enables the type of error to be indicated in plain text (e.g. Parameter error).

When Device-related Diagnostics is selected, an abbreviated diagnostics message is generated that simply shows the gateway diagnostics (device-related diagnostics). The diagnostics bytes of all station modules are attached that support diagnostics.

Note that the Measurement mode diagnostics is only set in conjunction with another diagnostics bit.

Table 6-7: Meaning and position of the data bits (diagnostics)

Name of error type	Position	Explanations
short-/open circuit ERR_DO	0	Short-/open circuit/excess temperature at output DO1. This diagnostics information must be acknowledged with the EXTF_ACK (process output) control bit.
short-circuit sensor pwr supply	1	Short-circuit of sensor supply. This diagnostics information must be acknowledged with the EXTF_ACK control bit.
end of counter range wrong	2	The following parameter errors are indicated: Upper count limit = lower count limit Upper count limit ≤ lower count limit Upper count limit < 0 The numerical values are displayed as two's complement values. The permissible range for the upper count limit is therefore: $0_{hex....}$7FFF FFFD$_{hex}$; 7FFF FFFE$_{hex}$; 7FFF FFFF$_{hex}$ The decimal value range for this SINT value is: 0...2147483645; 2147483646; 2147483647
start of counter range wrong	3	The following parameter errors are indicated: Lower count limit = upper count limit Lower count limit ≤ upper count limit Lower count limit > 0 The numerical values are displayed as two's complement values. The permissible range for the lower count limit is therefore: 8000 0000$_{hex}$...FFFF FFFE$_{hex}$; FFFF FFFF$_{hex}$; 0$_{hex}$ The decimal value range for this SINT value is: -2147483648...-2,-1.0
invert-DI+latch-retr. not perm.	4	Inverting the digital input signal with the Latch Retrigger function is not permissible.

Table 6-7: Meaning and position of the data bits (diagnostics)

Name of error type	Position	Explanations
main count direction wrong	5	The value (11) for selecting the main count direction is incorrect. Permissible values: 00 → None 01 → Up 10 → Down
operating mode wrong	6	The value (XXXX11) for selecting the operating mode is incorrect. Permissible values for count mode: 000000 Continuous count 000001 Single-action count 000010 Periodical count Permissible values for measurement mode: 100000 → Frequency measurement 100001 → Revolutions measurement 100010 → Period duration measurement
measurement mode	7	This message is always shown in conjunction with other diagnostics messages and indicates that measurement mode is active. This message never occurs in count mode.

Note

Counting should not be started if there is a parameter error (diagnostics bits 2 to 6)!

6.1.2 Measurement mode: data image

Process output for measurement mode

The process output data is the data that is output from the PLC via the gateway to the BL20-1CNT-24VDC module.

The BL20-1CNT-24VDC module allows some parameters to be modified during operation.

The other parameters must be changed prior to commissioning.

Note

The current count operation is stopped if parameters are changed during the measuring operation.

Note

The parameters modified via the process output data are not retentive. The commissioning after a power failure is based on the parameter data of the configuration tool or default configuration.

The data is transferred in 8 byte format:

- The first 2 bytes are not yet assigned.
- Two control bytes contain the control functions for transferring the parameter values, for starting/ stopping the measurement, for acknowledging errors and for resetting the status bit.
- Four bytes represent the parameter values for Lower limit or Upper limit, Function of DO1 or Integration time.

Structure of the data bytes in PROFIBUS-DP with „Function of DO1" set:

Table 6-8: Structure of the data bytes with „Function of DO1" set

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
0	X							
1	X							
2	X	X	X	LOAD_ DO_ PARAM	X	LOAD_ INTTIME	LOAD_ UPLIMIT	LOAD_ LOLIMIT
3	EXTF_ ACK	X	X	CTRL_ DO1	SET_ DO1	RES_ STS	X	SW_ GATE
4	X							
5	X							
6	X							
7	X						MODE_DO1	

Structure of the data bytes in PROFIBUS-DP with „Lower limit" or „Upper limit" set:

Table 6-9: Structure of the data bytes with „Lower limit" or „Upper limit" set

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
0	X							
1	X							
2	X	X	X	LOAD_ DO_ PARAM	X	LOAD_ INTTIME	LOAD_ UPLIMIT	LOAD_ LOLIMIT
3	EXTF_ ACK	X	X	CTRL_ DO1	SET_ DO1	RES_ STS	X	SW_ GATE
4	Lower limit or upper limit							
5								
6								
7								

Structure of the data bytes in PROFIBUS-DP with „Integration time set":

Table 6-10: Structure of the data bytes with „Integration time set"

X = reserved

Bit	7	6	5	4	3	2	1	0
Byte								
0	X							
1	X							
2	X	X	X	LOAD_ DO_ PARAM	X	LOAD_ INTTIME	LOAD_ UPLIMIT	LOAD_ LOLIMIT
3	EXTF_ ACK	X	X	CTRL_ DO1	SET_ DO1	RES_ STS	X	SW_ GATE
4	X							
5	X							
6	Integration time							
7								

Table 6-11: Meaning of the data bits (process output)

Control bit	Explanations
EXTF_ ACK	Error acknowledgement The ERR_DO or ERR_24Vdc 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 configured for indicating 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 display the value of SET_DO1.
RES_STS	0 → 1 Initiate resetting of status bits. The STS_UFLW, STS_OFLW and STS_CMP1 (process input) status bits 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.

Table 6-11: Meaning of the data bits (process output)

Control bit	Explanations
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 forming 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 x 10 ms. With period duration measurement, this factor determines the number of periods measured in order to calculate a mean value. A factor 1 to 1000 (1hex to 3E8hex) is permissible.
LOAD_ UPLIMIT	Parameter setting of the upper measuring limit 0 → 1: The value in bytes 0 to 3 is accepted directly as the new upper measuring limit. LOAD_UPLIMT: 1 to 200 000 000 x 10-3 Hz 1 to 25 000 000 x 10-3 rpm 1 to 100 000 000 ms
LOAD_ LOPLIMIT	Parameter setting of the lower measuring limit 0 A 1: The value in bytes 0 to 3 is accepted directly as the new lower measuring limit. LOAD_LOLIMIT: 0 to 199 999 999 x10-3 Hz 0 to 24 999 999 x 10-3 rpm 0 to 99 999 999 ms
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 indicates 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)

Process input for measurement mode

Process input data is data from the connected field device that is transmitted via the BL20-1CNT-24VDC module to the PLC. This is transferred in an 8-byte format as follows:

- 2 bytes contain status information.
- 1 byte contains the diagnostics data.
- Four bytes are used to contain the measured values.

Structure of the data bytes in PROFIBUS-DP

Table 6-12: PDIn

X = reserved

Bit	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Byte								
7	X							
6	X	STS_UFLW	STS_OFLW	X	STS_CMP1	x		X
5 Status	STS_DN	STS_UP	X	X	STS_DO1	X	STS_DI	STS_GATE
4 Diagn.	ERR_24Vdc	ERR_DO	ERR_PARA	X	X	RES_STS_A	ERR_LOAD	STS_LOAD
3	measured value							
2								
1								
0								

Table 6-13: Meaning of the data bits (process input)

Bits	**Explanations**
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
ERR_PARA	– 1: There is a parameter error. ERR_PARA is a group diagnostics bit. With the separate diagnostics message bits 3 to 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.

Table 6-13: Meaning of the data bits (process input)

Bits	Explanations
ERR_LOAD	1: Error with load function The control bits LOAD_UPLIMIT and LOAD_LOLIMIT must not be set simultaneously during the transfer. The value of LOAD_UPLIMT and LOAD_LOLIMIT was selected outside of the permissible range. Permissible values for LOAD_LOLIMIT: 0 to 199 999 999 x10-3 Hz 0 to 24 999 999 x 10-3 rpm 0 to 99 999 999 ms Permissible values for LOAD_UPLIMIT: 1 to 200 000 000 x 10-3 Hz 1 to 25 000 000 x 10-3 rpm 1 to 100 000 000 ms
STS_LOAD	Status of load function Set if the Load function is running.
STS_DN	Direction status: 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	Direction status: 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 → 1.
STS_OFLW	1: The upper measuring limit was exceeded. The bit must be reset with RES_STS: 0 → 1.
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 with RES_STS: 0 → 1.

Parameters for measurement mode

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

Some parameters refer to the physical inputs/outputs A, B, DI, DO.

The parameters are stored in a non-volatile memory before being checked. The parameters that are not mode-dependent are evaluated and processed first of all. If some of the mode-dependent parameters have an error, the appropriate diagnostic message is initiated and the bits in the check-back interface/ process input are set. (X = reserved)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0 (15/ 16)	X	X	measurement mode					
Byte 1(14/ 15)	X	X	X	X	function DI		digital input DI	X
Byte 2 (13/ 14)	lower limit (LWORD)							
Byte 5 (12/ 13)								
Byte 4 (11/ 12)	lower limit (HWORD)							
Byte 5 (10/ 11)	upper limit (LWORD)							
Byte 6 (9/ 10)								
Byte 7 (8/9)	upper limit (HWORD)							
Byte 8 (7/8)	integration time [n*10ms]							
Byte 9 (6/7)								
Byte 10 (5/ 6)	sensor pulses per revolution							
Byte 11 (4/ 5)								
Byte 12 (3/ 4)	X	X	X	function DO1			diagnostic DO1	substitute value DO1
Byte 13 (2/ 3)	direction input (B)	sensor (A)		sensor/ input filter (DI)	sensor/ input filter (B)	sensor/ input filter (A)	signal evaluation (A,B)	
Byte 14 (1/ 2)	X	X	behavior CPU/ master STOP		X	X	X	Group diagnostics
Byte 15 (0/ 1)	X	X	X	X	X	X	X	X

Table 6-14: Parameters for measurement mode

A*Default value*

Designation		**Description**
Value		
– measurement mode		
100000 **A**	frequency measurement	The module counts the pulses received within a specified integration time.
100001	revolutions measurement	In this operating mode, the counter module counts the pulses received from a rotary sensor within a predefined integration time.
100010	period duration measurement	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).
100011 to 111111	reserved	-
– digital input DI		
0 **A** 1	Normal Inverted	
– function DI		
00 **A**	Input	
01	HW gate	Hardware release
10 to 11	reserved	-

Designation		**Description**
Value		
– lower limit (HWORD) **B**		Lower limit for – 0 to f_{max}-1 – 0 to n_{max}-1 – 0 to t_{max}-1
0 **A**	0 to 255 (SINT)	
– lower limit (LWORD) **B**		
0 **A**	0 to 65 535 (SINT)	

Table 6-14: Parameters for measurement mode

Designation		Description
Value		
– upper limit (HWORD) **B**		Upper limit for – 1 to f_{max} – 1 to n_{max} – 1 to t_{max}
255 **A**	0 to 255	
– upper limit (LWORD) **B**		
65 535 **A**	0 to 65 535	
*– integration time [n*10 ms]:" **or** number of periods*		
10 **A**	1 to 1000	Factor for forming an integration time (frequency measurement) and number of measured periods for determining an average period duration.
– sensor pulses per revolution		
1 **A**	1 to 65 535 (SINT)	This parameter is used to determine the rotational speed.
– substitute value DO1		
0 **A** 1	0 1	This value determines the state of output DO1 in the event of a failure if: behavior CPU/Master STOP = 10
– diagnostic DO1		
0 **A**	On	The Short-/open circuit DO diagnostics message is not blocked.
1	Off	The Short-/open circuit DO diagnostics message is blocked.
– function DO1		
00 **A**	Output	Behaviour of the digital outputs DO1/DO2.
01	outside of limits	
10	below lower limit	
11	above upper limit	
– signal evaluation (A,B)		
00 **A**	Pulse and direction	In this mode input B can receive a signal for the rotational direction. The process entry/check-back interface returns the status rotation direction via STS_DN and STS_UP.
01	rotary sensor: single	The evaluation options can be set in the BL20 counter module configuration. The following settings are possible: – Single – Double – Fourfold
10 to 11	reserved	-

