

TURCK

Industrial
Automation

BL20 –
USER MANUAL

ECO -GATEWAY FOR PROFIBUS-DP





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Subject to alterations without notice

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighboring units that are live.
- Follow the engineering instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0 105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60 364-4-41 (VDE 0 100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60 204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).
- The electrical installation must be carried out in accordance with the relevant regulations (e. g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC 60 364 and HD 384 and national work safety regulations).
- All shrouds and doors must be kept closed during operation.

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1.1 Documentation Concept

This manual contains all information about the PROFIBUS-DP-gateway of the BL20 product series BL20-ECO (BL20-E-GW-DP).

The following chapters contain a short BL20 system description, a description of the fieldbus system PROFIBUS-DP, exact information about function and structure of the BL20-ECO gateway for PROFIBUS-DP 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 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-E-GW-DP. It has been specially conceived for personnel with the necessary qualifications.

1.2.1 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.

1.2.2 Notes Concerning Planning /Installation of this Product



Danger

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

1.3 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.

1.4 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	deleted
9	BL20-Approvals for Zone 2/ Division 2 → seperate manual D301255			X

Note

The publication of this manual renders all previous editions invalid.

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2.1 The Basic Concept

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

BL20 offers modules for practically all applications:

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

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

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

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



Note

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

Flexibility

All BL20 stations can be planned to accommodate the exact number of channels to suit your needs, because the modules are available with different numbers of channels in block and slice design.

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

Compactness

The slim design of the BL20 modules (standard gateway 50.4 mm / 1.98 inch, ECO gateway 34 mm/ 1.34 inch, standard slice 12.6 mm / 0.49 inch, ECO slice 13 mm / 0.51 inch and block 100.8 mm / 3.97 inch) and their low overall height favor the installation of this system in confined spaces.

Easy to handle

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

The gateway and the base modules are snapped onto a mounting rail. The electronics modules are plugged onto the appropriate base modules.

The base modules of the standard line are designed as terminal blocks. The wiring is secured by tension clamp or screw connection.

The electronics 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.

The ECO electronics modules combine base module and electronics module in one housing. All BL20-ECO modules can be used with the standard products with tension clamp connection technology.

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.

Figure 2-2: Gateway BL20-GWBR-PBDP



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 2-3: Power distribution module



2.2.3 Electronics Modules (Standard Product Line)

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

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

Figure 2-4: Electronics module in slice design

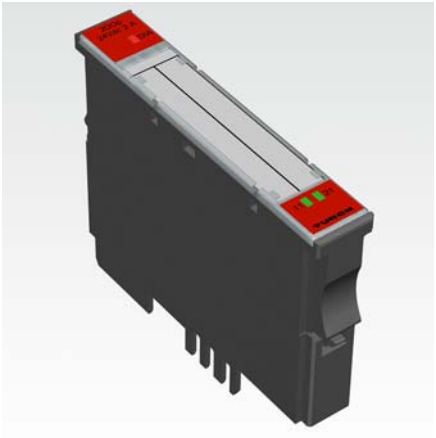
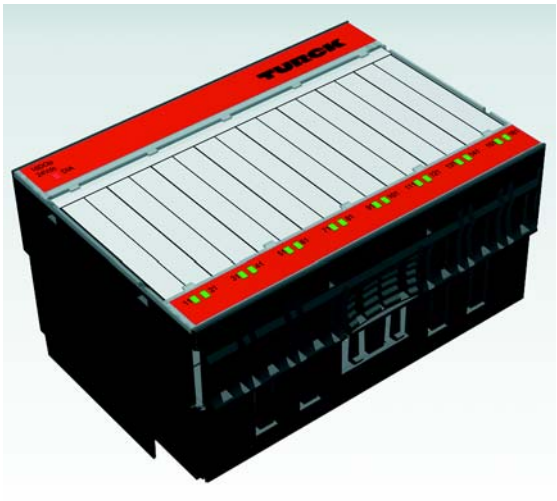


Figure 2-5: Electronics module in block design



2.2.4 ECO Electronics Modules

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

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

All advantages at a glance:

- Space saving thanks to 16 channels on 13 mm/ 0.51 inch width
- Cost saving thanks to electronics with integrated connection level
- High signal density
- Tool-less connection via "push-in" spring-type terminal technology for simple and fast mounting
- Simple assembly reduces error sources

Figure 2-6: ECO I/O module



2.2.5 Base Modules

At the standard electronics 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 × 2-/3-wire (4-channel).

Figure 2-7:
Base module with tension clamp connection

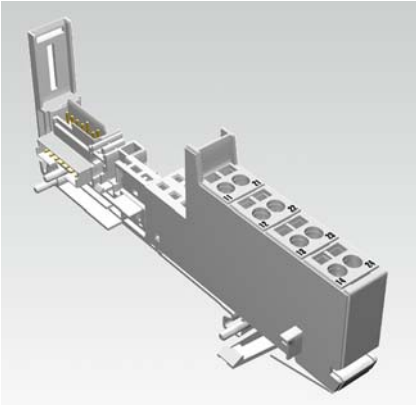


Figure 2-8:
Base module with screw connection

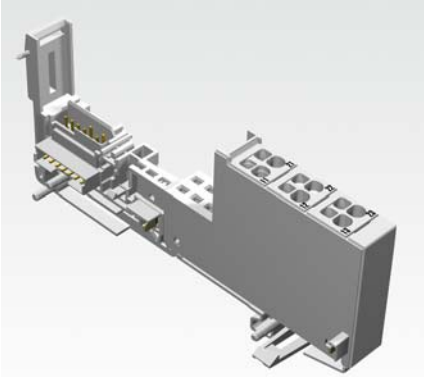
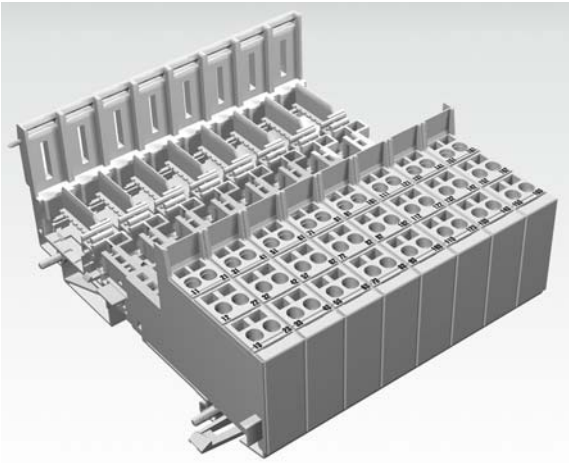


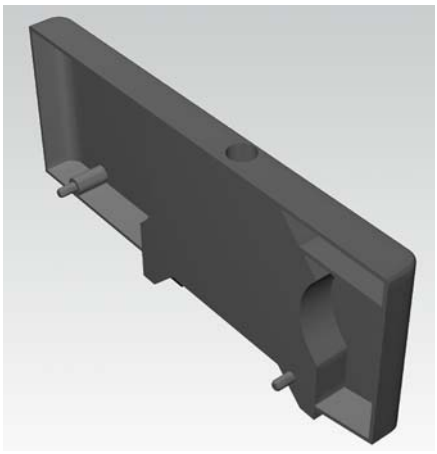
Figure 2-9:
Base module in block design



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.

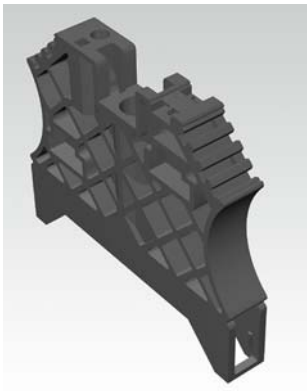
Figure 2-10: End plate



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.

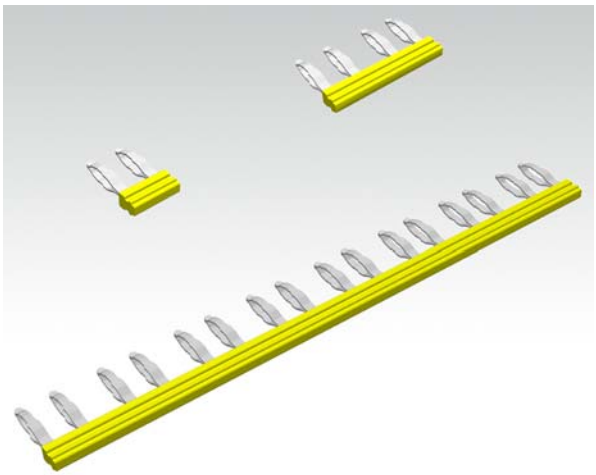
Figure 2-11: End bracket



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.

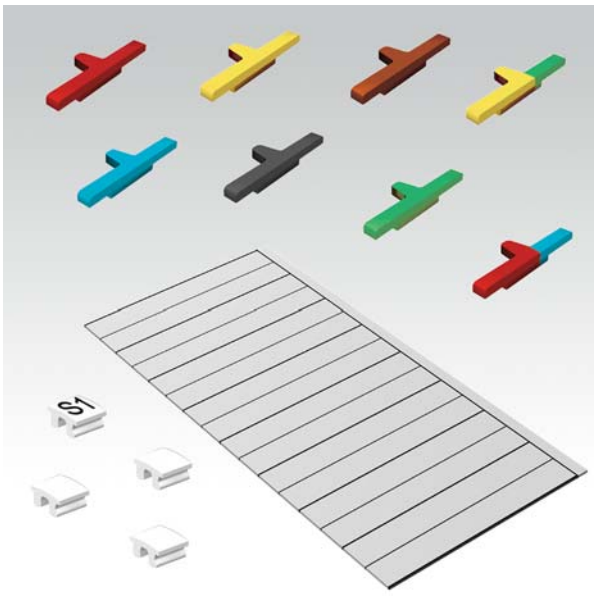
Figure 2-12: Jumpers



2.2.9 Marking Material

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

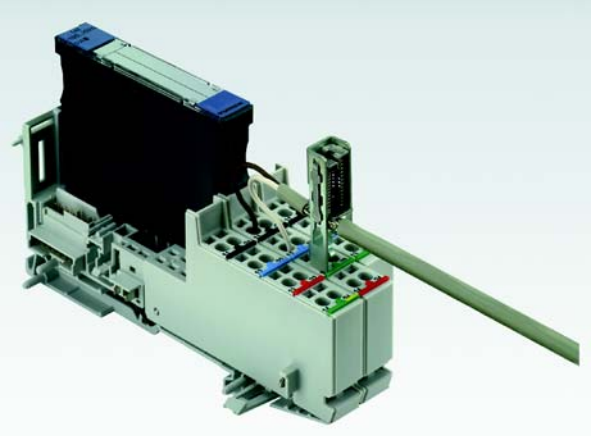
Figure 2-13: Marking material



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 2-14:
Shield connection



3 PROFIBUS-DP

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3.1 System overview

PROFIBUS is a manufacturer-independent and open fieldbus standard for a wide area of applications in factory and process automation. Manufacturer independence and openness are guaranteed by the international standards EN 50170 and EN 50254. PROFIBUS enables communication of devices of various manufacturers without requiring particular interface adaptations.

PROFIBUS-DP (Decentral Periphery) is designed for data transfer between the control and the input/output level. TURCK BL20 stations support PROFIBUS-DP.

PROFIBUS-DP is the speed-optimized PROFIBUS version, specially designed for communication between automation devices and decentralized peripheral devices. PROFIBUS-DP is suited to replace cost-intensive parallel signal transmission via digital and analogue sensors and actuators.

PROFIBUS-DP is based on DIN 19245, part 1 and part 4. During the course of European fieldbus standardization, PROFIBUS-DP has been integrated into the European fieldbus standard EN 50170.

3.1.1 Master/Slave system

PROFIBUS-DP is a master/slave system, which consists of a master (usually integrated in the PLC) and up to 31 slaves per segment. During operation, the master constantly scans the connected slave stations. Several masters may be connected within a single network; this would then be classified as a multi-master system. In this case they pass on their transmission permission (Token Passing).

PROFIBUS-DP uses a bit transmission layer (Physical Layer) based on the industrially proven RS485 standard.

3.1.2 System configuration and device types

PROFIBUS-DP is suited for both mono-master or multi-master system configuration. Thus a high level of flexibility in system configuration is guaranteed. The network comprises 126 devices max. (master or slaves).

Configurable system parameters include the number of stations, the assignment of the station address to the I/O addresses, data consistence of I/O data, format of diagnostic messages and the bus parameters used. Every PROFIBUS-DP system consists of different types of devices.

One distinguishes between three device types:

- DP master class 1 (DPM1)

This is a central control, which exchanges data in a defined message cycle with the remote stations (slaves). Typical devices are, for instance, programmable logic controllers (PLCs) or PCs.

- DP master class 2 (DPM2)

Devices of this type are engineering, configuration or operating devices. They are used during set-up, maintenance and diagnosis, to configure the connected devices, to evaluate parameters and to scan the device status.

- DP slave

A PROFIBUS-DP slave is a peripheral device (I/Os, drives, transducers), which reads input data and provides output data to the periphery. Of course, there are also devices which provide only input or only output data. The input and output data volume depends on the specific device and may comprise up to 244 bytes input data and 244 bytes output data.

Single-Master systems

With mono-master systems merely a single master on the bus is active during bus operation. The PLC is the central control component. The slaves are coupled decentrally to the PLC via the transmission medium. With this type of system configuration the shortest bus cycle times are achieved.

Multi-Master systems

In multi-master operation there are several masters on the bus. These form independent sub-systems, consisting of one DPM1 each and the associated slaves, or additional configuration and diagnostic devices. The slave input and output data can be read by all DP masters. Writing of outputs is reserved to a single DP master (the assigned DPM1 during configuration). Multi-Master systems achieve an average bus cycle time. In time-critical applications you should monitor the bus cycle time via a connected diagnostic tool.

3.1.3 Topology

PROFIBUS-DP communicates via a shielded 2-wire cable according to the RS485 standard. The network topology accords to a line structure with active bus terminators on both ends.

3.1.4 Maximum system extension

PROFIBUS-DP is suited for connection of a large number of I/O points. Up to 126 addressable bus nodes enable connection of thousands of analogue and digital I/O points within a network.

PROFIBUS-DP allows a maximum of 32 nodes per segment; please note that masters and repeaters always count as nodes. One segment is defined as the bus section between two repeaters. If no repeaters are used, the entire network corresponds to one segment.
Segments must comply with the specified maximum length and the specified transmission rates. Up to nine repeaters, type "REP-DP0002" may be connected within a network. The maximum length of a bus line within a segment and the number of repeaters are listed in the following table.

Table 3-1: Maximum System expansion PROFIBUS-DP

Communication rate	Length of bus line	Max. no. of repeaters	Max. no. of nodes
9.6 kbps	1200 m	2	126
19,2 kbps	1200 m	2	126
93,75 kbps	1200 m	2	126
187,5 kbps	1000 m	2	126
500 kbps	400 m	4	126
1.5 Mbps	200 m	6	126
12 Mbps	100 m	9	126



Attention

The maximum number of 32 bus nodes may not be exceeded without a repeater.