A *Default value*

B *In some PLCs the count limits (one double word each) consist of a High Word (HWORD) and Low Word (LWORD). The relevant ranges are stated.*

Table 6-14: Parameters for measurement mode

Designation		Description
Value		
– Sensor/Input filter (A)		An input filter at inputs A,B and DI can suppress high-frequency interference and thus increase the accuracy of the counting. The limit frequency can be adapted to the application: 20 kHz or 200 kHz
0 **A**	2.5 ms (200 kHz) **A**	
1	25 ms (20 kHz)	
– Sensor/Input filter (B)		
0 **A**	2.5 ms (200 kHz) **A**	
1	25 ms (20 kHz)	
– Sensor/Input filter (DI)		
0 **A**	2.5 ms (200 kHz) **A**	
1	25 ms (20 kHz)	
– sensor (A)		
00 **A**	Normal	
01	Inverted	
– direction input (B)		
0 **A**	Normal	
1	Inverted	
– Group diagnostics		
0 **A**	Release **A**	Separate diagnostics is released.
1	Block	Separate diagnostics is blocked.
– Behavior CPU/master stop		
00 **A**	turn off DO1 **A**	A failure of the higher-level PLC causes output DO1 to be switched off or held.
01	Proceed with operating mode	A failure of the higher-level PLC causes the module to continue operating without restriction.
10	DO1 switch substitute value	A failure of the higher-level PLC causes output DO1 to assume the value specified at Substitute value DO1.
11	DO1 hold last value	A failure of the higher-level PLC causes output DO1 to retain the status in the event of a failure

Diagnostics for measurement mode

The parameter setting for the PROFIBUS-DP gateway provides the Gateway Diagnostics parameter for selecting between two different diagnostics displays. Choose "Devices, ID, Channel Diagnostics" to select more detailed diagnostics indication. The diagnostics message will then consist of the following elements:

- Two bytes of gateway diagnostics (device-related diagnostics)
- 64 bits of ID-specific diagnostics
- n x 3 bytes of channel-specific diagnostics (n: number of channels with active diagnostics)

With channel-specific diagnostics, the use of an error number enables the type of error to be indicated in plain text (e.g. Parameter error).

When Device-related Diagnostics is selected, an abbreviated diagnostics message is generated that simply shows the gateway diagnostics (device-related diagnostics). The diagnostics bytes of all station modules are attached that support diagnostics.

The Measurement mode diagnostic should only be set together with another diagnostics bit.

Table 6-15: Meaning and position of the data bits (diagnostics)

Name of error type	Position	Explanation
short-/open circuit ERR_DO	0	Short-/open circuit/excess temperature at the output DO1 This diagnostics information must be acknowledged with the EXTF_ACK control bit.
short-circuit sensor pwr supply	1	Short-circuit of sensor supply This diagnostics information must be acknowledged with the EXTF_ACK control bit.
sensor pulse wrong	2	This error signal refers to the parameter value Sensor pulses per revolution. The latest configuration tools prevent an incorrect value from being entered.
integration time wrong	3	The value for the integration time is incorrect. The permissible value range is: 1 to 1000 This enables permissible integration times (frequency measurement/ revolutions measurement) from 10 ms to 10 000 ms in 10 ms increments and for period duration measurement averaging over 1 to 1000 periods.
upper limit wrong	4	The value for the upper limit is incorrect. Permissible value range: 1 to 16777215
lower limit wrong	5	The value for the lower limit is incorrect. Permissible value range: 0 to 16777214

Table 6-15: Meaning and position of the data bits (diagnostics)

Name of error type	Position	Explanation
operating mode wrong	6	The value (XXXX11) for selecting the operating mode is incorrect. Permissible values for count mode: 000000 → Continuous count 000001 → Single-action count 000010 → Periodical count Permissible values for measurement mode: 100000 → Frequency measurement 100001 → Revolutions measurement 100010 → Period duration measurement
measurement mode	7	This message is always shown in conjunction with other diagnostics messages and indicates that messages refer to an active measurement mode.

6.1.3 Guide to setting the high and low words

Setting the lower and upper limit

The **lower count limit** is divided as follows
(range: -2 147 483 648 (-231) to 0) in a High and a Low word:

Convert your decimal count limit to hexadecimal format.

- Example:
- The lower count limit is to be -123 456. This decimal value is represented in hexadecimal format (double word) as FFFE 1DC0.
- The hexadecimal value (double word) is divided into a High word (FFFE) and a Low word (1DC0). Both these values must be converted from hexadecimal to decimal values as many controllers only accept decimal values for setting parameters.
- Due to the fact that many tools and PCs can only process hexadecimal values in unsigned format during the conversion from hexadecimal to decimal values (i.e. bit 15 is not interpreted as a sign bit but as a value), negative values (bit 15 = 1) must be converted manually.
- The following applies to the Low word:
  If bit 15 is not set, the Low word is converted to the corresponding positive decimal value.
- In the example:
  Low word (hexadecimal): 1DC0

Low word (binary): 0001 111 1100 0000

Bit 0:	2^0	= 1	x 0 = 0
Bit 1:	2^1	= 2	x 0 = 0
Bit 2:	2^2	= 4	x 0 = 0
Bit 3:	2^3	= 8	x 0 = 0
Bit 4:	2^4	= 16	x 0 = 0
Bit 5:	2^5	= 32	x 0 = 0
Bit 6:	2^6	= 64	x 1 = 64
Bit 7:	2^7	= 128	x 1 = 128
Bit 8:	2^8	= 256	x 1 = 256
Bit 9:	2^9	= 512	x 0 = 0
Bit 10:	2^{10}	= 1024	x 1 = 1024
Bit 11:	2^{11}	= 2048	x 1 = 2048
Bit 12:	2^{12}	= 4096	x 1 = 4096
Bit 13:	2^{13}	= 8192	x 0 = 0
Bit 14:	2^{14}	= 16384	x 0 = 0
Bit 15:	2^{15}	= 32768	x 0 = 0

Low word (decimal): 7 616

- If bit 15 is set, the reciprocal value is formed. This procedure is described in the following for the High word.
- The same principle applies to the High word:
- If bit 15 is not set, the High word is converted to the correponding positive decimal value.
- If bit 15 is set, the reciprocal value of the hexadecimal value is formed:

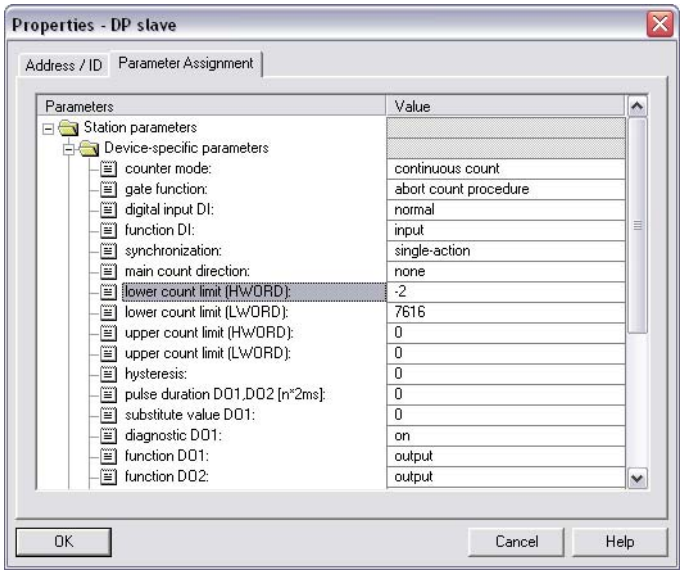
  The high word (hex) is subtracted from the hexadecimal value FFFF. 1 is added to the result.

  Example:
  FFFF - FFFE = 0001
  0001 + 1 = 0002
  This value is converted to the corresponding decimal value:

  In the example:
  0002 is converted to 2
  The result will be negative, as bit 15 is set in the High word (hex) (FFFE in signed format).
- You receive as a decimal value for FFFE: -2

- In the example:
  High word (hexadecimal): FFFE
  High word (binary): 1111 1111 1111 1110
  High word (decimal): -2
- The calculated values are entered in the appropriate entry lines of the parameter mask for the BL20 counter module (count mode).

Figure 6-1: Entering the lower count limit as a High and Low word (dez.)



The **upper count limit** is divided as follows
(range: 0 to +2 147 483 647 (231-1)) in a High and a Low word:

- Convert your decimal count limit to hexadecimal format. The upper count limit is always a positive value.
- Example:
  The upper count limit is to be 12 345 678. This decimal value is represented in hexadecimal format (double word) as 00BC 614E.
- The hexadecimal value (double word) is divided into a High word (00BC) and a Low word (614E).
- The Low value is converted to a decimal value:
- In the example:
  Low word (hexadecimal): 614E

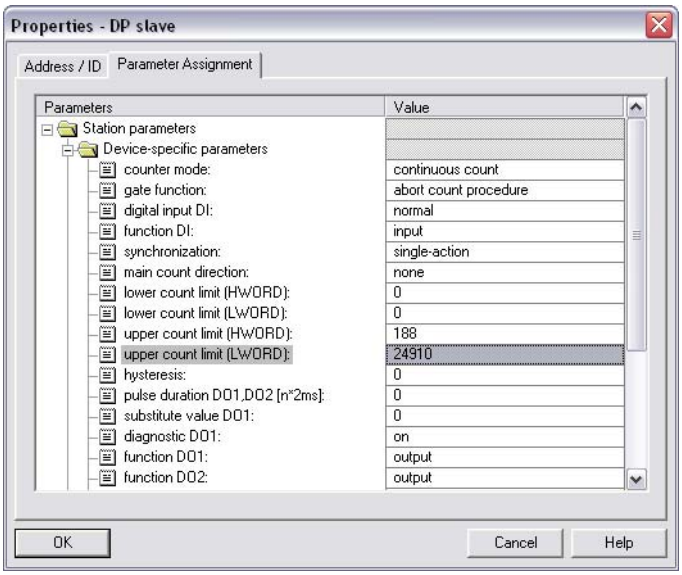
Low word (binary): 0110 0001 0100 1110

Bit 0:	2^0	= 1	x 0 = 0
Bit 1:	2^1	= 2	x 1 = 2
Bit 2:	2^2	= 4	x 1 = 4
Bit 3:	2^3	= 8	x 1 = 8
Bit 4:	2^4	= 16	x 0 = 0
Bit 5:	2^5	= 32	x 0 = 0
Bit 6:	2^6	= 64	x 1 = 64
Bit 7:	2^7	= 128	x 0 = 0
Bit 8:	2^8	= 256	x 1 = 256
Bit 9:	2^9	= 512	x 0 = 0
Bit 10:	2^{10}	= 1024	x 0 = 0
Bit 11:	2^{11}	= 2048	x 0 = 0
Bit 12:	2^{12}	= 4096	x 0 = 0
Bit 13:	2^{13}	= 8192	x 1 = 8192
Bit 14:	2^{14}	= 16384	x 1 = 16384
Bit 15:	2^{15}	= 32768	x 0 = 0

Low word (decimal): 24 910

- The same principle applies to the High word:
- In the example:
  High word (hexadecimal): 00BC
  High word (binary): 0000 0000 1011 1100
  High word (decimal): 188
- The calculated values are entered in the appropriate entry lines of the parameter mask for the BL20 counter module (count mode).