Use of Drop lines



Note

The length of drop lines may not exceed 6.6 m at a transmission speed of 1.5 Mbps. At a transmission speed of 12 Mbps it is not permitted to use drop lines.

3.1.5 Transmission rate/Cycle times

The transmission rate set by the PROFIBUS-DP master determines the system's transmission speed. Depending on the gateway, the transmission speed can be adjusted in a range of 9,6 kbps up to 12 Mbps.

3.1.6 Transmission cables

The bus nodes are interconnected via fieldbus cables, which accord to RS485 specifications and DIN19 245. The cables must thus have the following characteristics:

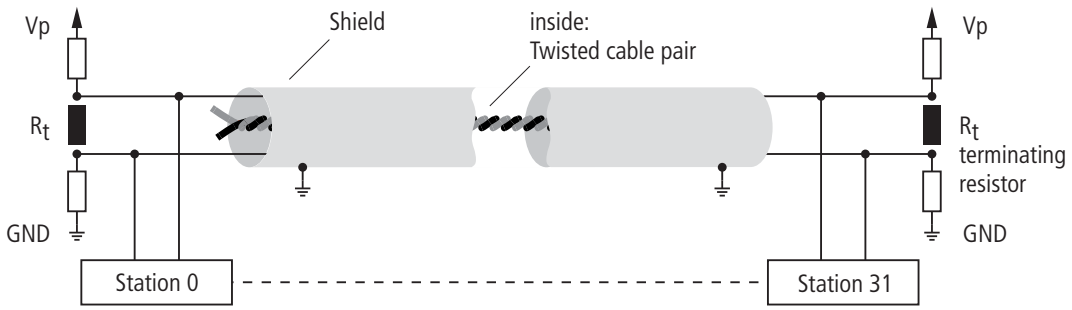
Table 3-2: Characteristics of PROFIBUS-DP transmission cables

Parameters	Cable type A (DIN 19 245 part 3)
Wave resistance	135 to 165 Ω (3 to 20 MHz)
Capacitance	< 30 pF/km
Loop resistance	< 110 Ω/km
Conductor diameter	> 0.64 mm
Conductor cross section	> 0.34 mm^2
Terminating resistors	220 Ω

Attention

The higher the transmission rate, the higher the number of bus nodes and the longer the transmission cables, the more important to observe these parameters.

Figure 3-1: Schematic PROFIBUS-DP cables



Cable types

The bus cable of the PROFIBUS-DP network is a special shielded twisted data cable according to RS485 standards. The data transmission rate is 12 Mbps max.

Note

Premoulded PROFIBUS-DP cables simplify network installation, shorten set-up times and reduce wiring errors. TURCK offers an extensive and varied product spectrum for this purpose.

The ordering information on the available cable types can be taken from the respective product catalogue.

Installation guidelines

When mounting the modules and routing the cables please observe the technical guidelines of the PROFIBUS user organization concerning PROFIBUS-DP/FMS (see www.profibus.com).

Checking the PROFIBUS cabling

A PROFIBUS cable (or the cable segment if repeaters are used) can be tested with a few resistance measurements. For this the cable should be disconnected from all stations:

- Resistance between "A" and "B" at the beginning of the cable: approx. 110 Ω
- Resistance between "A" and "B" at the end of the cable: approx. 110 Ω
- Resistance between "A" at the beginning and "A" at the end of the cable: approx. 0 Ω
- Resistance between "B" at the beginning and "B" at the end of the cable: approx. 0 Ω
- Resistance between shield at the beginning and shield at the end of the cable: approx. 0 Ω

If these measurements are successful, then the cable can be used according to standards. However, if there are further disturbances on the bus, electromagnetic interference should be considered as cause. Please also observe the installation guidelines of the PROFIBUS user organization (www.profibus.com)

3.1.7 Diagnostic functions

The comprehensive diagnostic functions of PROFIBUS-DP allow fast error localization.

The PROFIBUS-DP diagnosis is divided into three levels:

Table 3-3: PROFIBUS-DP diagnosis

Type of diagnosis	Description
station-related diagnostics	Messages concerning the general operational readiness of a bus node.
Module-related diagnostics	These messages indicate that there is a diagnostic message within the a certain I/O area (e.g. 8 bit output module) of a bus node.
Channel-related diagnostics	Here the error cause of a single input/output bit, i.e. relating to a single channel, is indicated. Example: "Short-circuit at output 2"

The PROFIBUS slaves of the BL20 series support the diagnostic functions of PROFIBUS-DP.

The evaluation of the diagnostic data via the control depends on the support of the master.



Note

Further information on diagnostics can be taken from the device descriptions of the master interfaces of the various manufacturers.

3.1.8 Sync and Freeze Mode

In addition to the node-specific user data traffic, which is automatically controlled by the DPM1, the DP master has the possibility to send control commands to a slave, a group of slaves, or simultaneously to all DP slaves. These control commands are transmitted as multicast messages.

The Sync and Freeze mode for synchronization of the DP slaves can be determined via the control commands. They enable event-controlled synchronization of the DP slaves.

Sync Mode

The DP slaves initiate the Sync mode upon receipt of a Sync control command from the assigned DP master. In this mode, all addressed DP slaves "freeze" their present output status.

During the following user data transfer cycles, the output data are stored by the DP slaves, while the output states are retained. Only after receipt of the next Sync control command from the master, the stored output data are switched through to the outputs.
The Sync mode is terminated upon an Unsync control command.

Freeze Mode

The Freeze control command induces the addressed DP slaves to assume the Freeze mode. In this mode, the momentary values of the input states are "frozen". Input data will only be updated upon receipt of the next freeze command from the DP master by the affected devices.
The Freeze mode is terminated upon an Unfreeze control command.

3.1.9 System performance

In order to achieve a relatively high level of device interchangeability, the PROFIBUS-DP system performance has also been standardized. It is largely determined by the operating status of the DPM1. This can be either controlled locally or via the bus from the configuration device.

One distinguishes between three major conditions:

Table 3-4: Operating modes

Operating mode	Description
Stop	There is no data transfer between the DPM1 and the DP slaves. The coupling module merely addresses the modules once after power-up (none of the I/O LEDs illuminate).
Clear	The DPM1 reads the input data of the DP slaves and retains the outputs of the DP slaves in the safe state (depending on the reaction to fieldbus errors, the green I/O LED illuminates and the outputs are set).
Operate	The DPM1 is in the data transfer phase. During cyclic data exchange the inputs of the DP slaves are read and the output information is transferred to the DP slaves (the green I/O LED illuminates).

The DPM1 sends its local status within a configurable time interval via a multi-master command to all assigned DP slaves. The system response to an error in the data transfer phase of the DPM1, e.g. a failure of a DP slave, is determined by the operating parameter "Auto-Clear". If this parameter is set to "True", then the DPM1 switches all outputs of the assigned DP slaves to the safe status, as soon as a DP slave is no longer capable of user data transfer. Then the DPM1 changes to the "Clear" state. If this parameter is set to "False", then the DPM1 will retain its operating condition also in the event of an error and the user can determine the system response.

Data transfer between DPM1 and the DP slaves

Data exchange between the DPM1 and the assigned DP slaves is automatically controlled by the DPM1 in a determined fixed order. During configuration of the bus system, the user assigns the DP slaves to the DPM1. It is also defined which DP slaves are to be included in or excluded from cyclic user data transfer.

Data exchange between DPM1 and the DP slaves can be divided into the phases parameterization, configuration and data transfer.

Prior to including a DP slave in the data transfer phase, the DPM1 checks during the parameterization and configuration phase, whether the programmed required configuration complies with the actual device configuration. This check is used to verify that the device type, the format and length information as well as the number of inputs and outputs accord. The user thus is securely protected against parameterization errors. Additionally to the user data transfer, which is automatically effected by the DPM1, it is also possible to send new parameters to the DP slaves upon request of the user.

Protective mechanisms

In the decentralized periphery it is required to provide the system with highly effective protective functions against faulty parameterization or failure of the transmission devices. PROFIBUS-DP applies certain mechanisms to monitor the DP master and the DP slaves. These can be described as time monitoring functions. The monitoring interval is determined during system configuration.

Table 3-5: Protective mechanisms

Protective mechanisms	Description
Of the DP master	The DPM1 controls the user data transfer of the slaves via the Data_Control_Timer. Each assigned slaves has a monitoring timer of its own. The timer actuates if no user data are transferred correctly during a certain time interval. In this case the user is informed on this condition. If automatic error response (Auto_Clear = True) is enabled, the DPM1 terminates the "Operate" status, switches the outputs of the assigned slaves into the safe status and returns to the operating status "Clear".
Of the DP slave	The slave carries out response monitoring to detect master or transmission errors. If there is no data exchange during the response monitoring interval with the associated master, the slave automatically switches the outputs into the safe status. In multi-master system operation, an additional access protection is required for the inputs and outputs of the slaves, in order to ensure that only the authorized master has direct access. The slaves provide an input and output image for all other masters so that this map can be read by any master, even without access token.

Ident. number

Each DP slave and each DPM1 must have an individual ident. number. It is needed so that the DP master can identify the connected devices directly without creating significant protocol overhead. The master compares the ident. numbers of the connected DP devices with the ident. numbers registered in the configuration data of the DPM2. User data transfer will only be started, if the right device types with the right station addresses are connected to the bus. This provides additional protection against configuration errors. The manufacturer specific ident. nos. are determined and assigned by the PROFIBUS user organization (PNO). The PNO governs the ident. nos. together with the GSD files.

3.1.10 GSD files

Each PROFIBUS-DP module has a so-called GSD file (German abbr. for device data base file) that comprises detailed information on the module: I/O data volume, transmission rates, revision status etc. This GSD file is needed to configure the station within the PROFIBUS-DP system.

The GSD files can be downloaded via the TURCK website under www.turck.com.

3.2 Short Description of PROFIBUS-DPV1

3.2.1 General

PROFIBUS-DPV1 is an enhancement of PROFIBUS-DP which provides the possibility of acyclic data communication.

A cyclic and centrally directed data transfer between master and slaves is characteristic for the standard functions of PROFIBUS-DP. A Class1 master (PLC) controls the cyclic exchange of process data with the slaves. The data exchange is carried out in rotation and in a defined order. The data which have to be transmitted are projected beforehand.

Via acyclic communication functions, PROFIBUS-DPV1 now offers the possibility to transmit data to the slave in addition to the cyclic process data.

3.2.2 Acyclic data transfer

The need for acyclic data transfer exists wherever slave devices which provide several parameterization options have to be parameterized during operation.

Typical examples are the parameters of a drive, like limit values, rotational speed or torque, operation mode and the generation of an error list.

Acyclic services are handled with low priority, parallelly and additionally to the cyclic process data transfer. The negative influence on the speed of the high-priority process data transfer, shall thus be minimized.

3.2.3 DPV1-functions

The DPV1-functions consist basically of the services "Read" and "Write". The master uses these services for read- or write access to data blocks in PROFIBUS.

In addition to that, an "intiate" and "abort"-service for the connection management, a "data-transport"-service for the exchange of large data packages and the "alarm"-and "status"-services for the transmission of alarm messages have been defined.



Note

At present, the BLxx-gateways for DPV1 only support the services "Read" and "Write".

3.2.4 DPM1 versus DPM2

PROFIBUS-DPV1 differentiates between two master classes.

An automation system (PLC), which generally controls the basic cyclic process data transfer with standard DP-functions, is defined as Class1-master. A Class1-master can use DPV1-functions optionally.

The new Class2-master is generally an engineering tool which is used for the acyclic data transfer.

The protocol cycle of the DPV1-functions on the fieldbus depends on the use of a Class1- or a Class2-master.

3.2.5 Addressing the data in DPV1

The data-addressing is done per module by means of the following details:

- slot
- index
- length

The slot-number addresses the module and the index addresses the module's parameters. Each data block can have a maximum size of 240 bytes.

In case of a successful data access, the slave sends a positive answer. If the data access failed, a negative answer which classifies the problem precisely is sent.

4 Eco-Gateway for PROFIBUS-DP

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4.1 Introduction

This chapter contains a description of the BL20-ECO gateway for the use with the standardized fieldbus PROFIBUS-DP. The chapter is divided up as follows: a description of functions, general and specific technical data, a description of addressing and status displays, and parameter assignment.

4.1.1 Function

The BL20-ECO gateways for PROFIBUS-DP enable BL20 modules to operate on PROFIBUS-DPV0 as well as on PROFIBUS-DPV1. A gateway is the connection between the BL20 modules and the PROFIBUS-DP master. It regulates the process data between the I/O level and the fieldbus, and generates diagnostics data for the higher-level master. Information is made available to the software tool I/O-ASSISTANT via the service interface.



Note

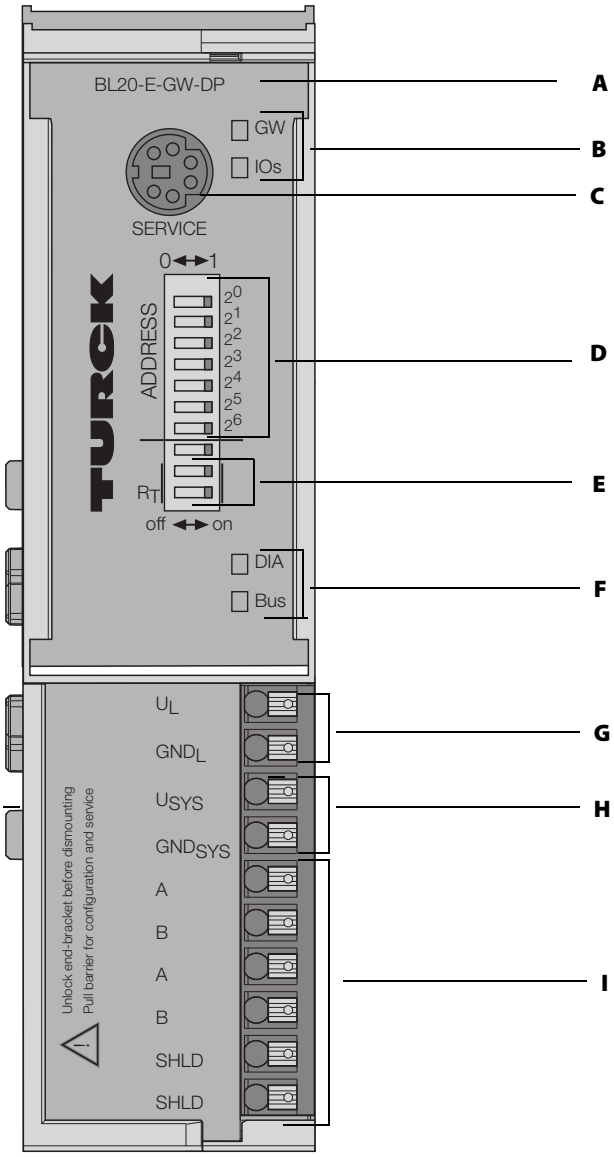
BL20 gateways can only be used as slaves.