Figure 6-2: Entering the upper count limit as a High and Low word (dez.)



6.1.4 Setting the lower and upper measuring limits

The lower measuring limit is divided as follows into a High and a Low word:

- Convert your decimal measuring limit to hexadecimal format.
- Example:
  The lower measuring limit is to be 654 321. This decimal value is represented in hexadecimal format (double word) as 0009 FBF1.
- The hexadecimal value (double word) is divided into a High word (0009) and a Low word (FBF1).
- The Low value is converted to a decimal value:
- In the example:
  Low word (hexadecimal): FBF1

Low word (binary): 1111 1011 1111 0001

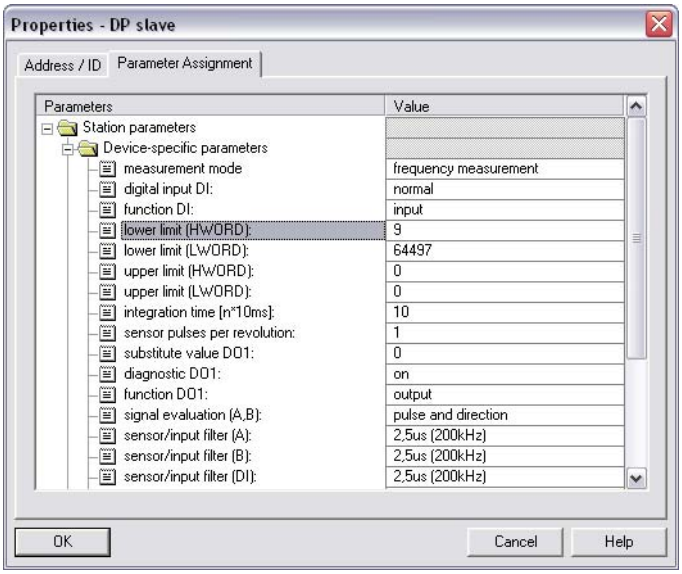
Bit 0:	2^0	= 1	x 1 = 1
Bit 1:	2^1	= 2	x 0 = 0
Bit 2:	2^2	= 4	x 0 = 0
Bit 3:	2^3	= 8	x 0 = 0
Bit 4:	2^4	= 16	x 1 = 16
Bit 5:	2^5	= 32	x 1 = 32
Bit 6:	2^6	= 64	x 1 = 64
Bit 7:	2^7	= 128	x 1 = 128
Bit 8:	2^8	= 256	x 1 = 256
Bit 9:	2^9	= 512	x 1 = 512
Bit 10:	2^{10}	= 1024	x 0 = 0
Bit 11:	2^{11}	= 2048	x 1 = 2048
Bit 12:	2^{12}	= 4096	x 1 = 4096
Bit 13:	2^{13}	= 8192	x 1 = 8192
Bit 14:	2^{14}	= 16384	x 1 = 16384
Bit 15:	2^{15}	= 32768	x 1 = 32768

Low word (decimal): 64 497

- The same principle applies to the High word:
- In the example:
  High word (hexadecimal): 0009
  High word (binary): 0000 0000 0000 1001
  High word (decimal): 9

- The calculated values are entered in the appropriate entry lines of the parameter mask for the BL20 counter module (measurement mode).

Figure 6-3: Entering the lower measuring limit as a High and Low word (dez.)



The **upper measuring limit** is divided as follows into a High and a Low word:

- Convert your decimal measuring limit to hexadecimal format.
- Example:
  The upper measuring limit is to be 782 955. This decimal value is represented in hexadecimal format (double word) as 000B F26B.
- The hexadecimal value (double word) is divided into a High word (000B) and a Low word (F26B).
- The Low value is converted to a decimal value:
- In the example:
  Low word (hexadecimal): F26B

Low word (binary): 1111 0010 0110 1011

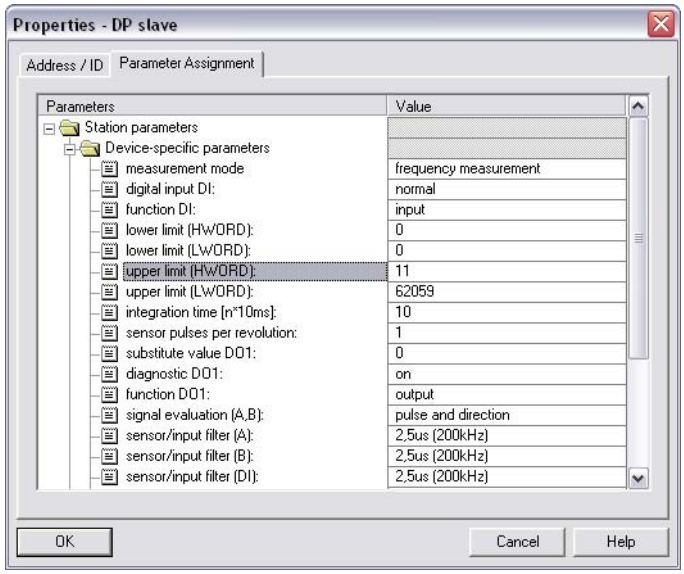
Bit 0:	2^0	= 1	x 1 = 1
Bit 1:	2^1	= 2	x 1 = 2
Bit 2:	2^2	= 4	x 0 = 0
Bit 3:	2^3	= 8	x 1 = 8
Bit 4:	2^4	= 16	x 0 = 0
Bit 5:	2^5	= 32	x 1 = 32
Bit 6:	2^6	= 64	x 1 = 64
Bit 7:	2^7	= 128	x 0 = 0
Bit 8:	2^8	= 256	x 0 = 0
Bit 9:	2^9	= 512	x 1 = 512
Bit 10:	2^{10}	= 1024	x 0 = 0
Bit 11:	2^{11}	= 2048	x 0 = 0
Bit 12:	2^{12}	= 4096	x 1 = 4096
Bit 13:	2^{13}	= 8192	x 1 = 8192
Bit 14:	2^{14}	= 16384	x 1 = 16384
Bit 15:	2^{15}	= 32768	x 1 = 32768

Low word (decimal): 62 059

- The same principle applies to the High word:
- In the example:
  High word (hexadecimal): 000B
  High word (binary): 0000 0000 0000 1011
  High word (decimal): 11

- The calculated values are entered in the appropriate entry lines of the parameter mask for the BL20 counter module (measurement mode).

Figure 6-4: Entering the upper measuring limit as a High and Low word



6.2 Integration of the RS232 module BL20-1RS232

6.2.1 Data image

Process input data (PDin)

The incoming data are stored in the receive-buffer of the BL20-1RS232 module, segmented and transferred to the PLC via the module bus and the gateway.

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

- 6 byte user data
- 1 byte diagnostic data
- 1 status byte, used to guarantee error free data-transmission.

Figure 6-5: Process input data

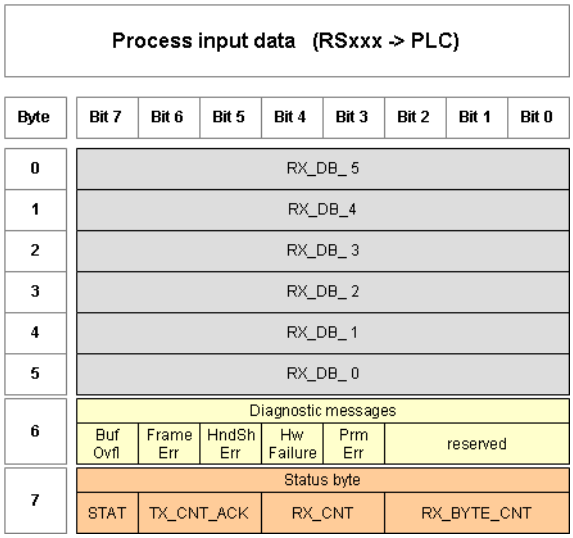


Table 6-16: Meaning of the data bits (process input)

Designation	Value	Meaning
BufOvfl; FrameErr; HndShErr; HwFailure; PrmErr	0 - 255	Diagnostic information (correspond to the diagnostic information in the diagnosis telegram). These diagnostics are always displayed and independent to the setting of the parameter „Diagnostics".
STAT	0-1	1: The communication with the data terminal equipment (DTE) is error free 0: The communication with the data terminal equipment (DTE) is disturbed. A diagnosis message is generated if the parameter „Diagnostics" is set to „0/ release". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.

Table 6-16: Meaning of the data bits (process input)

Designation	Value	Meaning
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. TX_CNT has been transmitted together with the last data segment of the process output data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with 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.

Process output data (PDout)

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

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

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

- 6 byte user data
- 1 byte containing signals to flush the transmit- and receive buffer.
- 1 control byte, used to guarantee error free data-transmission.

Figure 6-6: Process output data

Proces output data (PLC -> RSxxx)

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	TX_DB_5							
1	TX_DB_4							
2	TX_DB_3							
3	TX_DB_2							
4	TX_DB_1							
5	TX_DB_0							
6	Reset of RX_- and TX_buffer							
	reserved						RXBUF FLUSH	TXBUF FLUSH
7	Control byte							
	STAT-RES	RX_CNT_ACK			TX_CNT		TX_BYTE_CNT	

Table 6-17: Meaning of the data bits (process output)	**Designation**	**Value**	**Meaning**
	RXBUF FLUSH	0 - 1	This bit is used to flush the receive-buffer. If STATRES = 1: The command RXBUF FLUSH = 1 is ignored. If STATRES = 0: RXBUF FLUSH = 1 causes the flushing of the receive-buffer.
	TXBUF FLUSH	0-1	This bit is used to flush the transmit-buffer. If STATRES = 1: The command TXBUF FLUSH = 1 is ignored. If STATRES = 0: TXBUF FLUSH = 1 causes the flushing of the tranceive-buffer.
	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. Flushing the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is possible. If this bit is 1 or with the change from 0 to 1, the flushing of the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is not possible.
	RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. TX_CNT has been transmitted together with the last data segment of the process input data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with RX_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 user data in this data segment. In PROFIBUS-DP, the data segments contain a maximum number of 6 bytes of user data.

6.3 Integration of the RS485/422 module BL20-1RS485/422

6.3.1 Data image

Process input data (PDin)

The incoming data are stored in the receive-buffer of the BL20-1RS485/422 module, segmented and transferred to the PLC via the module bus and the gateway.

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

- 6 byte user data
- 1 byte diagnostic data
- 1 status byte, used to guarantee error free data-transmission.