When the BL20 gateway has the "WAIT_PRM” status, it is not possible to check the parameters in the parameter telegram of the PROFIBUS-DP master due to the large number of module combinations and module variants. This check is performed after successful configuration by the PROFIBUS-DP master in the context of the configuration.

4.2 Technical Data

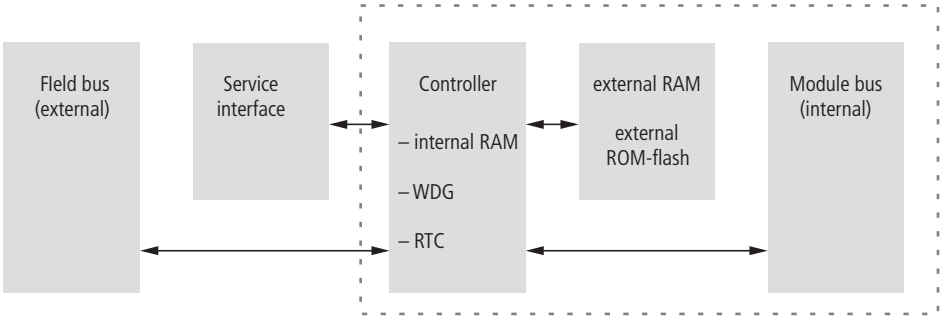
Figure 4-1: Gateway BL20-E-GW-DP

A *Type designation*
B *LEDs for BL20 module bus*
C *Service interface*
D *DIP switches for the field bus address setting*
E *DIP switches for the terminating resistor*
F *LEDs for PROFIBUS-DP*
G *Field supply*
H *System supply*
I *PROFIBUS-D connection*



Structure of a BL20-ECO gateway

Figure 4-2: Structure of a BL20-E-GW-DP



4.2.1 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: General technical data of a station

Supply voltage/ auxiliary voltage	
U_{sys} Nominal value (provision for other modules)	24 V DC
I_{sys} (at maximum station extension) → see chapter 6, page 6-3 ff.	ca. 600 mA
Permissible range	according to EN 61131-2 (18 to 30 V DC)
Residual ripple	according to EN 61131-2
Isolation voltage (U_L to U_{SYS})	500 V_{eff}
Voltage anomalies	according to EN 61131-2
I_{MB} (supply of module bus nodes)	1 A
Connection technology	Push-in tension clamp terminals LSF from Weidmueller
Physical interfaces	
Fieldbus	
Protocol	PROFIBUS-DPV0/ PROFIBUS-DPV1
Transmission rate	9,6 kBit/s to 12 Mbit/s
Terminating resistor	activation via DIP-switch on the gateway
Isolation voltage (field to U_{sys} and to U_L)	500 V_{eff}
Fieldbus connection	Push-in tension clamp terminals LSF from Weidmueller
Address setting	via DIP-switch (addresses 1 to126)
Service interface	
connection	RS232 via PS2/ mini DIN female connector

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 EN 61131-2/EN 50178	5 to 95 % (indoor), Level RH-2, no condensation (storage at 45 °C, no function test)
Climatic tests	according to IEC 61131-2
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	
Height of fall (weight < 10 kg)	1,0 m
Height of fall (weight 10 to 40 kg)	0,5 m
Test runs	7
Device with packaging, electrically tested printed-circuit board.	
Electromagnetic compatibility (EMC) according to EN 50 082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and ENV 50 204	10 V/m

A*This device can cause radio disturbances in residential areas. Additional measures to suppress the disturbance are necessary.*	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

Approvals and Tests

Table 4-2: Approvals and tests

Description	
Approvals	
UL cUL	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

4.2.2 Technical Data for the Push-in tension clamp terminals

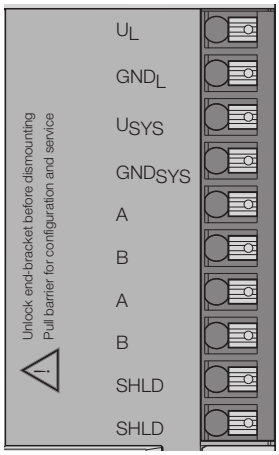
Table 4-3: Technical data for the Push-in tension clamp terminals

Designation	
Protection class	IP20
Insulation stripping length	8 mm + 1/ 0.32 inch + 0,039
Max. wire range	0.14 to 1.5 mm^2 / 0.0002 to 0.0023 $inch^2$ / 26 to 16 AWG
Crimpable wire	
"e" solid core H 07V-U	0.14 to 1.5 mm^2 / 0.0002 to 0.0023 $inch^2$/ 26 to 16 AWG
"f" flexible core H 07V-K	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$ / 25 to 16 AWG
"f" with ferrules according to DIN 46 228/1 (ferrules crimped gas-tight)	0.25 to 1.5 mm^2 / 0.0004 to 0.0023 $inch^2$ / 30 to 16 AWG

4.3 Connection Possibilities at the Gateways

The fieldbus connection as well as the power supply connection are realized via Push-in tension clamp terminals.

Figure 4-3: Push-in tension clamp terminals at the gateway



Attention

Mixing-up the connectors for power supply and bus connection can lead to the destruction of the gateway electronics!

4.3.1 Voltage Supply

The BL20-E-GW-DP provides an integrated power supply an has connectors for:

- field supply (U_L, GND_L)

and

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

4.3.2 Fieldbus Connection via Push-in Tension Clamp Terminals

Push-in tension clamp terminals are also used for the gateway's connection to PROFIBUS-DP.

The pin assignment for the tension clamp terminals is as follows:.

Table 4-4: Pin assignment for the Push-in tension clamp terminals for the bus connection

Designation	Description
B	receive-/transmit data -P
A	receive-/transmit data -N
SHLD	shield/ functional earth

Note

The shielding of the field bus cable is established directly on the mounting rail using a SHLD terminal.

Note

Equipotential bonding impedance ≤ 1/10 shielding impedance.

4.4 Service Interface Connection

In order to connect the service interface on the gateway with a PC and the I/O-ASSISTANT software (project planning and diagnostics software), a cable with a pin assignment, different from the PS2 standard pin assignment, has to be used:

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

Attention

Standard commercial cables will have to be rewired!

4.4.1 Connection through an I/O-ASSISTANT Cable

The I/O-ASSISTANT cable is fitted with a PS/2 plug (connection to the socket on the gateway) and a SUB-D socket (connection to the plug on the PC).

Note

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

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

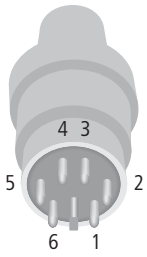


Figure 4-5: 9-pole SUB-D socket connector on the cable for connecting to PC (top view)

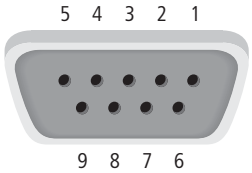


Table 4-5: Pin assignment PS/2- and SUB-D-interface

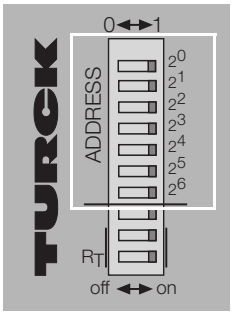
Pin	BL20 gateway PS/2-socket	Sub-D-interface at the PC	Pin
1	CLK	DTR, DSR	4, 6
2	GND	GND	5
3	DATA	–	–
4	n.c. (DATA2)	RxD	2
5	+5 V	RTS	7
6	n.c. (CLK2)	TxD	3

4.5 Addressing at the fieldbus

Addressing the BL20-ECO gateways on PROFIBUS-DP is done via the DIP-switches on the gateway.

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

Figure 4-6: DIP-switches on the gateway



Note

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

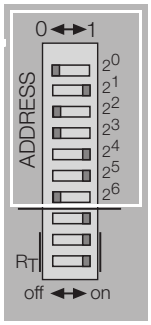
Attention

A maximum of 125 addresses (001 to 125) can be assigned. Each address can only be assigned once in the entire bus structure. Bus addresses 000, 126 and 127 must not be used.

The gateway's bus address results from the addition of the valences (2^0 to 2^6) of the switched DIP-switches (position = 1).

Example:
Bus address 50 = 0×32 = 0110010

Figure 4-7: Bus address 77



The internal module bus does not require any addressing.

4.6 Setting the Baud Rate

The gateway BL20-E-GW-DP offers an automatic baud rate detection.

The baudrate set on the PROFIBUS-DP is automatically detected by the gateway as soon as the device is connected to the PROFIBUS-DP and is started.

4.7 Activating the bus terminating resistor

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

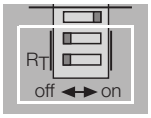
The BL20-E-GW-DP allows the activation of the resistors $\mathbf{R_T}$ using the two last DIP-switches.

Note

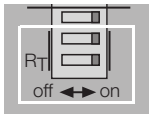
Both DIP-switches have to be in the same position in order to activate or deactivate the bus terminating resistor.

Figure 4-8: Bus terminating resistor R_T

Bus terminating resistor switched off:



Bus terminating resistor switched on:



4.8 Parametrization

4.8.1 Gateway Parameters

The BL20-ECO gateways for PROFIBUS-DP require five parameter bytes. These describe exclusively the behavior of the gateway itself.

Description of gateway parameters

The texts in the columns "Parameter name" and "Meaning" correspond to those determined in the GSD files (Electronic Device Data Sheets).

Table 4-6: Gateway parameters

A*default settings*

Byte/ parameter name	**Value**	**Meaning**
General parameters		
Byte 0: reserved		
Byte 1:		
– Bit 0: startup when expected/actual config. differ		
0	activated **A**	Reaction depending on the parameter Bit 6: Static configuration, byte 4, bit 6 → If the static configuration is **deactivated**, the process data exchange is not disturbed in case of module sequence error.
1	deactivated	Reaction depending on the parameter Bit 6: Static configuration, byte 4, bit 6 → If the static configuration is **activated**, the process data exchange is not disturbed in case of module sequence error.
– Bit 1 to 7	reserved	
Byte 2:		
– Bit 0 to 5	reserved	
– Bit 6:	reserved	depending on the configuration tool
– Bit 7:	reserved	

Table 4-6: Gateway parameters

Byte/ parameter name	Value	Meaning
Device specific parameters		
Byte 3:		
– Bit 0 and 1: Outputs module sequence deviation		
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 decide to 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 decide to set their outputs either to "0" or to a default value, or to 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 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 decide to 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 decide to set their outputs either to "0" or to a default value, or to 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.

A*default settings*

A

Table 4-6: Gateway parameters

Byte/ parameter name	Value	Meaning
– 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 0: Integer data format		
0	LSB first	Data is converted to INTEL format (standard format).
1	MSB first	16-bit data are transmitted with the high and low bytes reversed (MOTOROLA format). This parameter influences the process data!
– Bit 1: Diagnostics from modules		
0	activate **A**	Diagnostic messages from the module bus stations are made known to the fieldbus master as extended diagnostics.
1	deactivate	Diagnostic messages from the module bus stations will not be displayed. A station diagnostic is not automatically generated along with module diagnostics.
– Bit 2: U_L diagnostics		
0	activate **A**	The monitoring function for the field supply U_L (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	A possible over- or undervoltage at U_L will not be detected.
– Bit 3: reserved		

Table 4-6: Gateway parameters

Byte/ parameter name	Value	Meaning
– Bit 4: I/O-ASSISTANT Force Mode		
0	release **A**	I/O-ASSISTANT can set the force mode.
1	block	I/O-ASSISTANT cannot set the force mode, if the station was parameterized by the DP master.
– Bit 6: Static configuration		
0	activate **A**	Changes in the station configuration are stored in the gateway following a power-on reset. In case of a module sequence error, a process data exchange is still possible.
1	deactivate	If the static configuration is deactivated, a dynamic configuration take-over is realized directly following station configuration changes (important for acyclic parameterization). The station stops the process data exchange and the bus communication as soon as a module sequence error appears, ignoring the parameterization for error handling. But, the communication is not interrupted, if the gateway-parameter byte 1, bit 0 "startup when expected/actual config. differ" (see page 4-12) is activated.
– Bit 7	reserved	

4.8.2 Parameter "module parameterization"

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

- **"module parameterization" activated**

The module receives its parameter settings from the controller, IO-supervisor 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

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.



Note

If the "module parameterization" is activated and a module is replaced by a new one, the gateway has to be operated with active V_I, in order to keep the module's parameter-settings for the new module.

V_o 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.

4.8.3 Module Parameters

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	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...20 mA)					
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...20 mA)					
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 4-7: Module parameters

***A**default settings*

Assignment			Parameter name	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
	0	4 to 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
	1	0	Measurement Mode K1	0 1	– 2-wire **A** – 3-wire

Table 4-7: Module parameters

A*Default*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-2AI-PT/NI-2/3					
1	2	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
	2	4 to 7	Element K2	0000 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1001 1100 1101 1110 1111	– Pt100, -200...8500 °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
	3	0	Measurement Mode K2	0 1	– 2-wire **A** – 3-wire

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
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
	0	4 to 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
		4 to 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

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-4AI-U/I					
0 to 3	0 to 3	0	range x	0 1	– 0...10 V/ 0...20 mA **A** – -10...10 V/ 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
BL20-1AO-I(0/4...20 mA)					
1	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...20 mA)					
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".

Table 4-7: Module parameters

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-2AO-I(0/4...20 mA)					
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".
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".

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1CNT-24VDC, counter mode					
0	0	0 to 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. – synchronization when edge pos.
		4	Synchronization	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**	
	6 to 9		Upper count limit	0 to + 2147483647 (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)	

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1CNT-24VDC, counter mode					
	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
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
	14	0	Group diagnostics	0 1	– release **A** – block
		4/ 5	Behavior 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 4-7: Module parameters

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1CNT-24VDC, measurement mode					
0	0	0 to 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 to 4	Function DO1	00 01 10 11	– output **A** – outside of limit – below lower limit – above upper limit
	13	0 to 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)

A*default settings*

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1CNT-24VDC, measurement mode					
0	13	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 to 5	Behavior 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 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS232					
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: Diagnostics activated/ diagnostics deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnostics embedded in the process input data.

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1RS232					
0	1	0	Stop bits	0 1	– 1 stop bit – 2 stop bits **A**
		1 - 2	Parity	0	– None
				1	– Odd: **A** The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
				2	– Even: The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is even.
			Data bits	0 1	– The number of data bits is 7. **A** – The number of data bits is 8.
			Flow control	0	– None:**A** Data flow control is switched off.
				1	– "XON/XOFF": Software handshake (XON/XOFF) is switched on.
				2	– "RTS/CTS" Hardware handshake (RTS/CTS) is switched on.
	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 4-7: Module parameters

A*default settings*

Assignment			Parameter name	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: Diagnostics activated/ diagnostics deactivated: This affects the separate fieldbus-specific diagnostic message – not the diagnostics embedded in the process input data.

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	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	– None
				1	– Odd: **A** The parity bit is set so that the total number of bits (data bits plus parity bit) set to 1 is odd.
				2	– 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 -5	Flow control	0	– None:**A** Data flow control is switched off.
				2	– "XON/XOFF": Software handshake (XON/XOFF) is switched on.
				3	– "RTS/CTS" Hardware handshake (RTS/CTS) is switched on.
				4	– reserved
	2	0 - 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.