Figure 6-7: Process input data

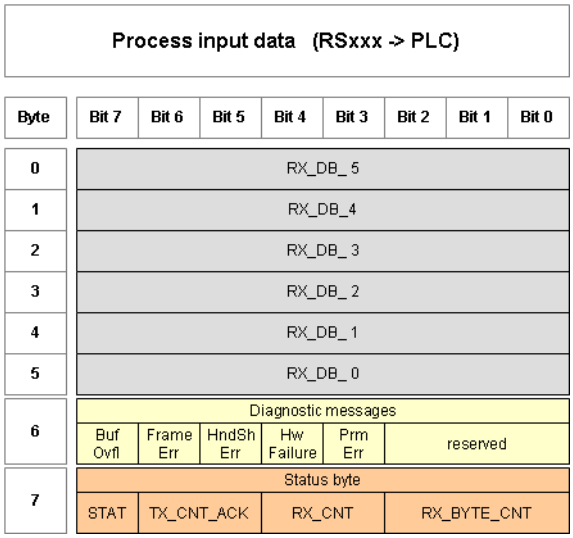


Table 6-18: Meaning of the data bits (process input)

Designation	Value	Meaning
BufOvfl; FrameErr; HndShErr; HwFailure; PrmErr	0 - 255	Diagnostic information (correspond to the diagnostic information in the diagnosis telegram). These diagnostics are always displayed and independent to the setting of the parameter „Diagnostics".
STAT	0-1	1: The communication with the data terminal equipment (DTE) is error free 0: The communication with the data terminal equipment (DTE) is disturbed. A diagnostic message is generated if the parameter „Diagnostics" is set to „0/ release". The diagnostic data show the cause of the communication disturbance. The user has to set back this bit in the process output data by using STATRES.

Table 6-18: Meaning of the data bits (process input)

Designation	Value	Meaning
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. TX_CNT has been transmitted together with the last data segment of the process output data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with 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.

Process output data (PDout)

Process output data are data which are sent from the PLC via the gateway and the BL20-1RS485/422 module to a connected field device.

The data received from the PLC are loaded into the transmit- buffer in the BL20-1RS485/422 module.

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

- 6 byte user data
- 1 byte containing signals to flush the transmit- and receive buffer.
- 1 control byte, used to guarantee error free data-transmission.

Figure 6-8: Process output data

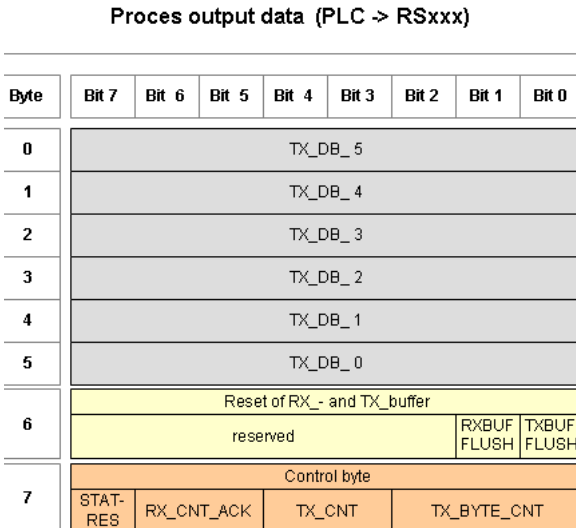


Table 6-19: Meaning of the data bits (process output)

Designation	Value	Meaning
RXBUF FLUSH	0 - 1	This bit is used to flush the receive-buffer. If STATRES = 1: The command RXBUF FLUSH = 1 is ignored. If STATRES = 0: RXBUF FLUSH = 1 causes the flushing of the receive-buffer.
TXBUF FLUSH	0-1	This bit is used to flush the transmit-buffer. If STATRES = 1: The command TXBUF FLUSH = 1 is ignored. If STATRES = 0: TXBUF FLUSH = 1 causes the flushing of the tranceive-buffer.
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. Flushing the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is possible. If this bit is 1 or with the change from 0 to 1, the flushing of the transmit-/ receive-buffer with RXBUF FLUSH/ TXBUF FLUSH is not possible.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. TX_CNT has been transmitted together with the last data segment of the process input data. TX_CNT_ACK is an acknowledge for the successful transmission of the data segment with RX_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 user data in this data segment. In PROFIBUS-DP, the data segments contain a maximum number of 6 bytes of user data.

6.4 Integration of the SSI module BL20-1SSI

6.4.1 Data image

Process input data (PDin)

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

The process input data is the data that is transferred to the PLC from the BL20-1SS1 via a gateway.

This is transferred in an 8 byte format as follows:

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

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

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

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

Figure 6-9: Process input data

Process input data (SSI -> PLC)

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

Table 6-20: Meaning of the data bits (process input)

Designation	Value	Meaning
REG_RD_DATA	0... 2^{32}-1	Content of the register to be read if REG_RD_ABORT = 0. If REG_RD_ABORT = 1, then REG_RD_DATA = 0.
REG_RD_ABORT	0	The reading of the register stated at REG_RD_ADR was accepted and executed. The content of the register is located in the user data range (REG_RD_DATA Bytes 0-3).
	1	The reading of the register stated at REG_RD_ADR was not accepted.The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_RD_ADR	0...63	The reading of the register stated at REG_RD_ADR was not accepted.The user data range (REG_RD_DATA Bytes 0-3) is zero.
REG_WR_ACEPT	0	The writing of user data for process output to the register with the address stated at REG_WR_ADR in the process output data could not be executed.
	1	The writing of user process output data to the register with the address stated at REG_WR_ADR in the process output data was successfully completed.
REG_WR_AKN	0	No modification of the data in the register bank by process output, i.e. REG_WR = 0. A write job would be accepted with the next telegram of process output data. (handshake for data transmission to the register.)
	1	A modification of the register contents by a process output was initiated, i.e. REG_WR = 1. A write job would not be accepted with the next telegram of process output data.
SSI_STS3	0	These four bits transfer the status bits of the SSI encoder with the status messages of the SSI module. With some SSI encoders, the status bits are transferred together with the position value.
	1	
SSI_STS2	0	
	1	
SSI_STS1	0	
	1	
SSI_STS0	0	
	1	
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.

Table 6-20: Meaning of the data bits (process input)

Designation	Value	Meaning
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
REL_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) ?≥ (REG_CMP2)
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.
STS_CMP2	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP2)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP2)
REL_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_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 when CLR_CMP1 = 1 in the process output data.
STS_CMP1	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≠ (REG_CMP1)
	1	A comparison of the register contents has produced the following result: (REG_ SSI_POS) = (REG_CMP1)
STS_STOP	0	The SSI encoder is read cyclically.
	1	Communication with the SSI encoder is stopped as STOP = 1 (process output) or ERR_PARA = 1.
ERR_PARA	0	The parameter set of the module has been accepted.
	1	Operation of the module is not possible with the present parameter set.

Table 6-20: Meaning of the data bits (process input)

Designation	Value	Meaning
STS_UFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≥ (REG_LOWER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) < (REG_LOWER_LIMIT)
STS_OFLW	0	A comparison of the register contents has produced the following result: (REG_SSI_POS) ≤ (REG_UPPER_LIMIT)
	1	A comparison of the register contents has produced the following result: (REG_SSI_POS) > (REG_UPPER_LIMIT)
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty. (e.g. due to a cable break).
SSI_DIAG	0	No enabled status signal is active (SSI_STSx = 0).
	1	At least one enabled status signal is active (SSI_STSx = 1).

Process output data (PDout)

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

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

This is transferred in an 8 byte format as follows:

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

Figure 6-10: Process output data

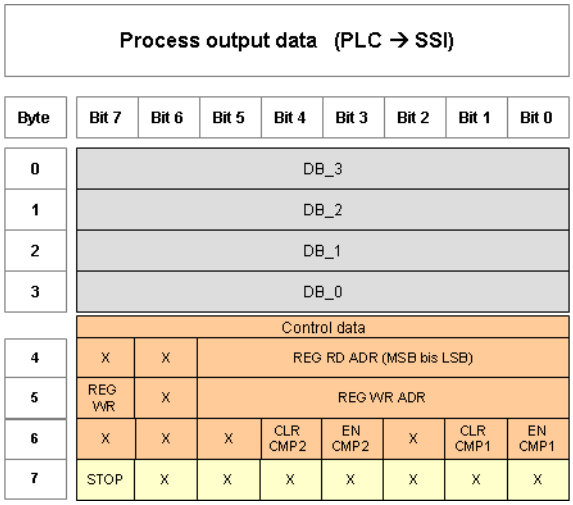


Table 6-21: Meaning of the data bits (process output)

Designation	Value	Meaning
REG_WR_DATA	0... 2^{32}-1	Value to be written to the register with the address stated at REG_WR_ADR.
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 4 – 7).
REG_WR	0...63	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 ith the address stated at REG_WR_ADR with REG_WR_DATA.
REG_WR_ADR	0...63	Address of the register to be written with REG_WR_DATA.

Table 6-21: Meaning of the data bits (process output)

Designation	Value	Meaning
CLR_CMP2	0	Default status, i.e. no reset of FLAG_CMP2 active.
	1	Reset of FLAG_CMP2 active
EN_CMP2	0	Default status, i.e. the data bits REL_CMP2, STS_CMP2 and FLAG_CMP2 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP2,STS_CMP2 and FLAG_CMP2 have a value based on the result of the comparison with the SSI encoder value.
CLR_CMP1	0	Default status, i.e. reset of FLAG_CMP1 not active.
	1	Reset of FLAG_CMP1 active
EN_CMP1	0	Default status, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 always have the value 0, irrespective of the actual SSI encoder value.
	1	Comparison active, i.e. the data bits REL_CMP1, STS_CMP1 and FLAG_CMP1 have a value based on the result of the comparison with the SSI encoder value.
STOP	0	Request to read the SSI encoder cyclically
	1	Request to interrupt communication with the encoder

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

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

6.5.1 Data mapping under PROFIBUS-DP

Process input

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

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

Table 6-22: Data structure

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

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

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

Table 6-23: Process input for i SWIRE-DIL

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

The following table shows the meaning of the data bits:

Table 6-24: Data bits

Designation	Status	Comment	
SIx		Switch status, relay x	
		SIx supplies the switch status of the contactor coil of the SWIRE bus slave as a feedback signal. SIx makes it possible to check whether the set switch status was executed by a mechanical connection. This must take into account the time delay between the setting of an output, a mechanical execution and the subsequent feedback signal.	
0	Off	Off	Contactor coil is switched off
1	On	On	Contactor coil is switched on
PKZSTx		Switch status, PKZ x	
0	Off	Off	The motor-protective circuit-breaker is off or has tripped
1	On	On	The motor-protective circuit-breaker is switched on
SDx		Communication error, slave x	
		Setting the NDDIAG parameter copies the slave diagnostics message (input byte 1 / bit 3) to the feedback interface. The information is provided as status information in the PLC for the user.	
0	ON LINE	ON LINE	Status of slave x: Everything o.k.
1	OFF LINE	OFF LINE	Status of slave x: Slave diagnostics message present

Process output

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

- Switch status of contactor coil on/off

Table 6-25: Data structure

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

The data of SWIRE slave 1 is the data of the first physical slave on the SWIRE bus. The remaining slaves are assigned in the same way. The meaning of the data of an SWIRE slave depends on the product concerned.

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

Table 6-26: Process output for SWIRE-DIL

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

The following table shows the meaning of the data bits:

Table 6-27: Data bits

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

Diagnostics

Diagnostics data contains the error messages for the higher-level system that are related to operation and application.

The diagnostics indication mode for the PROFIBUS-DP gateway can be set in two ways with the "Gateway diagnostics" parameter. "Devices, ID, Channel diagnostics" selects a more detailed diagnostics indication. The diagnostics message then consists of:

- 2 bytes of gateway diagnostics (device-related diagnostics)
- 64 bits of ID-specific diagnostics
- n ∞ 3 bytes channel-specific diagnostics (n: number of channels with active diagnostics)

The channel specific diagnostics indication enables the name of the error type to be displayed in plain text (e.g. Parameter error) through the use of an error number.