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1SSI					
0	0	5	Sensor data cable test	0	– Activate: **A** Data cable is checked for ZERO.
				1	– Deactivate: After the last valid bit, there will be no check that the data cable is at ZERO.
			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	4 -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 -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

Table 4-7: Module parameters

A*default settings*

Assignment			Parameter name	Value	Meaning
Ch.	**Byte**	**Bit**			
BL20-1SSI					
0	3	0 -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	– Binary coded: **A** The SSI-encoder transmits data in binary code
				1	– GRAY coded: The SSI-encoder transmits data in Gray code

4.9 Status Indicators/Diagnostic Messages Gateway

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

Diagnostic messages are displayed in two ways:

- via individual LEDs
- via the software of the respective fieldbus master (for example, PLC)

4.9.1 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 PROFIBUS-DP communication (fieldbus LEDs): DIA and Bus

LED indicators

Table 4-8: LED indicators

LED	Status	Meaning	Remedy
GW	Green	5 V DC operating voltage present; firmware active; gateway ready to operate and transmit.	-
	Green, flashing, 1 Hz **and** LED IOs: Red	Firmware not active.	– Re-install the firmware or contact your Turck representative.
	Green, flashing, 4 Hz	Firmware active, gateway hardware defect.	– Replace the gateway.
	Green, flashing, 1 Hz	U_{SYS}: undervoltage or overvoltage U_L: undervoltage	– Check that the supply voltage is within the permissible range.
IOs	Off	CPU not supplied	Check the wiring of the voltage supply.
	Green	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.
	Red and LED "GW" off	Controller is not ready or U_{sys} level is not within the required range.	– Check the wiring at the gateway. If the mains voltage is correctly connected, contact your Turck representative.
	Red	Module bus is not ready.	– Check the individual BL20 modules for correct mounting.

Table 4-8: LED indicators

LED	Status	Meaning	Remedy
IOs	Red, flashing, 1 Hz	Non-adaptable modification of the physically connected station.	– Compare the planned BL20 station with the physical station. – Check the physical station for defective or incorrectly fitted electronics modules.
	Red/green, flashing, 1 Hz	Adaptable modification of the physically connected station.	– Check the physical station for pulled or new but not planned modules.
	Red, flashing, 4 Hz	No communication via the module bus.	– Ensure that the guidelines for the use of power distribution modules have been observed.
DIA	Off	Gateway not transmitting diagnostic.	-
	Red, flashing, 1 Hz	Gateway transmitting extended diagnostic.	– Check the individual electronics modules on the station for diagnostic messages. – Check the diagnostic messages using the PLC software.
	Red	Gateway is generating statistical diagnostic.	– Check the individual electronics modules on the station for diagnostic messages. – Check the diagnostic messages using the PLC software.
Bus	Off	Fieldbus not in operation.	– Wait until firmware has been completely downloaded. – After completion of download: hardware error; replace the gateway.
	Green	Communication between gateway and PROFIBUS-DP master is error free.	-
	Red	Bus error on the gateway.	– If the gateway is the last module in the bus topology, check that the PROFIBUS-DP has been terminated with a terminating resistor. – Check if the PROFIBUS-DP connection is fitted correctly. All connections must be correctly and securely fitted. – Check the cable to the PROFIBUS-DP master for damage and correct fitting. – Check if the correct baud rate has been set in the PLC master. – Compare the station engineering with the existing list of modules.
	Red flashing, 1 Hz	Invalid station address set.	– Set the correct station address via the hexadecimal rotary coding-switches.

4.9.2 Diagnostic Messages via the Software

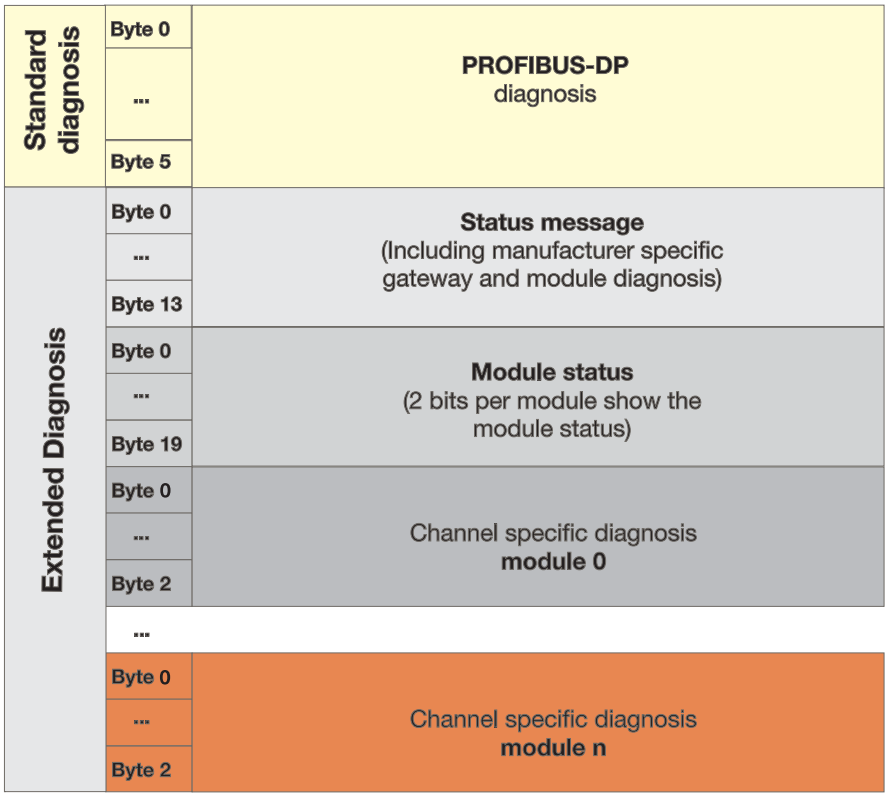
The diagnostic messages are displayed in the corresponding software of the PROFIBUS-DP master as diagnostic bytes.

For the meaning of the individual diagnostic bits of BL20-E-GW-DP, please refer to the following section.

4.10 The Diagnosis Telegram

The diagnosis telegram of the BL20-E-GW-DP gateway is structured as follows:

Figure 4-9: The diagnosis telegram of the BL20-E-GW-DP



4.10.1 Status message

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4/5	Byte 6 to 13
block header byte	status type	slot-no.	specifier	gateway-diagnosis	Common-module-diagnosis

Table 4-9: Status message

Byte 0	**Block header byte:** This header byte defines status- and alarm-PDUs (bit 6 and bit 7 = "00"). In addition to that, it contains information about the length of the diagnosis telegram (length = 14 bytes). The header byte included.
Byte 1	**Status type**: bit 7 = 1 (defines, that the message is a status-PDU). bit 0 to 6: define the type of the status-PDU: bit 0 = 1 → *status message*
Byte 2	**Slot number**: Always "0", because the gateway is the first module of the station.
Byte 3	**Specifier**: "0" = no further differentiation
Byte 4 and Byte 5	**Gateway diagnosis** (see also section Description of the gateway diagnostic bytes, page 4-40) Byte 4, bit 0 shows, if a module within the station sends a diagnosis (bit 0 = 1) or not (bit 0 = 0).
Byte 6 to 13	Common module diagnosis (1 bit per module) Shows, which module sends a diagnosis, if a wrong module is plugged or if a module is missing).

Note

In the 8 byte-common module diagnostics (bytes 6 to 13), 1 bit is reserved for every module. A status message can thus display diagnostic messages of at most 64 modules.

These 8 bytes are always sent. So, it is not relevant, if the modules within the station send diagnostic messages or not. Additionally, the status message is independent of the actual number of modules in the station.

Pending diagnostic messages are indicated by "1". "0" indicates no active diagnostic message.

4.10.2 Module status

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4 to 19
block header byte	status type	slot-no.	specifier	module diagnosis (2 bits per module)

Table 4-10: Module status

Byte 0	**Block header byte:** This header byte defines status- and alarm-PDUs (bit 6 and bit 7 = "00"). In addition to that, it contains information about the length of the diagnosis telegram (length = 14 bytes). The header byte is included.
Byte 1	**Status type**: bit 7 = 1 (defines, that the message is a status-PDU). bit 0 to 6: define the type of the status-PDU: bit 1 = 1 → *module status*
Byte 2	**Slot number**: Always "0", because the gateway is the first module of the station.
Byte 3	**Specifier**: "0" = no further differentiation
Byte 4 to 19	**Module status** (2 bits per module): **00** = data valid, ok. **01** = module sends a diagnosis; data not valid, for example "short-circuit". **10** = wrong module in slot (the plugged module does not correspond to the module planned in the reference module list of the gateway); data not valid **11** = module missing (no module is plugged, although it is planned in the reference module list of the gateway); data not valid.



Note

In the 16 byte-module status (bytes 4 to 19), 2 bits are reserved for every module. A module status can thus display diagnostic messages of at most 64 modules.

These 16 bytes are always sent. So, it is not relevant, if the modules within the station send diagnostic messages or not. Additionally, the module status is independent of the actual number of modules in the station.

Please refer to Table 3: "Module status" for the meaning of the diagnostic message. "0" indicates no active diagnostic message.

4.10.3 Channel-specific diagnosis

The channel-specific diagnosis consists of 3 bytes **per module**:

1 byte Header
+ 1 byte channel description
+ 1 byte error-codes

Table 4-11: channel specific diagnosis

Byte 1	**Header** Defines the channel specific diagnosis via bit 6 and bit 7 = "10". In addition to that, it contains the number of the module which sends the diagnosis message (bit to bit 5).
Byte 2	**Module**: Bit 0 to bit 5 contain the channel number. Bit 6 and bit 7 define, if the channel is an input or an output channel: **01** = input **10** = output **11** = in- and output
Byte 3	**Diagnosis message**: Bit 5 to bit 7 define, if the module is a bit-, byte- or word-oriented module: **001** = bit-oriented **010** = 2 bit-oriented **011** = 4 bit-oriented **110** = word-oriented **111** = double word-oriented Bit 0 to bit 4 contain an error code (decimal), which specifies the diagnostic message (see section Channel-specific diagnostic messages of the modules, page 4-42)

Note

The channel-specific diagnosis is generated for every channel of a module within a station, which is actually present and which sends active diagnosis.

4.10.4 Description of the gateway diagnostic bytes

Table 4-12: Gateway diagnostic byte

Diagnostic byte	Bit	Description
Byte 1	**Gateway warnings**	
	0	Module diagnostics available
		0 = No module bus station is signaling a diagnostic. **1** = At least one module bus station with diagnostic function is signaling a diagnostic.
	1	reserved
	2	reserved
	3	Station configuration changed
		0 = The actual list of modules matches the configuration set in the configuration software of the corresponding fieldbus master. **1** = The actual list of modules has been altered in such a manner, that 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 fieldbus master serves as a reference.
	4	undervoltage field supply U_L
		0 = U_L is within the permissible range **1** = U_L s not within the permissible range
	5 to 7	reserved

Table 4-12: Gateway diagnostic byte

Diagnostic byte	Bit	Description
Byte 2	**Gateway errors**	
	0...1	reserved
	2	Module bus error
		0 = Communication with the module bus station on the module bus is possible. **1** = Communication with the module bus station on the module bus is not possible.
	3	Master configuration error
		0 = The actual list of modules matches the configuration set in the configuration software of the corresponding fieldbus master. **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. The constellation of the module bus station, set in the configuration software of the corresponding fieldbus master serves as a reference.
	4	reserved
	5	Station configuration error
		0 = The gateway has prepared the station's configuration to be read out. **1** = The gateway could not prepare the station's configuration to be read out.
	6	I/O-ASSISTANT Force Mode active
		0 = The fieldbus master can access the parameter, diagnostics and process data of the module bus stations. **1** = The force mode has been activated via the service interface (by I/O-ASSISTANT). This separates the fieldbus master from the outputs of the module bus stations. No process data exchange is taking place from the fieldbus master to the output modules.
	7	reserved

4.10.5 Channel-specific diagnostic messages of the modules

The channel-specific diagnostic messages are defined as follows:

Table 4-13: channel-specific diagnosis

Value (dec.)	Diagnostics
Error-Codes (1 to 9 according to DP-spec.)	
1	short-circuit
2	undervoltage
3	overvoltage
4	overload
5	overtemperature
6	wire-break
7	upper limit value exceeded
8	lower limit value exceeded
9	error
Error-Codes (16 to 31, 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, HART 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 the user 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.
27	Unknown Error An error bit which is not known by the gateway is set. The gateway received an unknown error message.

Table 4-13: channel-specific diagnosis

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 (see diganostic and status messages). Error types can depend on the operation mode and the parameterization.
29	Configuration Error After the validity check, the configuration data is (possibly partially) rejected. Check the context.

4.11 Description of User Data for Acyclic Services

The following instances are defined for the BLxx-DPV1-gateway:

- Gateway Application Instance (Slot 0)
- Module Application Instance (Slot 1 to n)

4.11.1 Gateway Application Instance

Table 4-14: Gateway Application Instance

Index	Name	Data type	r/w	Remark
1	Gateway-parameters	WORD	r/w	Parameter data of the gateway
2	Gateway-name	STRING	r	Name of the gateway
3	Gateway-revision	STRING	r	Firmware-revision of the gateway
4	Gateway-ID	DWORD	r	IDENT number of the gateway
5 to 23	reserved			
24	Gateway-diagnosis	WORD	r	Diagnostics data of the gateway
25 to 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 diagnostic messages
35	Module-parameter-list	Array of BYTE	r	List of all module parameters
36 to 244	reserved			
255	I&M-functions		r/w	Identification & Maintaining-services, I&M0 according to PROFIBUS-DP specification

4.11.2 Module Application Instance

Table 4-15: Module Application Instance

Index	Name	Data type	r/w	Remark
1	Modul-ID	DWORD	r	Indent number of the module
2	Modul-type	ENUM UINT8	r	Module type
3	Modul-revision	UINT8	r	Firmware-Revision of the module
4 to 18	reserved			
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 30	reserved			
31	Module-parameters	specific	r/w	Parameters of the respective modules
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 to Automation Devices

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5.1 Introduction

This chapter contains detailed information on how to connect a BL20 station to higher-level automation devices, for example, programmable logic controllers (PLC) on PROFIBUS-DP.

PROFIBUS-DP is based on DIN 19 245 Parts 1 and 3, and has been integrated into the European fieldbus standard EN 50 170.



Note

The BL20 gateway can only be used as slave on PROFIBUS-DP. The gateway has no master functionality.

All manufacturers of control systems offer plug-in network cards for their PLCs, to which BL20 gateways can easily be connected if they are meeting the PROFIBUS-DP standards. Furthermore, it is possible to use a PC as a master if it has an appropriate PC PROFIBUS card.

Please refer to the respective manuals supplied by manufacturers for detailed information concerning individual control systems and automation devices.

Connections to the Siemens Simatic S7 PLC are described.



Attention

The network and PC cards must comply with standards defined in PROFIBUS-DP DIN 19 245 Part 3.

The designations used in this manual for programmable logic controllers and software programs are registered and protected trademarks belonging to the respective manufacturer.

5.2 Electronic Device Data Sheets (GSD)

BL20 gateways are integrated into PROFIBUS structures using electronic device data sheets (GSD).

5.2.1 Electronic Data Sheet File

The device data of all BL20 modules and gateways are described in the Electronic Device Data Sheets (GSD files).



Note

The respective actual versions of the GSD file "TRCKFF35.gsx" is available directly from the Turck homepage: www.turck.com. It is also possible to gain updates by downloading the files from the PROFIBUS User Organization's homepage (www.profibus.com).

5.3 Connection to a Siemens S7 PLC

The software SIMATIC Manager 5.0.2.0 from Siemens is used to configure the connection of a BL20 gateway with a Siemens S7 PLC.

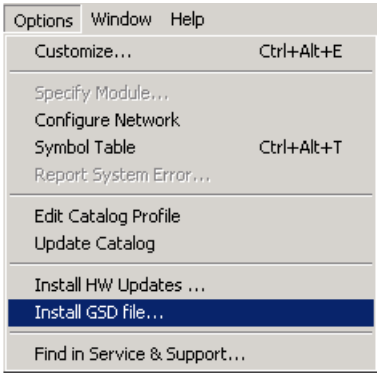
5.3.1 Reading-in the GSD File

The GSD files for BL20 must be read into the software before you can begin with the initial configuration.

Proceed as follows to read-in the above GSD files:

- Create a new or open an existing project.
- Open the hardware configuration software.
- Copy the required GSD file using the "Options → Install New *.GSD Files..." command.

*Figure 5-1: Inserting a new GSD file using the "Install New *.GSE Files..." command*



- Select the GSD file from the corresponding source directory.
- The GSD files are listed as separate entries in the hardware catalog following correct installation.
- In some cases it might additionally be necessary to update the Hardware Catalog using the „Options → Install GSD file...“-option.

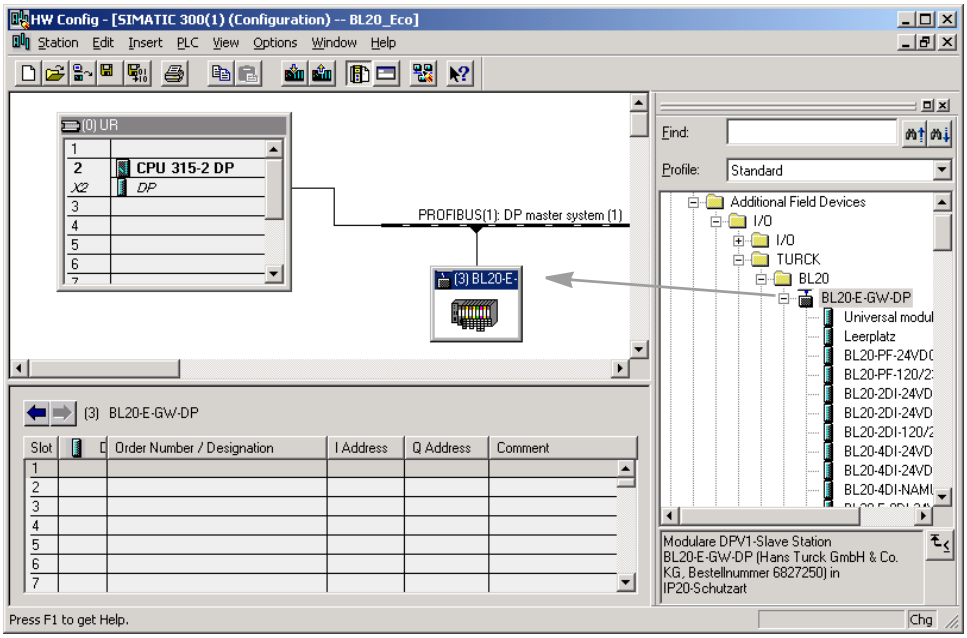
Note

The exact configuration procedure can be found in the operators manual, supplied with the software.

5.3.2 Selecting the BL20 Gateway as a Slave

To insert a BL20-ECO station as a slave, select the required entry from the hardware catalog.

Figure 5-2: Inserting a BL20-E-GW-DP



5.3.3 Setting Gateway Parameters

To set the gateway parameters, double-click the corresponding BL20 station. In the window which opens, click the "Assigning Parameters" button to open the dialog box where you can set the gateway parameters.

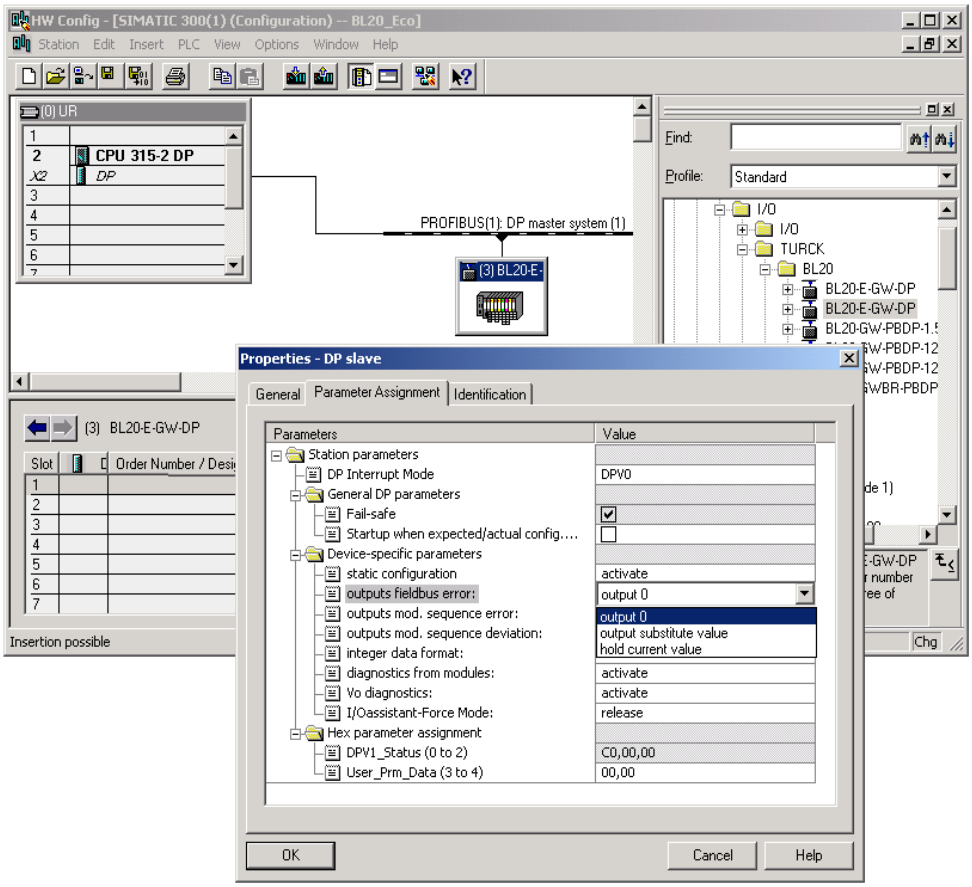


Figure 5-3: Parameterization of the BL20-gateway

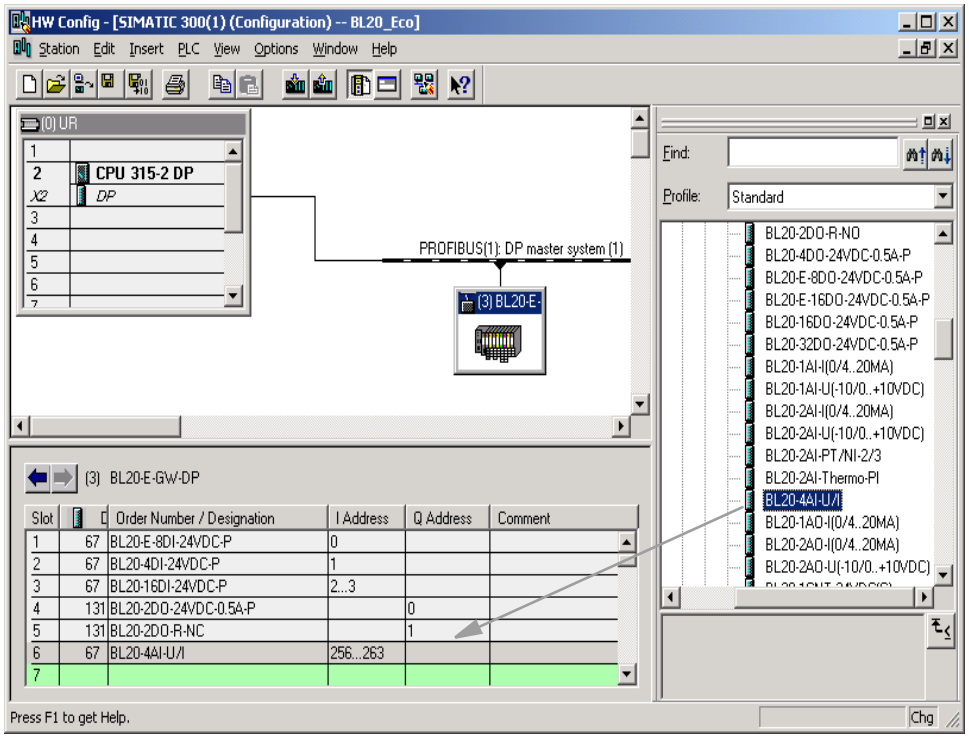
Double-click a parameter to open the dialog box with the relevant options for setting the parameters.

The meaning of the gateway parameters are described in the section Parametrization, page 4-12 ff.

5.3.4 Configuring the BL20 Station

To configure your BL20 station, place the required module into the list of the corresponding station from the hardware catalog using the drag-and-drop or the double-click feature. The list is opened by clicking on the appropriate BL20 station.

Figure 5-4: Selecting the BL20 modules



5.3.5 Setting Parameters for BL20 modules

If BL20 modules are entered whose parameters can be set, it is possible to open the dialog box with the relevant options by double-clicking the corresponding module.

The parameters of the individual BL20 modules are described starting with page 4-17 in chapter 4.

5.4 Example Diagnosis

In addition to the device related diagnosis according to DPV0 and DPV1, the BL20-ECO gateways for PROFIBUS-DP also show channel related diagnosis.

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

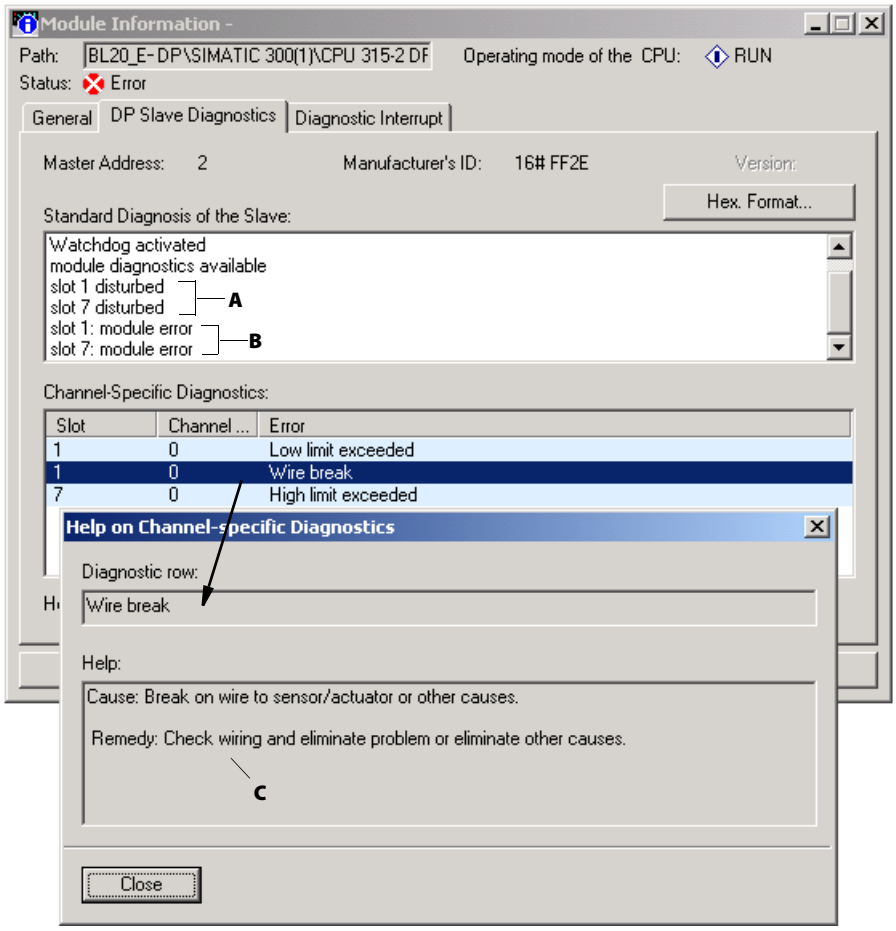


Figure 5-5: Diagnosis of a BL20-ECO gateway for DP

A *device related diagnosis acc. to DPV0*

B *device related diagnosis acc. to DPV1*

C *manufacturer specific help texts*

5.5 Acyclic data transfer with system function bocks (SFBs) by Siemens

The need for acyclic data transfer exists wherever slave devices which provide several parameterization options have to be parameterized during operation.

In the Siemens PLC, the acyclic services are executed via the system function blocks SFB52 "RDREC" and SFB53 "WRREC".

The access to the process data of the gateway and the connected I/O-modules in a station is realized via the indices of the Gateway Application Instance and the Module Application Instance, see chapter 4 Description of User Data for Acyclic Services.

5.5.1 Acyclic reading with SFB52

Figure 5-6: SFB52 (RDREC)

```
CALL  "RDREC" , DB52
 REQ    :=TRUE
 ID     :=DW#16#0
 INDEX  :=19
 MLEN   :=8
 VALID  :="VALID"
 BUSY   :="Busy"
 ERROR  :="Error"
 STATUS:="Status"
 LEN    :="Length"
 RECORD:=DB10.DBB0
```

Table 5-1: Input data SFB52

Parameter name	Meaning
REQ	REQ = 1, starts the data transmission
ID	Logical address of the respective BL××-I/O-module, taken from the hardware configuration. When establishing a connection to the gateway, the logical address is the "Diagnostic Address" assigned in the hardware configuration. Note: If the module to be addressed is an output module, bit 15 has to be set (e.g. for address 5: ID:=DW#16#8005). If the module concerned is a combination module, the lowest address has to be chosen.
INDEX	Number of the module's index to be read (see chapter 4, Description of User Data for Acyclic Services (page 4-44)).
MLEN	Maximum length of the data to be read.

Table 5-2: Output data SFB52

Parameter name	Meaning
VALID	New data set was received and valid.
BUSY	BUSY = 1: The read process is not yet terminated.
ERROR	ERROR = 1:Error occurred while reading.
STATUS	Error code of the function block (see Siemens-online help for SFB54 "RALRAM")
LEN	Length of the read data.
RECORD	Target area for the read data record. (in this example DB10).