When "Device-related Diagnostics" is selected, an abbreviated diagnostics message is generated that simply shows the gateway diagnostics (device-related diagnostics). The diagnostics bytes of all station modules are attached that support diagnostics.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	GENE-RAL$_{ERR}$	U_{SWERR}	free	COM_{ERR}	free	RDY_{ERR}	free	SW_{ERR}
Byte 2	free	U_{AUXERR}	TYP_{ERR}	free	PKZ_{ERR}	free	SD_{ERR}	free
TYP_{ERR} field								
Byte 3	TYP_{ERR}S8	TYP_{ERR}S7	TYP_{ERR}S6	TYP_{ERR}S5	TYP_{ERR}S4	TYP_{ERR}S3	TYP_{ERR}S2	TYP_{ERR}S1
Byte 4	TYP_{ERR} S16	TYP_{ERR} S15	TYP_{ERR} S14	TYP_{ERR} 13	TYP_{ERR} S12	TYP_{ERR} S11	TYP_{ERR} S10	TYP_{ERR}S9
Slave diagnostics bit field								
Byte 5	SD_{ERR}S8	SD_{ERR}S7	SD_{ERR}S6	SD_{ERR}S5	SD_{ERR}S4	SD_{ERR}S3	SD_{ERR}S2	SD_{ERR}S1
Byte 6	SD_{ERR}S16	SD_{ERR}S15	SD_{ERR}S14	SD_{ERR}S13	SD_{ERR}S12	SD_{ERR}S11	SD_{ERR}S10	SD_{ERR}S9
PKZ field								
Byte 7	PKZ_{ERR}S8	PKZ_{ERR}S7	PKZ_{ERR}S6	PKZ_{ERR}S5	PKZ_{ERR}S4	PKZ_{ERR}S3	PKZ_{ERR}S2	PKZ_{ERR}S1
Byte 8	PKZ_{ERR}S 16	PKZ_{ERR}S 15	PKZ_{ERR} S14	PKZ_{ERR} S13	PKZ_{ERR} S12	PKZ_{ERR} S11	PKZ_{ERR} S10	PKZ_{ERR}S9

The following table shows the meaning of the diagnostics bits:

Table 6-28: Meaning of diagnostics data bits

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

Table 6-28: Meaning of diagnostics data bits

Designation	Value	Meaning	
Byte 1			
COM_{ERR}	Communication SWIRE		
	A communication error is present, such as a slave is no longer reached, its internal timeout has elapsed or communication is faulty. The master cannot carry out data exchange with at least one slave.		
	0	OK	Error
	1	faulty	No error.
U_{SWERR}	Voltage U_{SW}		
	Voltage fault in U_{SW}, voltage U (17 VDC) for supplying the SWIRE slaves		
	0	OK	No error present.
	1	Undervoltage	An error is present
GENE-RAL_{ERR}	Error message		
	The creation of a function block shows that systems / function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.		
	0	None	No diagnostics message present
	1	Present	One/several diagnostics messages present
Byte 2			
SD_{ERR}	Communication SWIRE slave		
	If the parameter SD_{ERR}A is set for group diagnostics, this bit indicates an error as soon as only one slave on the bus sets its SD error bit.		
	0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1	faulty	Error
PKZ_{ERR}	Overcurrent protective circuit-breaker		
	If the parameter PKZ_{ERR}A is set for group diagnostics, this bit indicates an error as soon as only one PKZ of a slave has tripped.		
	0	OK	No PKZ has tripped or diagnostics function has been deactivated via the parameter setting.
	1	Tripping	At least one PKZ has tripped.
Byte 2			

Table 6-28: Meaning of diagnostics data bits

Designation	Value	Meaning	
$TYPE_{ERR}$	Configuration		
	If the $TYPE_{ERR}$A parameter is set for group diagnostics, this bit indicates an error as soon as the ACTUAL configuration of a slave does not match the SET configuration for this position.		
	0	OK	The ACTUAL configuration fully matches the SET configuration or diagnostics function has been deactivated via the parameter.
	1	faulty	The actual configuration does not fully match set configuration.
U_{AUXERR}	Voltage U_{AUX}		
	If the U_{AUXERR}A parameter is activated, U_{AUXERR} will generate an error message as soon as the power supply goes below the level at which the function of the relays is not guaranteed.		
	0	OK	Contactor supply voltage is o.k. (> 20 VDC) or diagnostics function has been deactivated via this parameter.
	1	Undervoltage	Contactor supply voltage is not o.k. (< 18 VDC).
Byte 3,4			
$TYPE_{ERR}$Sx	Device configuration, slave x		
	Info field for the individual indication of a configuration error as error message. If the $TYPE_{INFO}$A parameter has been set for single diagnostics, this bit field indicates the error, as soon as the ACTUAL configuration of the slave was not accepted and is therefore not enabled for data exchange. The diagnostics LED of the slave flashes.		
	0	OK	No configuration error is present and the slave is in data exchange mode or diagnostics function has been deactivated via the parameter setting.
	1	Incorrect	No configuration error present and the slave is NOT in data exchange mode
Byte 5,6			
SD_{ERR}Sx	Communication, slave x		
	Info field for the individual indication of the release of the slave diagnostics as error message. If the SD_{INFO}A is set for single diagnostics, this bit field indicates the error as soon as the slave diagnostic message of the slave Sx is triggered.		
	0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
	1	Offline	A diagnostics message is present.

Table 6-28: Meaning of diagnostics data bits

Designation	Value	Meaning
Byte 7,8		
$PKZ_{ERR}Sx$	Overcurrent protective circuit-breaker, slave x	
	Info field for the individual indication of the tripping of a motor-protective circuit-breaker (PKZ) as error message. If the $PKZ_{INFO}A$ is set for single diagnostics, this bit field indicates the error as soon as the PKZ of the slave Sx has tripped.	
	0 OK	The PKZ of the slave has not tripped or diagnostics function has been deactivated via the parameter setting.
	1 Tripped	The PKZ of the slave has tripped.

Note

The error messages UAUXERR, TYPEERR, TYPEERRSx, PKZERR, PKZERRSx, SDERR and SDERRSx can be deactivated via the parameter setting.

Parameter

Parameters must be assigned to the module for correct operation of the application and in order to make it functional.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	reserved	free	free	free	MNA	Configuration	Disable Cfg	free
Byte 2	free	U_{AUXERR}	TYP_{ERR}	TYP_{INFO}	PKZ_{ERR}	PKZ_{INFO}	SD_{ERR}	SD_{INFO}
Byte 3	reserved							
Byte 4	Lifeguarding time							
Byte 5	$SD_{DIAG}S8$	$SD_{DIAG}S7$	$SD_{DIAG}S6$	$SD_{DIAG}S5$	$SD_{DIAG}S4$	$SD_{DIAG}S3$	$SD_{DIAG}S2$	$SD_{DIAG}S1$
Byte 6	$SD_{DIAG}S16$	$SD_{DIAG}S15$	$SD_{DIAG}S14$	$SD_{DIAG}S13$	$SD_{DIAG}S12$	$SD_{DIAG}S11$	$SD_{DIAG}S10$	$SD_{DIAG}S9$
Byte 7	reserved							
Byte 8	reserved							
Byte 9 - 24	Type designation slave 1 - 16							

The following table shows the meaning of the parameter bits:

Table 6-29: Meaning of the parameter bits

Designation	Status	
Byte 1		
Disable Cfg	Automatic SWIRE configuration	
	Disabling of the acceptance of the physically present configuration as ACTUAL configuration on manual pushbutton actuation.	
	0 = Inactive **A**	The physically present configuration of the SWIRE bus is only accepted as the ACTUAL configuration by pressing the CFG button. The comparison with the SET configuration is then carried out
	1 = Active	The physically present configuration is automatically accepted as the ACTUAL configuration and then compared with the SET configuration.
Configuration	PLC configuration check	
	The configuration check parameter enables a comparison of the set and actual configuration based on the device ID.	
	0 = Active **A**	Configuration check based on device ID. Only SWIRE slaves with a device ID completely matching the set configuration are accepted on the bus
	1 = Inactive	All slaves are mapped in 4Bit INPUT / 4Bit OUTPUT without checking the device ID.
Byte 1		
MNA	Configuration check	
	If the ACTUAL configuration of the SWIRE bus does not match the SET configuration, the master only exchanges data with the correctly configured and functional slaves.	
	0 = Bus based **A**	No data exchange with a slave with an incomplete / incorrect configuration.
	1 =Slave based	The bus also goes into operation with the correctly configured slaves even if the configuration is incomplete. This means in position oriented addressing: All slaves detected by the daisy chain configuration with a position that matches the set configuration are started up. Slaves that do not match the set configuration are inactive.
Byte 2		
SD_{INFO}	Slave error field	

Table 6-29: Meaning of the parameter bits

Designation	Status	
	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.	
	0 = Active **A**	Single diagnostics is activated
	1 = Inactive	Single diagnostics is not activated
Byte 2		
SD_{ERR}	Group error - slave error	
	Activate slave diagnostics $SD_{ERR}Sx$. As soon as only one slave on the bus sets its error bit, this is indicated as a group error depending on the parameter setting.	
	0 = Active **A**	Group diagnostics is activated
	1 = Inactive	Group diagnostics is not activated
PKZ_{INFO}	PKZ error field	
	Activate slave diagnostics info field $PKZ_{ERR}Sx$. As soon as a slave on the bus clears its PKZ bit, this is indicated as an individual error depending on the parameter setting.	
	0 = Active **A**	Single diagnostics is activated
	1 = Inactive	Single diagnostics is not activated
PKZ_{ERR}	Group PKZ error field	
	Activate slave diagnostics $PKZ_{ERR}Sx$. As soon as only one slave on the bus clears its PKZ bit, this is indicated as an error depending on the parameter setting.	
	0 = Active **A**	Group diagnostics is activated
	1 = Inactive	Group diagnostics is not activated
$TYPE_{INFO}$	Configuration error field	
	As soon as a slave on the bus does not match the set configuration and therefore cannot be started, this is indicated as an individual error depending on the parameter set.	
	Active	Single diagnostics is activated
	Inactive	Single diagnostics is not activated
$TYPE_{ERR}$	Group configuration error field	
	Activate slave diagnostics $TYPE_{ERR}Sx$. As soon as only one slave on the bus is incorrectly configured, this is indicated as an error depending on the parameter setting.	
	Active	Group diagnostics is activated
	Inactive	Group diagnostics is not activated

Table 6-29: Meaning of the parameter bits

Designation	Status	
U_{AUXERR}	Error message -U_{AUX}-	
	Activate system diagnostics U_{AUXERR}. U_{AUXERR} will generate an error message as soon as the power supply goes below a level at which the function of the relays is not guaranteed.	
	Active	Error message U_{AUXERR} activated
	Inactive	Error message U_{AUXERR} not activated
Byte 3	reserved	
Reserved		
Byte 4		
Lifeguarding	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) 0xFF: Lifeguarding off	
Byte 5,6		
$SD_{DIAG}Sx$	Input bit communication error, slave x	
	Slave diagnostics message from Byte 1 / Bit 7 is accepted in the feedback interface as Bit4	
	Active	$SD_{DIAG}Sx$ is accepted
	Inactive	$SD_{DIAG}Sx$ is not accepted
Byte 7, 8	reserved	
Byte 9-24		
Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus	
	SWIRE-DIL-MTB (: 0xFF)	
	Basic setting (no slave)	

7 Guidelines for station planning

7.1 Random module arrangement

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

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

Note

The mixed usage of base modules with screw connections and base modules with tension clamp connections requires a further power supply module to be mounted. Thereby, it must be ensured that the base modules are fitted with the same connection technology (screw or tension clamp) as the power supply module.