Example

Acyclic reading of input data for module no.3, Nr. 3, BL20-16DI-24VDC-P of the example station (see below Figure 5-7:):

The access to the module input data is carried out via module index no. 19 from the module application instance:

Table 5-3: Module Application Instance (excerpt)

Index (dec.)	Name	Data type	r/w	Remark
...				
19	Input data	specific	r	Input data of the respective module.
...				

Note

A detailed description of the Module Application Instance can be found in chapter 4 Eco-Gateway for PROFIBUS-DP, page 4-45.

Figure 5-7: Station structure in the hardware configuration

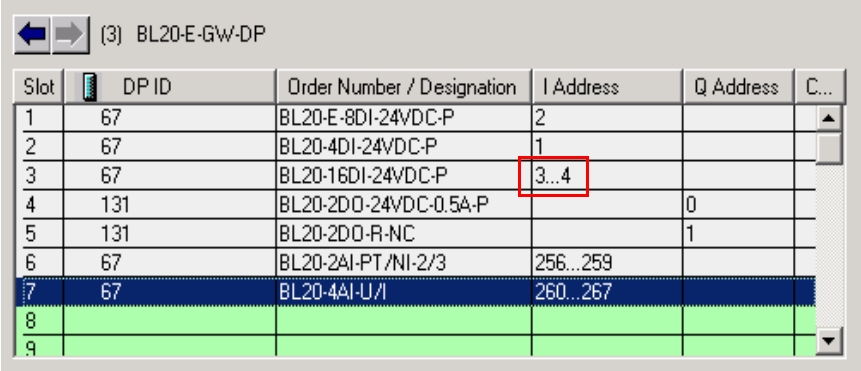


Figure 5-8: Access via SFB52

A *logical address of channel 1 from module no.3*
B *Index no.*

```
CALL  "RDREC" , DB52
 REQ    :=TRUE
 ID     :=DW#16#3        <- A
 INDEX  :=19             <- B
 MLEN   :=1
 VALID  :="VALID"
 BUSY   :="Busy"
 ERROR  :="Error"
 STATUS:="Status"
 LEN    :="Length"
 RECORD:=DB10.DBB0
```

5.5.2 Acyclic writing with SFB53

Figure 5-9: SFB53 (WRREC)

```
CALL  "WRREC" , DB53
 REQ   :=TRUE
 ID    :=DW#16#1E
 INDEX :=31
 LEN   :=4
 DONE  :="VALID"
 BUSY  :="Busy"
 ERROR :="Error"
 STATUS:="Status"
 RECORD:=DB11.DBB0
```

Table 5-4: Input data SFB53

Parameter name	Meaning
REQ	REQ = 1, starts the data transmission
ID	Logical address of the respective BLxx-I/O-module, taken from the hardware configuration. When establishing a connection to the gateway, the logical address is the "Diagnostic Address" assigned in the hardware configuration. Note: If the module to be addressed is an output module, bit 15 has to be set (e.g. for address 5: ID:=DW#16#8005). If the module concerned is a combination module, the lowest address has to be chosen.
INDEX	Number of the module's index to be written (see chapter 4, Description of User Data for Acyclic Services (page 4-44)).
MLEN	Maximum length of the data to be written.

Table 5-5: Output data SFB53

Parameter name	Meaning
VALID	New data set was written and valid.
BUSY	BUSY = 1: The write process is not yet terminated.
ERROR	ERROR = 1:Error occurred while writing.
STATUS	Error code of the function block (see Siemens-online help for SFB54 "RALRAM").
LEN	Length of the written data.
RECORD	Target area for the written data record. (here in this example DB11).

Example

Acyclic writing of parameters to module no. 6, BL20-4AI-U/I of the example station:

The access to the module input data is done via module index no. 31 from the module application instance:

Table 5-6: Module Application Instance (excerpt)

Index (dec.)	Name	Data type	r/w	Remark
...				
31	Module parameters	specific	r/w	Parameters of the respective module
...				

Note

A detailed description of the Module Application Instance can be found in chapter 4 Eco-Gateway for PROFIBUS-DP, page 4-45.

Figure 5-10: Station structure in the hardware configuration

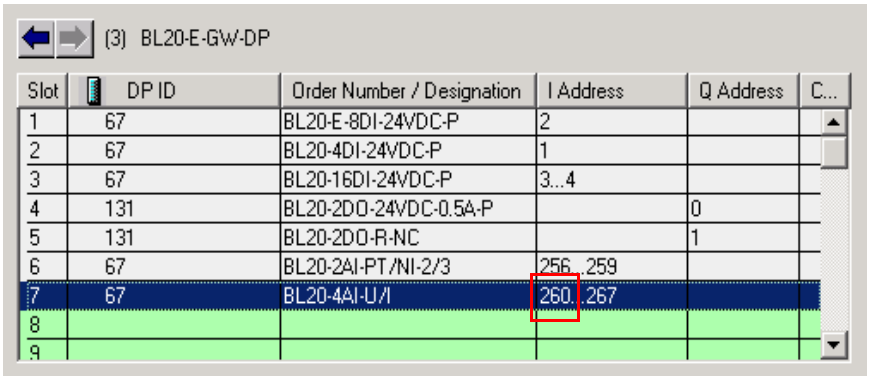


Figure 5-11: Access via SFB53

```
CALL  "WRREC" , DB53
 REQ   :=TRUE
 ID    :=DW#16#104
 INDEX :=31
 LEN   :=4
 DONE  :="VALID"
 BUSY  :="Busy"
 ERROR :="Error"
 STATUS:="Status"
 RECORD:=DB11.DBB0
```

A *logical address of channel 1 from module (260 dec. = 104 hex.)*

B *Index no.*

Changing the parameters

Table 5-7: Parameters BL20-4AI-U/I

A*default setting*

Assignment		Parameter		Value	Meaning
Ch.	**Byte**	**Bit**			
0 to 3	0 to 3	0	range x	0 1	– 0...10 V/ 0...20 mA **A** – -10...10 V/ 4...20 mA
		1	value representation x	0 1	– Integer (15 Bit + sign) **A** – 12Bit (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

The following parameters have to be changed:

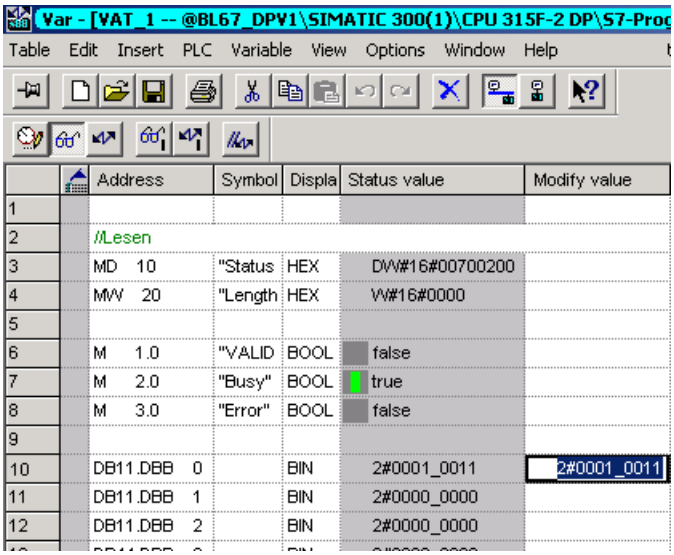
- "range" → "-10...10V/ 4...20 mA"
- "value representation" → "12 bit left-justified"
- "operation mode" → "current".

To achieve this, bit 0, bit 1 and bit 4 of byte 0 have to be set to "1" in DB11.

The module's parameter data are written to byte 1 via DB11:

Figure 5-12: DB11 in VAT1

A*Channel 0, bit 0 = 1, bit 1 = 1 and bit 4 = 1*



6 Guidelines for Station Planning

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6.1 Module Arrangement

6.1.1 Random Module Arrangement

The arrangement of the I/O modules within a BL20 station can basically be chosen at will. Nevertheless, it can be useful with some applications to group certain modules together.

Note

A mixed usage of gateways of the BL20 ECO and the BL20 standard product line and I/O modules of both product lines (base modules with tension clamp terminals) is possible without any problems.

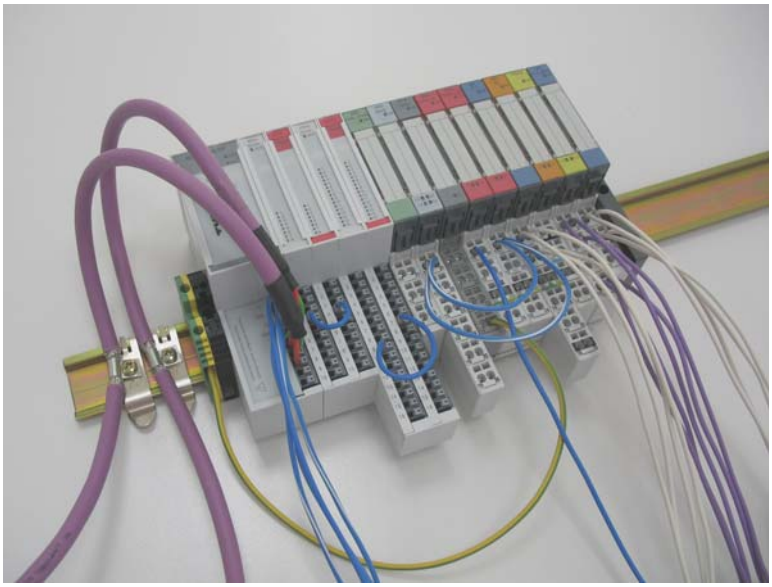


Figure 6-1: Example of a station structure with ECO gateway, ECO and standard I/O modules

6.1.2 Complete Planning

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.

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.

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

6.2 Maximum System Extension

The maximum number of modules within BL20 station with the gateway BL20-E-GW-DP depends on the factors described in the following.
The maximum system extension is therefore limited to 48 modules.

- The maximum permissible number of **244** configuration bytes per station on PROFIBUS-DP may not be exceeded.
- The maximum permissible number of **235** parameter bytes per station on PROFIBUS-DP may not be exceeded.
- The maximum permissible number of **252** communication bytes which are transmitted via the module bus from the modules to the gateway may not be exceeded.
- The maximum permissible sum for the nominal current consumptions ($\Sigma I_{MB} = 1$ A) of all modules in a station (without gateway) on the module bus may not be exceeded.

These factors have to be observed for the maximum system extension of a BL20-Station with BL20-E-GW-DP.

Attention

The use of Bus Refreshing module (BL20 standard product line) in combination with the BL20-E-GW-DP is not possible!

Attention

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

Note

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

For the calculation of the maximum system extension, the following table contains an overview of configuration, parameter and communication bytes as well as of the modules’ nominal current consumptions:

Table 6-1: Configuration, parameter and communication bytes and nominal current consumptions of the BL20 modules

Module	Number of bytes:			
	configuration bytes	parameter bytes	communication bytes	nominal current consumptions on module bus
BL20-PF-24VDC-D	4	1	2	28 mA
BL20-PF-120/230VAC-D	4	1	2	25 mA
BL20-2DI-24VDC-P	5	1	1	28 mA
BL20-2DI-24VDC-N	5	1	1	28 mA
BL20-2DI-120/230VAC	5	1	1	28 mA
BL20-4DI-24VDC-P	5	1	1	29 mA

Table 6-1: Configuration, parameter and communication bytes and nominal current consumptions of the BL20 modules

Module	Number of bytes:			
	configuration bytes	parameter bytes	communication bytes	nominal current consumptions on module bus
BL20-4DI-24VDC-N	5	1	1	28 mA
BL20-4DI-NAMUR	5	5	5	40 mA
BL20-E-8DI-24VDC-P	5	1	1	15 mA
BL20-E-16DI-24VDC-P	5	1	2	15 mA
BL20-16DI-24VDC-P	5	1	2	45 mA
BL20-32DI-24VDC-P	5	1	4	30 mA
BL20-1AI-I(0/4...20MA)	5	2	3	41 mA
BL20-2AI-I(0/4...20MA)	5	3	5	35 mA
BL20-1AI-U(-10/0...+10VDC)	5	2	3	41 mA
BL20-2AI-U(-10/0...+10VDC)	5	3	5	35 mA
BL20-2AI-PT/NI-2/3	5	5	5	45 mA
BL20-2AI-THERMO-PI	5	3	5	45 mA
BL20-4AI-U/I	5	5	9	30 mA
BL20-2DO-24VDC-0.5A-P	5	1	2	32 mA
BL20-2DO-24VDC-0.5A-N	5	1	2	32 mA
BL20-2DO-24VDC-2A-P	5	1	2	33 mA
BL20-2DO-120/230VAC-0.5A	5	1	2	35 mA
BL20-4DO-24VDC-0.5A-P	5	1	2	30 mA
BL20-E-8DO-24VDC-0.5A-P	5	1	2	15 mA
BL20-E-16DO-24VDC-0.5A-P	5	1	2	25 mA
BL20-16DO-24VDC-0.5A-P	5	1	3	120 mA
BL20-32DO-24VDC-0.5A-P	5	1	5	30 mA
BL20-1AO-I(0/4...20MA)	5	4	4	39 mA
BL20-2AO-I(0/4...20MA)	5	7	7	40 mA
BL20-2AO-U(-10/0...+10VDC)	5	7	7	43 mA
BL20-2DO-R-NC	5	1	1	28 mA
BL20-2DO-R-NO	5	1	1	28 mA
BL20-2DO-R-CO	5	1	1	28 mA

Table 6-1: Configuration, parameter and communication bytes and nominal current consumptions of the BL20 modules

Module	Number of bytes:			
	configuration bytes	parameter bytes	communication bytes	nominal current consumptions on module bus
BL20-1CNT-24VDC	6	17	9	40 mA
BL20-1RS232	6	5	9	140 mA
BL20-1RS485/422	6	5	9	60 mA
BL20-1SSI	6	5	9	50 mA
BL20-2RFID-×	6	9	9	30 mA
BL20-E-1SWIRE	6	25	9	60 mA

6.3 Power Supply

6.3.1 Power Supply to the Gateway

The gateway BL20-E-GW-DP has an integrated power supply (see also Voltage Supply page 4-7).



Attention

The use of Bus Refreshing module (BL20 standard product line) in combination with the BL20-E-GW-DP is not possible!

The number of BL20 modules, which can be supplied by the gateway via the internal module bus, depends on the nominal current consumptions of the individual modules (see Table 6-1:, page 6-3).



Attention

The sum of the nominal current consumptions (see Table 6-1:, page 6-3) of all BL20 modules used within a station must not exceed **1 A**.

If the power supply from the module bus is not guaranteed, the software I/O-ASSISTANT generates an error message when the user activates the command “Station → Verify“.

6.3.2 Creating Potential Groups

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.



Note

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

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



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.

6.3.3 C-Rail (Cross Connection)

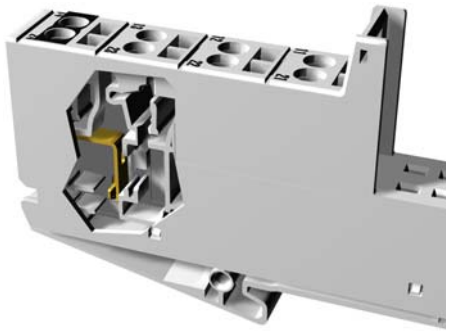
The C-rail runs through all base modules. The C-rail of the base modules for power distribution modules is mechanically separated; thus potentially isolating the adjoining supply groups.

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 6-2:
C-rail front view



Figure 6-3:
C-rail side view



Warning

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 6.

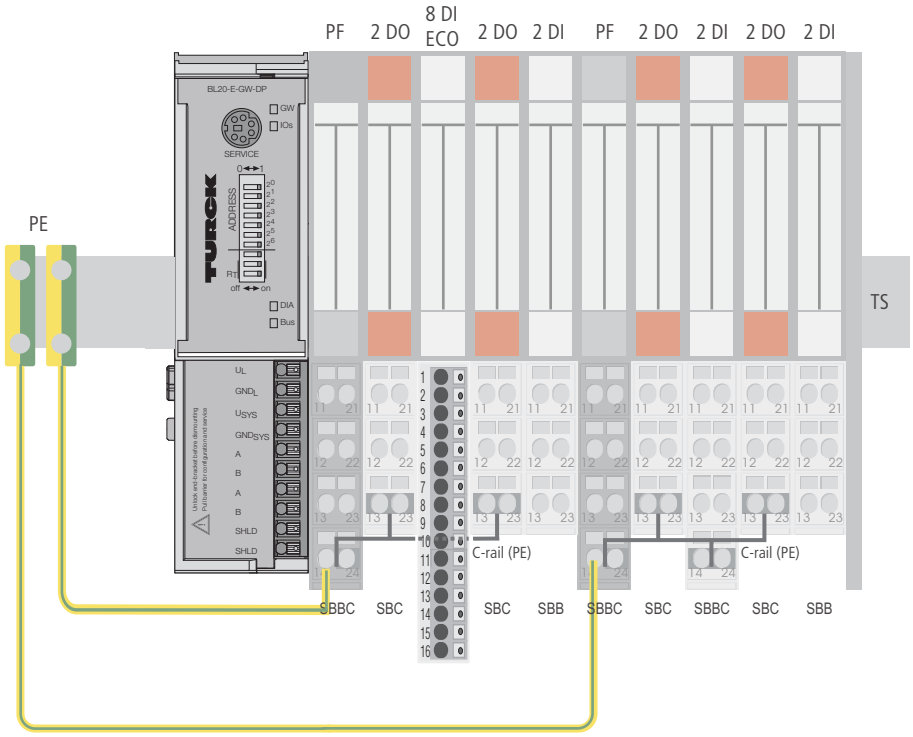


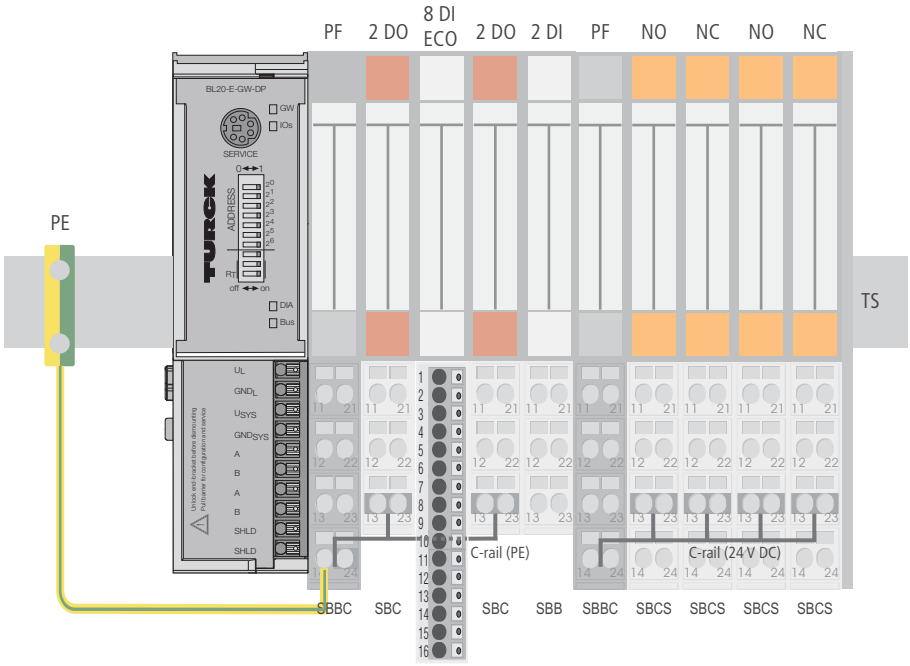
Figure 6-4: Using the C-rail as a protective earth

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 6-5: Using the C-rail as protective earth and for the power supply with relay modules



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

6.3.4 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.

6.4 Protecting the Service Interface on the Gateway

During operation, the label protecting the service interface and the DIP-switches must remain closed due to EMC and ESD.

6.5 Plugging and Pulling Electronics Modules

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



Attention

If the field and system supplies remain connected when electronics 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.

6.6 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.

6.7 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.

7 Guidelines for Electrical Installation

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7.1 General Notes

7.1.1 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.).

7.1.2 Cable Routing

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

Cable Routing Inside and Outside of Cabinets

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

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

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

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.



Danger

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

7.1.3 Lightning Protection

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

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

7.1.4 Transmission Cables

The bus stations are connected to one another via fieldbus cables, which comply with the RS 485 specifications and with DIN 19 245. Accordingly, the cable must have the following characteristics:

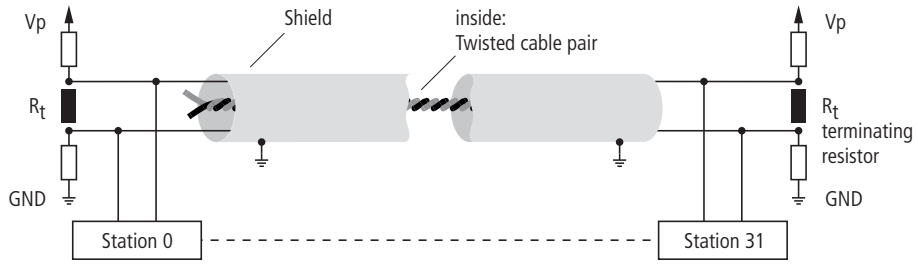
Table 7-1: Parameters of cable type A

Parameter	Cable A (DIN 19245, part 3)
Characteristic impedance	35 to 165 Ω (3 to 20 MHz)
Capacitance per unit length	< 30 nF/km
Loop resistance	< 110 Ω/km
Wire diameter	> 0.64 mm/ 0.025 inch
Wire cross-section	> 0.34 mm^2 / 0.0005 $inch^2$
Terminating resistor	220 Ω

Attention

The adherence to these parameters becomes more important the higher the baud rate, the more stations there are on the bus and the longer the length of the cable.

Figure 7-1: Representation of a PROFIBUS-DP cable



Cable Types

Turck offers a variety of cable types for fieldbus lines as premoulded or bulk cables with different connectors (M12 or SUB-D).

The ordering information for the available cable types can be found in the TURCK BL20 catalogs.

7.2 Potential Relationships

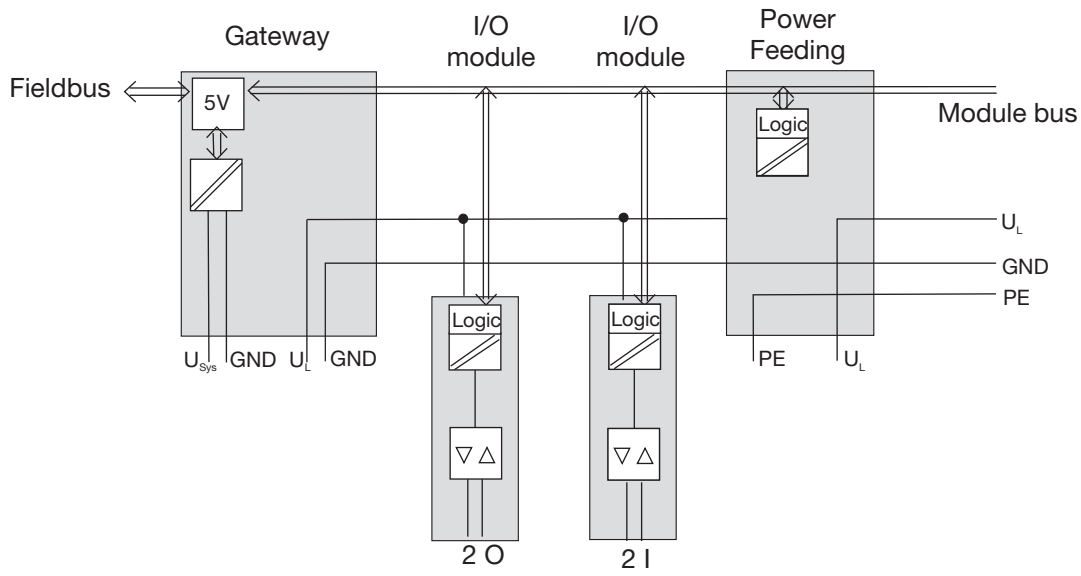
7.2.1 General

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

- The system's power supply to the gateway, I/O modules and the field level is connected to the gateway.
- All BL20 modules (gateway, Power Feeding and I/O modules) are connected capacitively via base modules to the mounting rails.
- Separate power supplies for the system and the field level allow a potential-free installation.

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

Figure 7-2: Block diagram of a BL20 station with an ECO-DP gateway



7.2.2 Potential-Free Installation

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

A potential-free installation is necessary with

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

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

7.3 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.

7.3.1 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.

7.3.2 Grounding of Inactive Metal Components

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

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



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.

7.3.3 PE Connection

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

7.3.4 Earth-Free Operation

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

7.3.5 Protection against high frequency interference signals

Attention

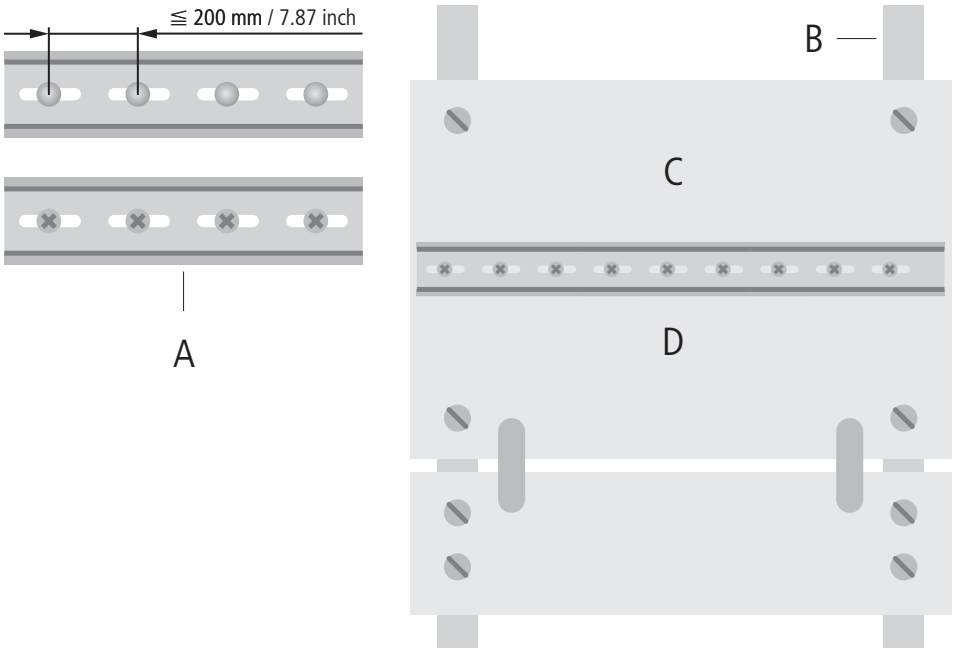
In order to comply with radiation limit values in accordance with EN 55 011/2 000, the supply lines for supplying the gateway with power are to be fed through a ferrite ring (PS416-ZBX-405). This is to be placed immediately next to the connection terminals. From there on, it is not permitted to make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

7.3.6 Mounting Rails

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

Figure 7-3: Mounting options

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

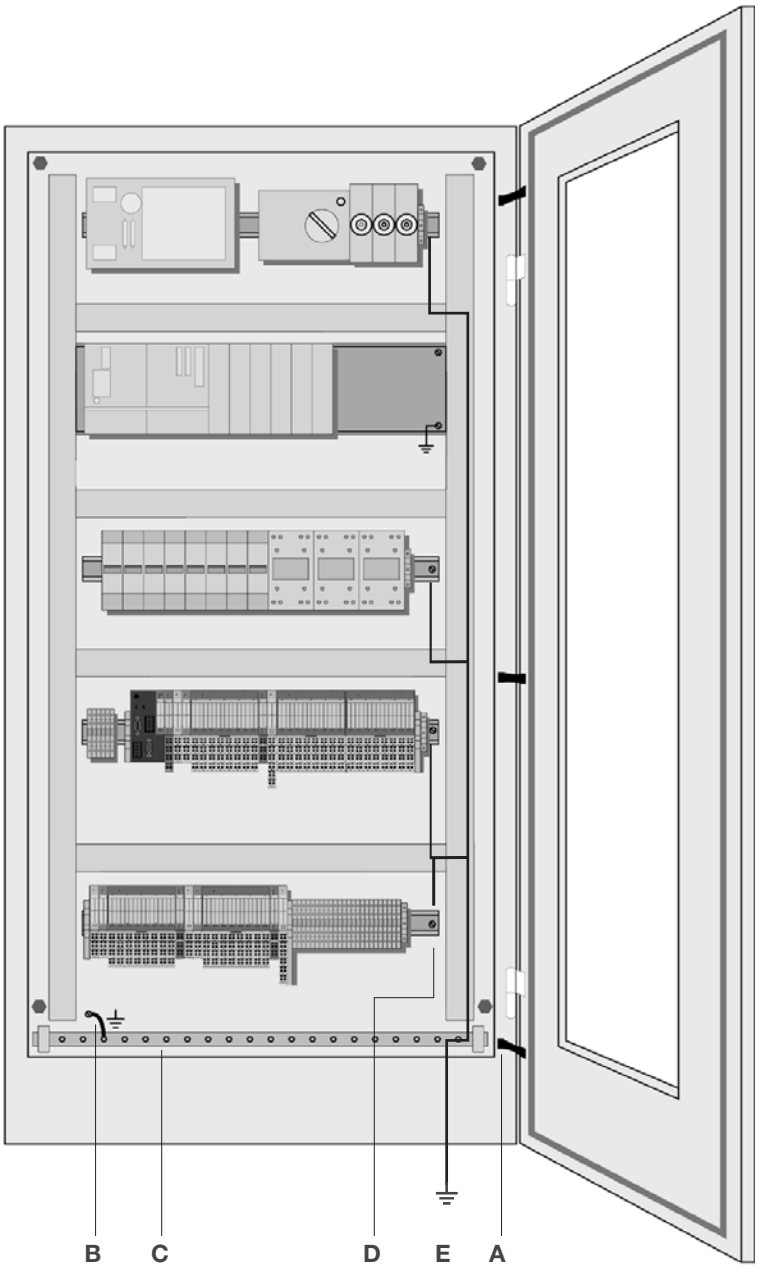


Mount the mounting rails over a large surface area and with a low impedance to the support system using screws or rivets.