7.1.1 Complete planning

The planning of a BL20 station should be thorough to avoid faults and increase operating reliability.

Attention

If there are more than two empty slots next to one another, the communication is interrupted to all following BL20 modules.

7.1.2 Maximum system extension

A BL20 station can consist of a gateway and a maximum of 74 modules in slice design (equivalent to 1 m in length of mounting rail including the end bracket and end plate). The maximum number of modules is less when using block modules (1 block module is equivalent to 8 modules in slice design). The following overview shows the maximum number of channels possible, on condition that the entire station is made up of that respective type of channel only:

Table 7-1: Maximum system extension, process data dependent

A*plus 1 Bus Refreshing module*
B*plus 2 Bus Refreshing module*
C*plus 3 Bus Refreshing module*
D*plus 7 Bus Refreshing module*

Channels		**Modules**	
Type	Max. No.	Type	Max. no.
Digital inputs	288	BL20-4DI-24VDC-P	72 **B**
Digital outputs	288	BL20-4DO-24VDC-0.5A-P	72 **B**
Analog inputs, current	144	BL20-2AI-I(0/4...20MA)	72 **B**
Analog inputs, voltage	144	BL20-2AI-U(-10/0...+10VDC)	72 **B**
Analog inputs, PT /Ni	144	BL20-2AI-PT/NI-2/3	72 **B**
Analog inputs, Thermocouple	144	BL20-2AI-THERMO-PI	72 **B**
Analog inputs, voltage/current	288	BL20-4AI-U/I	72 **B**
Analog outputs, current	144	BL20-2AO-I(0/4...20MA)	72 **B**
Analog inputs, voltage	144	BL20-2AO-U(-10/0...+10VDC)	72 **B**
Counter	72	BL20-1CNT-24VDC	72 **B**
RS232	67	BL20-1RS232	67 **D**
RS485/422	71	BL20-1RS485/422	71 **C**
SSI	72	BL20-1SSI	72 **B**
SWIRE	71	BL20-E-1SWIRE	71 **C**

Further limitations can be placed on the maximum possible number of BL20 modules by the use of the Power Feeding modules
BL20-PF-24VDC-D or BL20-PF-120/230VAC-D; these being used either for creating potential groups or by insufficient field supply.

Attention

Ensure that a sufficient number of Power Feeding or Bus Refreshing modules are used if the system is extended to its maximum.

Note

If the system limits are exceeded, the software I/O-ASSISTANT generates an error message when the user activates the "Station → Verify" command.

7.2 Power supply

7.2.1 Module bus refreshing

The number of BL20 modules that can be supplied by the gateway or a separate Bus Refreshing module via the internal module bus depends on the respective nominal current consumption of the individual modules on the module bus.

Note

The sum total of the nominal current consumption of the connected BL20 modules must not exceed 1.5 A.

The following examples show the calculation for the required number of Bus Refreshing modules:

Example 1:

The BL20 station consists of 20 BL20-1AI-I(0/4...20MA) modules. The number of additional Bus Refreshing modules required is calculated as follows:

Gateway		430 mA
20 BL20-1AI-I(0/4...20MA)	20 x 41 mA	820 mA
	Total:	1250 mA
Maximum permissible current via module bus:		1 500 mA

The calculation shows that no further Bus Refreshing module is required.

Example 2:

The BL20 station comprises 15 BL20-1AI-U(-10/0...+10VDC) modules, 10 BL20-2AO-U(-10/0...+10VDC) modules,
10 BL20-2DI-24VDC-P modules and 5 BL20-2DO-24VDC-0.5A-P modules.
The required number of Bus Refreshing modules is calculated as follows:

Gateway		430 mA
15 BL20-1AI-U(-10/0...+10VDC)	15 x 41 mA	615 mA
10 BL20-2AO-U(-10/0...+10VDC)	10 x 43 mA	430 mA
10 BL20-2DI-24VDC-P	10 x 28 mA	280 mA
5 BL20-2DO-24VDC-0.5A-P	5 x 32 mA	160 mA
	Total:	1 915 mA
Maximum permissible current via module bus:		1 500 mA

The calculation shows that an additional/further Bus Refreshing module is required at the latest following the last BL20-2AO-U(-10/0…+10VDC) module. This Bus Refreshing module is sufficient to supply the remaining modules.

Note

The power requirements of the BL20 gateway is to be considered when calculating the required number of Bus Refreshing modules.

The following table offers an overview of the nominal current consumption of the individual BL20 modules on the module bus:

Table 7-2: Nominal current consumption of the BL20 modules on the module bus

Module	Supply	Nominal current consumption
Gateway	1 500 mA	430 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-E-8DI-24VDC-P		15 mA
BL20-16DI-24VDC-P		45 mA
BL20-E-16DI-24VDC-P		15 mA
BL20-32DI-24VDC-P		30 mA
BL20-1AI-I(0/4...20MA)		41 mA
BL20-2AI-I(0/4...20MA)		35 mA
BL20-1AI-U(-10/0...+10VDC)		41 mA
BL20-2AI-U(-10/0...+10VDC)		35 mA
BL20-2AI-PT/NI-2/3		45 mA
BL20-2AI-THERMO-PI		45 mA
BL20-4AI-U/I		50 mA
BL20-2DO-24VDC-0.5A-P		32 mA
BL20-2DO-24VDC-0.5A-N		32 mA

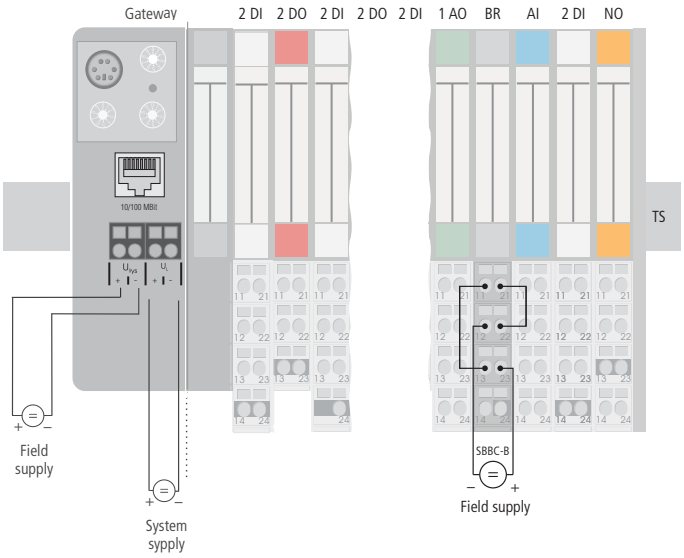
Module	Supply	Nominal current consumption
BL20-2DO-24VDC-2A-P		33 mA
BL20-4DO-24VDC-0.5A-P		30 mA
BL20-E-8DO-24VDC-P		30 mA
BL20-16DO-24VDC-0.5A-P		120 mA
BL20-E-16DO-24VDC-P		25 mA
BL20-32DO-24VDC-0.5A-P		30 mA
BL20-1AO-I(0/4...20MA)		39 mA
BL20-2AO-I(0/4...20MA)		40 mA
BL20-2AO-U(-10/0...+10VDC)		43 mA
BL20-2DO-R-NC		28 mA
BL20-2DO-R-NO		28 mA
BL20-2DO-R-CO		28 mA
BL20-1CNT-24VDC		40 mA
BL20-1RS232		140 mA
BL20-1RS485/422		60 mA
BL20-1SSI		50 mA
BL20-2RFID		30 mA
BL20-E-1SWIRE		60 mA

If the power supply from the module bus is not guaranteed, thereby making a further Bus Refreshing module necessary, the software
I/O-ASSISTANT generates an error message when the user activates the command "Station → Verify".

Note

Bus Refreshing modules which do not supply the gateway with power are to be combined with either a BL20-P3T-SBB-B or a BL20-P4T-SBBC-B (tension clamp connection) base module or with the base modules BL20-P3S-SBB-B or BL20-P4S-SBBC-B (screw connection).

Figure 7-1: Power supply of the station



It must be ensured that the same ground potential and ground connections are used. If different ground potentials or ground connections are used, compensating currents flow via the module bus, which can lead to the destruction of the Bus Refreshing module.

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

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

Attention

In order to comply with radiation limit values in accordance with EN 55 011/ 2 000, the supply lines of the BL20-BR-24VDC-D module for supplying the gateway with power are to be fed through a ferrite ring (PS416-ZBX-405). This is to be placed immediately next to the connection terminals. From there on, it is not permitted to make connections to further devices.

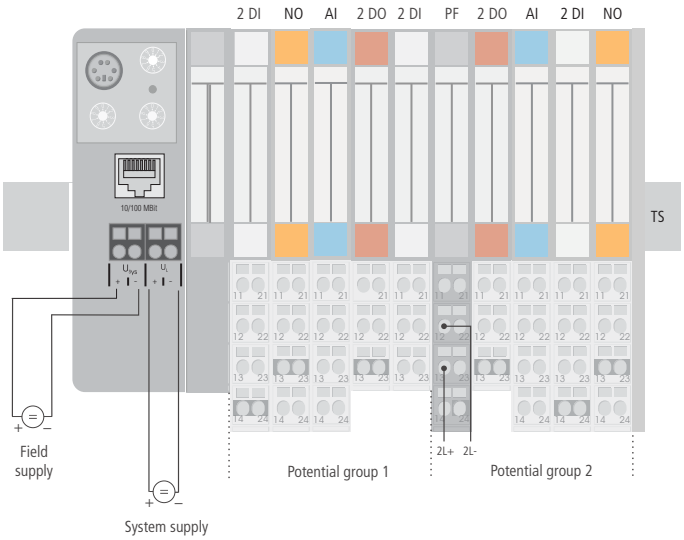
7.2.2 Creating potential groups

Bus Refreshing and Power Feeding modules can be used to create potential groups. The potential isolation of potential groups to the left of the respective power distribution modules is provided by the base modules.

Attention

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

Figure 7-2: Example for creating potential groups



Note

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

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

Attention

It is not permitted to use the modules with 24 V DC and 120/230 V AC field supply in a joint potential group.

7.2.3 Protecting the service interface on the gateway

During operation, the cover protecting the service interface and the hexadecimal rotary coding-switches must remain closed due to EMC and ESD.

7.2.4 C-rail (Cross Connection)

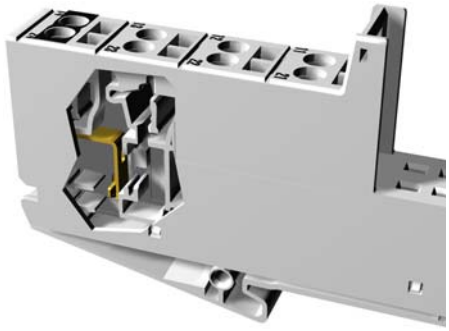
The C-rail runs through all base modules. The C-rail of the base modules for power distribution modules is mechanically separated; thus potentially isolating the adjoining supply groups.

Access to the C-rail is possible with the help of base modules with a C in their designation (for example, BL20-S4T-SBCS). The corresponding connection level is indicated on these modules by a thick black line. The black line is continuous on all I/O modules. On power distribution modules, the black line is

only above the connection 24. This makes clear that the C-rail is separated from the adjoining potential group to its left.

Figure 7-3:
C-rail front view

Figure 7-4:
C-rail side view



Danger

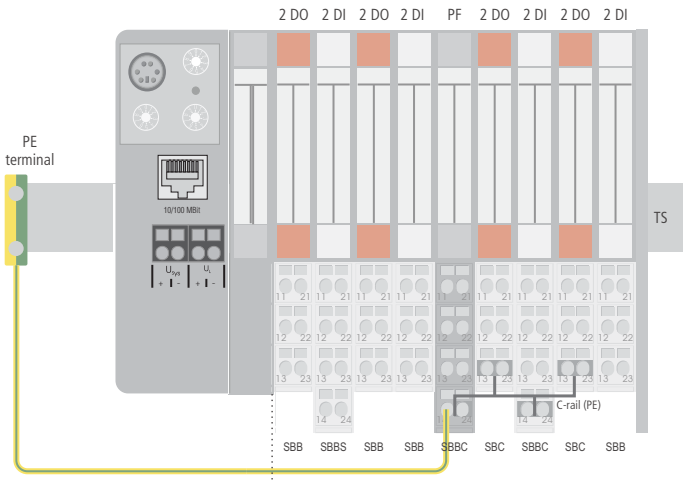
It is permitted to load the C-rail with a maximum of 24 V. Not 230 V!

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

Note

For information about introducing a BL20 station into a ground reference system, please read Chapter 7.

Figure 7-5: Using the C-rail as a protective earth

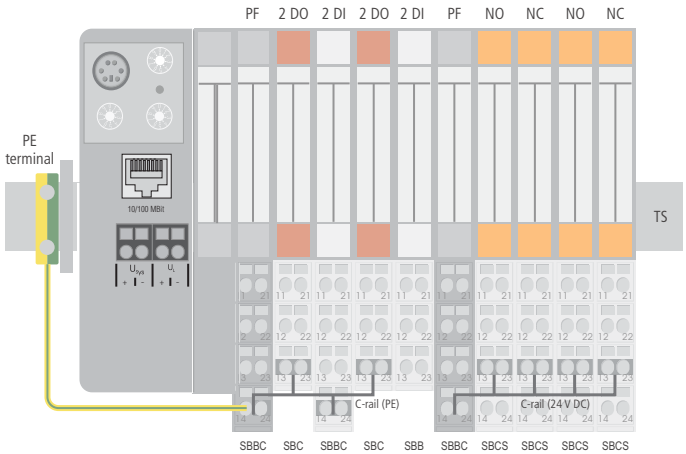


C-rails can be used for a common voltage supply when relay modules are planned. To accomplish this, the load voltage is connected to a Power Feeding module with the BL20-P4x-SBBC base module with tension clamp or screw connection. All the following relay modules are then supplied with power via the C-rail.

Attention

When relay modules are planned and the C-rail is used for a common voltage supply, a further power distribution module must be used for the potential isolation to the following modules. The C-rail can only again be used as a PE following potential isolation.

Figure 7-6: Using the C-rail as protective earth and for the power supply with relay modules



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

7.2.5 Direct wiring of relay modules

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

7.3 Plugging and pulling electronic modules

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

Attention

If the field and system supplies remain connected when electronic modules are plugged or pulled, short interruptions to the module bus communications can occur in the BL20 station. This can lead to undefined statuses of individual inputs and outputs of different modules.

7.4 Extending an existing station

Attention

Please note that extensions to the station (mounting further modules) should be carried out only when the station is in a voltage-free state.

7.5 Firmware download

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

Attention

The station should be disconnected from the fieldbus when downloading.

Firmware must be downloaded by authorized personnel only.

The field level must be isolated.

8 Guidelines for electrical installation

8.1 General notes

8.1.1 General

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

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

8.1.2 Cable routing

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

8.1.3 Cable routing inside and outside of cabinets

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

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

Group 1:

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

Group 2:

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

Group 3:

- unshielded cables for DC and AC voltages > 400 V

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

- **Group 1/Group 2**

The group combinations:

- **Group 1/Group 3 and Group 2/Group 3**

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

Cable routing outside buildings

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

Attention

Observe all valid guidelines concerning internal and external lightning protection and grounding specifications when routing cables outside of buildings.

8.1.4 Lightning protection

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

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

8.1.5 Transmission media

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

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

Note

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

The ordering information for the available cable types can be found under www.turck.com.

8.2 Potential relationships

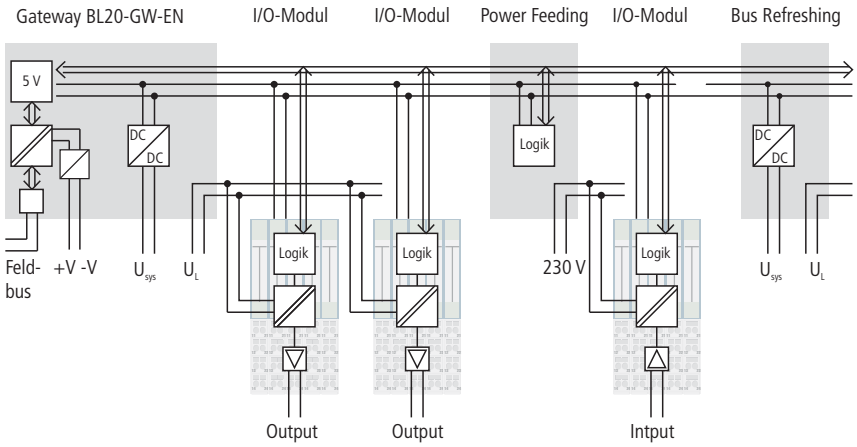
8.2.1 General

The potential relationship of a Ethernet system realized with BL20 modules is characterized by the following:

- The system supply of gateway and I/O-modules as well as the field supply are realized via one power feed at the gateway.
- All BL20 modules (gateway, Power Feeding and I/O-modules), are connected capacitively via base modules to the mounting rails.

The block diagram shows the arrangement of a typical BL20 station.

Figure 8-1: Block diagram of a BL20 station



8.3 Electromagnetic compatibility (EMC)

BL20 products comply in full with the requirements pertaining to EMC regulations.

Nevertheless, an EMC plan should be made before installation. Hereby, all potential electromechanical sources of interference should be considered such as galvanic, inductive and capacitive couplings as well as radiation couplings.

8.3.1 Ensuring electromagnetic compatibility

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

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

8.3.2 Grounding of inactive metal components

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

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

Danger

The grounding must never – including cases of error – take on a dangerous touch potential. For this reason, always protect the ground potential with a protective cable.

8.3.3 PE Connection

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

8.3.4 Mounting rails

All mounting rails must be mounted onto the mounting plate with a low impedance, over a large surface area, and must be correctly earthed.

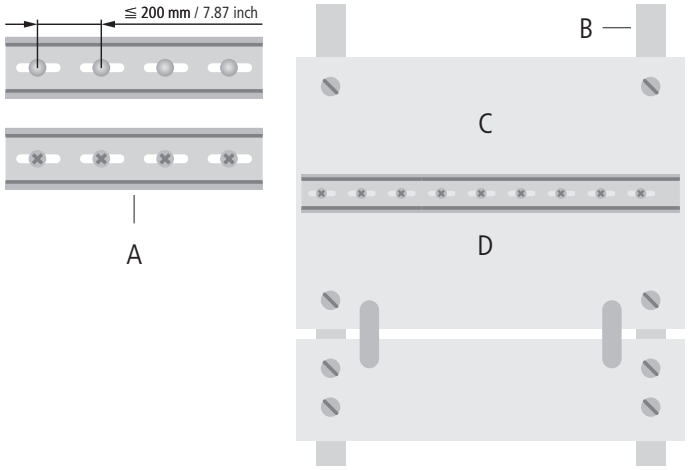


Figure 8-2: Mounting options

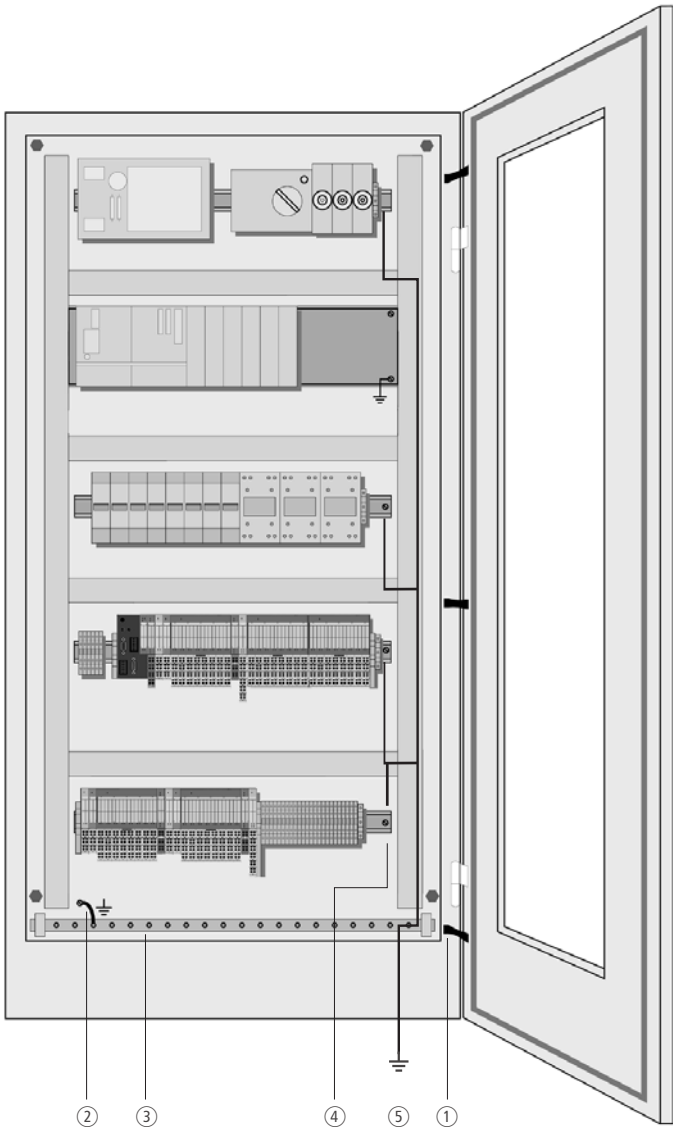
A*TS 35*
B*Mounting rail*
C*Mounting plate*

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

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

8.3.5 EMC compliant cabinet installation

Figure 8-3: EMC compliant cabinet installation



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

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

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

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

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

8.4 Shielding of cables

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

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

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

Attention

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

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

If the data cable is connected via a SUB-D connector, the shielding should never be connected via pin 1, but to the mass collar of the plug-in connector.

The insulation of the shielded data-cable should be stripped and connected to the shield rail when the system is not in operation. The connection and securing of the shield should be made using metal shield clamps. The shield clamps must enclose the shielding braid and in so doing create a large surface contact area. The shield rail must have a low impedance (for example, fixing points of 10 to 20 cm apart) and be connected to a reference potential area.

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

Note

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

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

8.5 Potential compensation

Potential differences can occur between installation components that are in separate areas and these

- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

A potential-compensation cable must be routed to the potential compensation.

Danger

Never use the shield as a potential compensation.

A potential compensation cable must have the following characteristics:

- Low impedance. In the case of compensation cables that are routed on both sides, the compensation line impedance must be considerably smaller than that of the shield connection (max. 10 % of shield connection impedance).
- Should the length of the compensation cable be less than 200 m, then its cross-section must be at least 16 mm^2 / 0.025 $inch^2$. If the cable length is greater than 200 m, then a cross-section of at least 25 mm^2 / 0.039 $inch^2$ is required.
- The compensation cable must be made of copper or zinc coated steel.
- The compensation cable must be connected to the protective conductor over a large surface area and must be protected against corrosion.
- Compensation cables and data cables should be routed as close together as possible, meaning the enclosed area should be kept as small as possible.

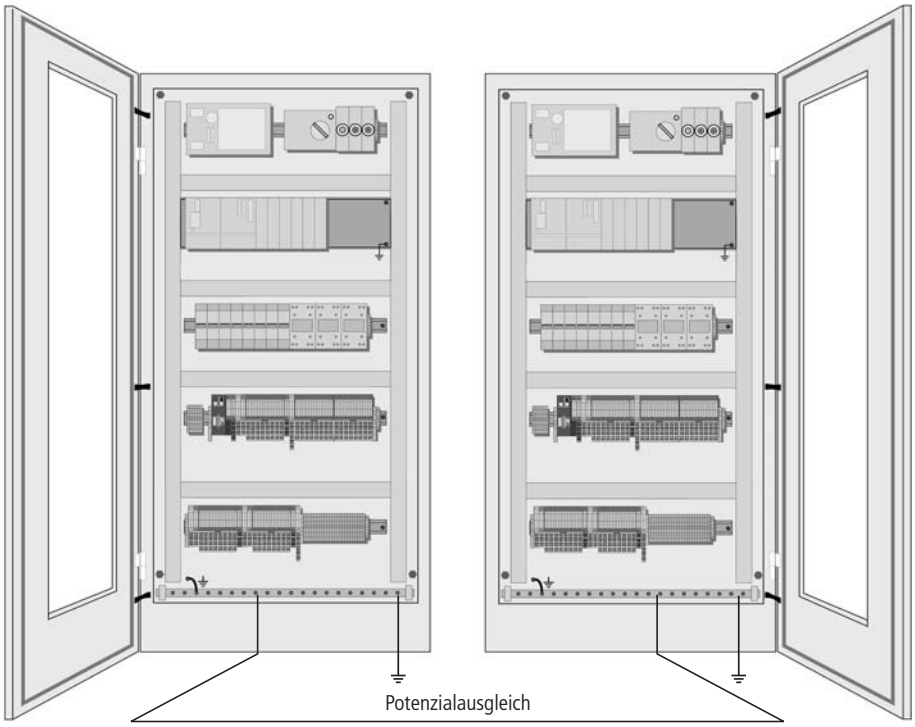


Figure 8-4: Potential compensation between switchgear cabinets

8.5.1 Switching inductive loads

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

8.5.2 Protection against electrostatic discharge (ESD

Attention

Electronic modules and base modules are at risk from electrostatic discharge when disassembled. Avoid touching the bus connections with bare fingers as this can lead to ESD damage.

9 BL20-Approvals for Zone 2/ Division 2

Note

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

10 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identification number of, e.g. a memory position, a system or a module within a network.

Addressing

Allocation or setting of an address, e. g. for a module in a network.

Analog

Infinitely variable value, e. g. voltage. The value of an analog signal can take on any value, within certain limits.

Automation device

A device connected to a technical process with inputs and outputs for control. Programmable logic controllers (PLC) are a special group of automation devices.

B

Baud

Baud is a measure for the transmission speed of data. 1 Baud corresponds to the transmission of one bit per second (Bit/s).

Baud rate

Unit of measurement for measuring data transmission speeds in Bit/s.

Bidirectional

Working in both directions.

Bus

Bus system for data exchange, e. g. between CPU, memory and I/O levels. A bus can consist of several parallel cables for data transmission, addressing, control and power supply.

Bus cycle time

Time required for a master to serve all slaves or stations in a bus system, i. e. reading inputs and writing outputs.

Bus line

Smallest unit connected to a bus, consisting of a PLC, a coupling element for modules on the bus and a module.

Bus system

All units which communicate with one another via a bus.

C

Capacitive coupling

Electrical capacitive couplings occur between cables with different potentials. Typical sources of interference are, for example, parallel-routed signal cables, contactors and electrostatic discharges.

Coding elements

Two-piece element for the unambiguous assignment of electronic and base modules.

Configuration

Systematic arrangement of the I/O modules of a station.

CPU

Central Processing Unit. Central unit for electronic data processing, the processing core of the PC.

D

Digital

A value (e. g. a voltage) which can adopt only certain statuses within a finite set, mostly defined as 0 and 1.

DIN

German acronym for German Industrial Standard.

E

EIA

Electronic Industries Association – association of electrical companies in the United States.

Electrical components

All objects that produce, convert, transmit, distribute or utilize electrical power (e. g. conductors, cable, machines, control devices).

EMC

Electromagnetic compatibility – the ability of an electrical part to operate in a specific environment without fault and without exerting a negative influence on its environment.

EN

German acronym for European Standard.

ESD

Electrostatic Discharge.

F

Field power supply

Voltage supply for devices in the field as well as the signal voltage.

Fieldbus

Data network on sensor/actuator level. A fieldbus connects the equipment on the field level. Characteristics of a fieldbus are a high transmission security and real-time behavior.

G

GND

Abbreviation of ground (potential „0").

Ground

Expression used in electrical engineering to describe an area whose electrical potential is equal to zero at any given point. In neutral grounding devices, the potential is not necessarily zero, and one speaks of the ground reference.

Ground connection

One or more components that have a good and direct contact to earth.

Ground reference

Potential of ground in a neutral grounding device. Unlike earth whose potential is always zero, it may have a potential other than zero.

GSD

Acronym for Electronic Device Data Sheet which contains standardized PROFIBUS DP station descriptions. They simplify the planning of the DP master and slaves. Default language is English.

H

Hexadecimal

System of representing numbers in base 16 with the digits 0... 9, and further with the letters A, B, C, D, E and F.

Hysteresis

A sensor can get caught up at a certain point, and then "waver" at this position. This condition results in the counter content fluctuating around a given value. Should a reference value be within this fluctuating range, then the relevant output would be turned on and off in rhythm with the fluctuating signal.

I

I/O

Input/output.

Impedance

Total effective resistance that a component or circuit has for an alternating current at a specific frequency.

Inactive metal components

Conductive components that cannot be touched and are electrically isolated from active metal components by insulation, but can adopt voltage in the event of a fault.

Inductive coupling

Magnetic inductive couplings occur between two cables through which an electrical current is flowing. The magnetic effect caused by the electrical currents induces an interference voltage. Typical sources of interference are for example, transformers, motors, parallel-routed network and HF signal cables.

Intelligent modules

Intelligent modules are modules with an internal memory, able to transmit certain commands (e. g. substitute values and others).

L

Load value

Predefined value for the counter module with which the count process begins.

Lightning protection

All measures taken to protect a system from damage due to overvoltages caused by lightning strike.

Low impedance connection

Connection with a low AC impedance.

LSB

Least Significant Bit

M

Mass

All interconnected inactive components that do not take on a dangerous touch potential in the case of a fault.

Master

Station in a bus system that controls the communication between the other stations.

Master/slave mode

Mode of operation in which a station acting as a master controls the communication between other stations in a bus system.

Module bus

The module bus is the internal bus in a BL20 station. The BL20 modules communicate with the gateway via the module bus which is independent of the fieldbus.

MSB

Most Significant Bit

Multi-master mode

Operating mode in which all stations in a system communicate with equal rights via the bus.

N

NAMUR

German acronym for an association concerned with standardizing measurement and control engineering. NAMUR initiators are special versions of the two-wire initiators. NAMUR initiators are characterized by their high immunity to interference and operating reliability, due to their special construction (low internal resistance, few components and compact design).

O

Overhead

System administration time required by the system for each transmission cycle.

P

PLC

Programmable Logic Controller.

Potential compensation

The alignment of electrical levels of electrical components and external conductive components by means of an electrical connection.

Potential free

Galvanic isolation of the reference potentials in I/O modules of the control and load circuits.

Potential linked

Electrical connection of the reference potentials in I/O modules of the control and load circuits.

PROFIBUS-DP

PROFIBUS bus system with DP protocol. DP stands for decentralized periphery. PROFIBUS-DP is based on DIN 19245 Parts 1 + 3 and has been integrated into the European fieldbus standard EN 50170.
It ensures a fast cyclic data exchange between the central DP master and the decentralized periphery devices (slaves). Its universal use is realized by the multi master concept.

PROFIBUS-DP address

Each PROFIBUS-DP module is assigned an explicit PROFIBUS-DP address, with which it can be queried by the master.

PROFIBUS-DP master

The PROFIBUS-DP master is the central station on the bus and controls access of all stations to PROFIBUS.

PROFIBUS-DP slave

PROFIBUS-DP slaves are queried by the PROFIBUS-DP master and exchange data with the master on request.

Protective earth

Electrical conductor for protection against dangerous shock currents. Generally represented by PE (protective earth).

R

Radiation coupling

A radiation coupling appears when an electromagnetic wave hits a conductive structure. Voltages and currents are induced by the collision. Typical sources of interference are for example, sparking gaps (spark plugs, commutators from electric motors) and transmitters (e. g. radio), that are operated near to conducting structures.

Reaction time

The time required in a bus system between a reading operation being sent and the receipt of an answer. It is the time required by an input module to change a signal at its input until the signal is sent to the bus system.

Reference potential

Potential from which all voltages of connected circuits are viewed and/or measured.

Repeater

The phase and the amplitude of the electric data signals are regenerated during the transmission process by the repeater.
Further, it is possible to change the topology of the PROFIBUS network. It can be extended considerably by means of the repeater.

Root-connecting

Creating a new potential group using a power distribution module. This allows sensors and loads to be supplied individually.

RS 485

Serial interface in accordance with EIA standards, for fast data transmission via multiple transmitters.

S

Serial

Type of information transmission, by which data is transmitted bit by bit via a cable.

Setting parameters

Setting parameters of individual stations on the bus and their modules in the configuration software of the master.

Shield

Conductive screen of cables, enclosures and cabinets.

Shielding

Description of all measures and devices used to join installation components to the shield.

Short-circuit proof

Characteristic of electrical components. A short-circuit proof part withstands thermal and dynamic loads which can occur at its place of installation due to a short circuit.

Station

A functional unit or I/O components consisting of a number of elements.

SUB-D connector

9-pin connector for connecting the fieldbus to the I/O-stations.

T

Terminating resistor

Resistor on both ends of a bus cable used to prevent interfering signal reflections and which provides bus cable matching. Terminating resistors must always be the last component at the end of a bus segment.

To ground

Connection of a conductive component with the grounding connection via a grounding installation.

Topology

Geometrical structure of a network or the circuitry arrangement.

U

UART

Universal Asynchronous Receiver/Transmitter. UART is a logic circuit which is used to convert an asynchronous serial data sequence to a parallel bit sequence or vice versa.

Unidirectional

Working in one direction.

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