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).

7.3.7 EMC Compliant Cabinet Installation

Figure 7-4: EMC compliant cabinet installation



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

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

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

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

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

7.4 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 or resistor can be connected parallel to the capacitor, to prevent disruptive discharges when interference pulses occur.

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

7.4.1 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.

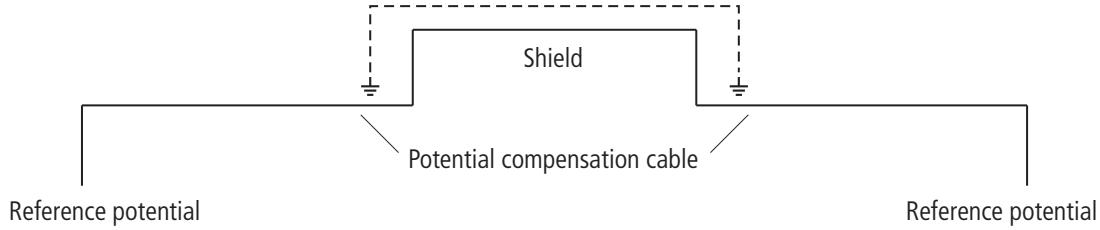


Danger

Never use the shield as a potential compensation.

Connection A				Connection B		
B	3	0	----------	0	3	B
	5	0		0	5	
A	8	0	----------	0	8	A

Figure 7-5: Potential compensation

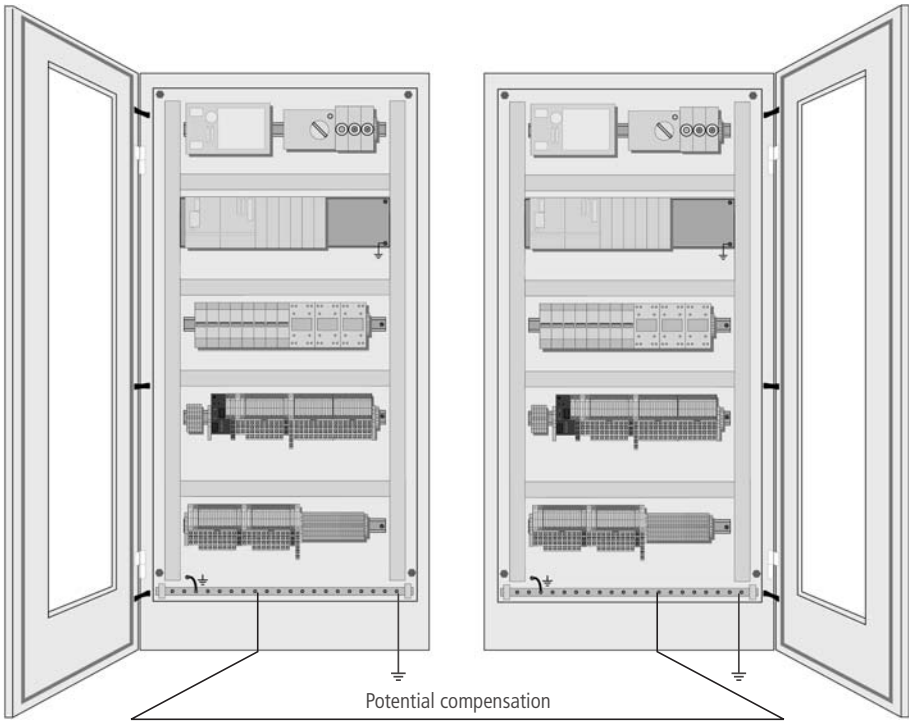


A potential compensation cable must have the following characteristics:

- 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 7-6: Potential compensation between switch-gear cabinets



7.4.2 Switching Inductive Loads

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

7.4.3 Protection against Electrostatic Discharge (ESD)

Attention

Electronics 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.

8 Integration of Technology Modules in PROFIBUS-DP

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

8.1.1 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 “Behavior 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 8-1: 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 behavior of DO1/DO2“:

Table 8-2: PDOut with “Function and behavior 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 8-3: 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 8-3: 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.
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.

Table 8-3: Meaning of the data bits (process output)

Control bit	Explanations
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 8-4: 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 8-5: 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.
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.

Table 8-5: Meaning of the data bits (process input)

Bits	Explanations
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.
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)

	B7	B6	B5	B4	B3	B2	B1	B0
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 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 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/O-ASSISTANT 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 8-6: Parameters for count modes

A*Default value*

Designation		**Description**
Value		
– Group diagnostics		
0 **A**	Release	Separate diagnostics is released.
1	Block	Separate diagnostics is blocked.
– Behavior CPU/master stop		
00 **A**	turn off DO1	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	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 µs (200 kHz) 25 µs (20 kHz)	
– Sensor/Input filter (B)		
0 **A** 1	2.5 µs (200 kHz) 25 µs (20 kHz)	
– Sensor/Input filter (DI)		
0 **A** 1	2.5 µs (200 kHz) 25 µs (20 kHz)	
– sensor (A)		
00 **A** 01	Normal Inverted	
– direction input (B)		
0 **A** 1	Normal Inverted	

Table 8-6: Parameters for count modes

A*Default value*

Designation		**Description**
Value		
– 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		
000000 **A**	continuous count	
000001	single-action count	
000010	periodical count	

Table 8-6: Parameters for count modes

A*Default value*

Designation		**Description**
Value		
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 8-6: Parameters for count modes

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.*

Designation		**Description**
Value		
– lower count limit (HWORD) **B**		
8000 0000 **A** to 0 ($_{hex}$)	-32768 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 655351 (SINT)	see above: „lower count limit“

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 8-7: 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.
main count direction wrong	5	The value (11) for selecting the main count direction is incorrect. Permissible values: 00 → None 01 → Up 10 → Down

Table 8-7: Meaning and position of the data bits (diagnostics)

Name of error type	Position	Explanations
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)!

8.1.2 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 8-8: 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 8-9: 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 8-10: 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 8-11: 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.
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.

Table 8-11: Meaning of the data bits (process output)

Control bit	Explanations
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 XN-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 8-12: 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 8-13: 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.
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

Table 8-13: Meaning of the data bits (process input)

Bits	Explanations
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 8-14: Parameters for measurement modes

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:*

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**	Normal	
1	Inverted	
– function DI		
00 **A**	Input	
01	HW gate	Hardware release
10 to 11	reserved	-
– 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)	
– 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	

Table 8-14: Parameters for measurement modes

A*Default value*

Designation		Description
Value		
*– 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	Behavior 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	-

Table 8-14: Parameters for measurement modes

A*Default value*

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 µs (200 kHz)	
1	25 µs (20 kHz)	
– Sensor/Input filter (B)		
0 **A**	2.5 µs (200 kHz)	
1	25 µs (20 kHz)	
– Sensor/Input filter (DI)		
0 **A**	2.5 µs (200 kHz)	
1	25 µs (20 kHz)	
– sensor (A)		
00 **A**	Normal	
01	Inverted	
– direction input (B)		
0 **A**	Normal	
1	Inverted	
– Group diagnostics		
0 **A**	Release	Separate diagnostics is released.
1	Block	Separate diagnostics is blocked.
– Behavior CPU/master stop		
00 **A**	turn off DO1	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 8-15: 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
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.

8.1.3 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 corresponding positive decimal value.

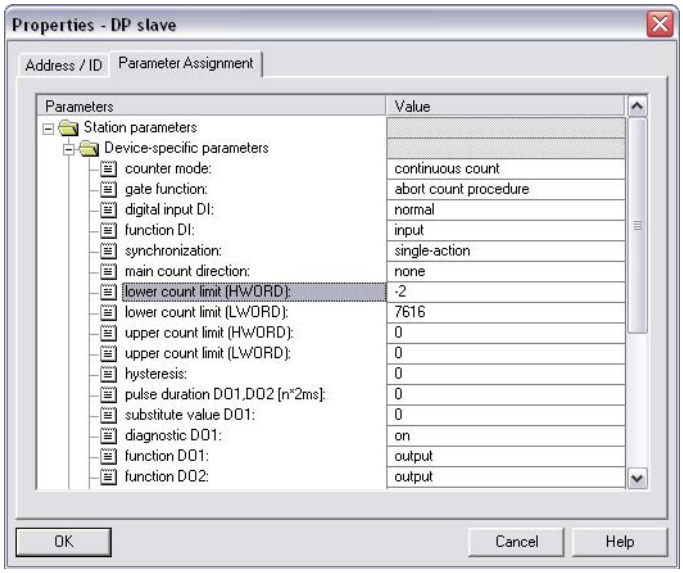
- If bit 15 is set, the reciprocal value of the hexadecimal value is formed:

  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 8-1: 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).

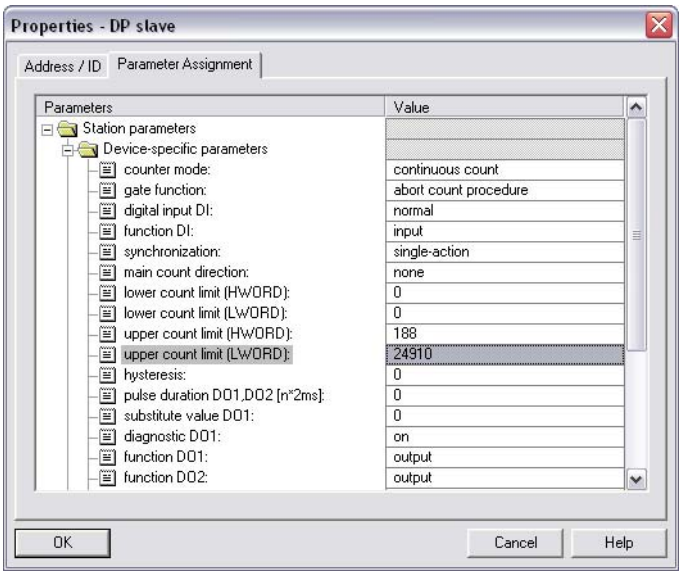


Figure 8-2: Entering the upper count limit as a High and Low word (dez.)

8.1.4 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

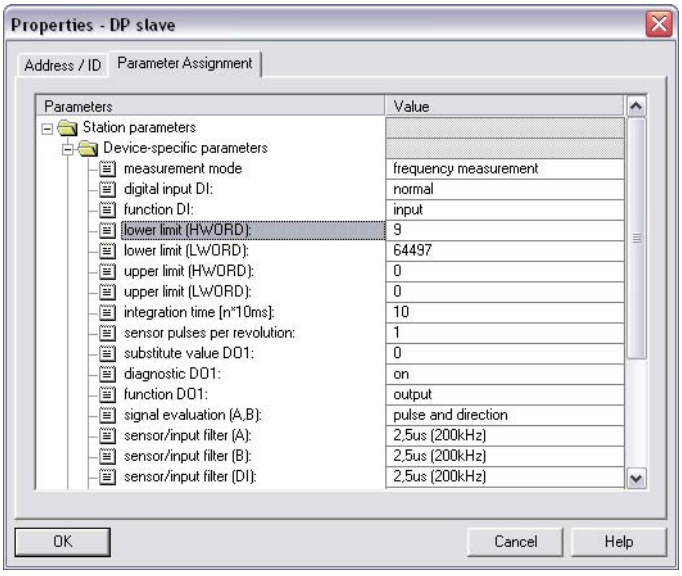
Low wOrd (binary): 1111 1011 1111 0001

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 8-3: 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:

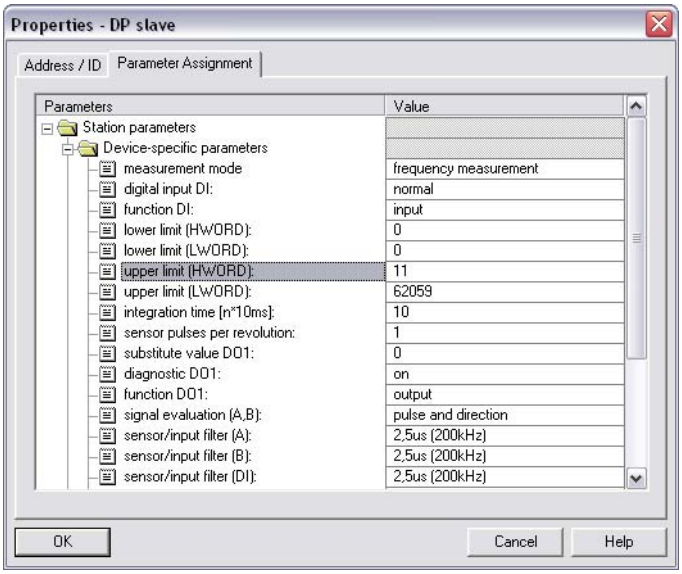
- Convert your decimal measuring limit to hexadecimal format.
- Example:
  The upper measuring limit is to be 782 955. This decimal value is represented in hexadecimal format (double word) as 000B F26B.
- The hexadecimal value (double word) is divided into a High word (000B) and a Low word (F26B).
- 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 8-4: Entering the upper measuring limit as a High and Low word



8.2 Integration of the RS232 module BL20-1RS232

8.2.1 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 8-5: Data image PLC input data

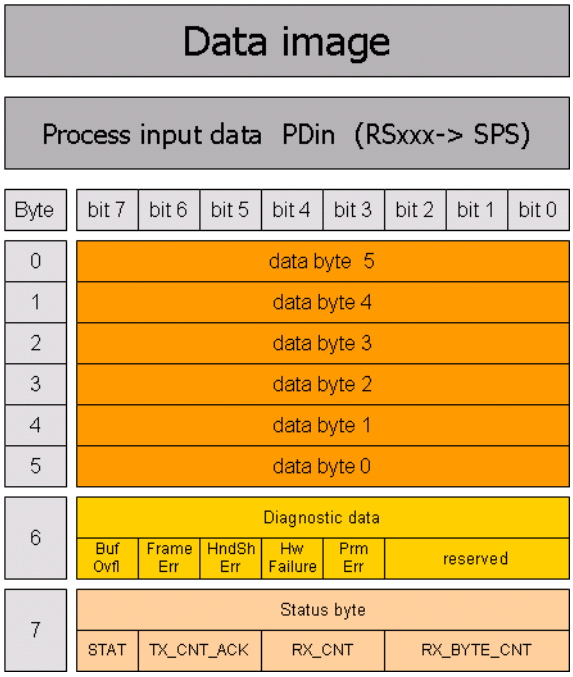


Table 8-16: Meaning of the data bits (process input)

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 8-16: 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 8-6: Process output data

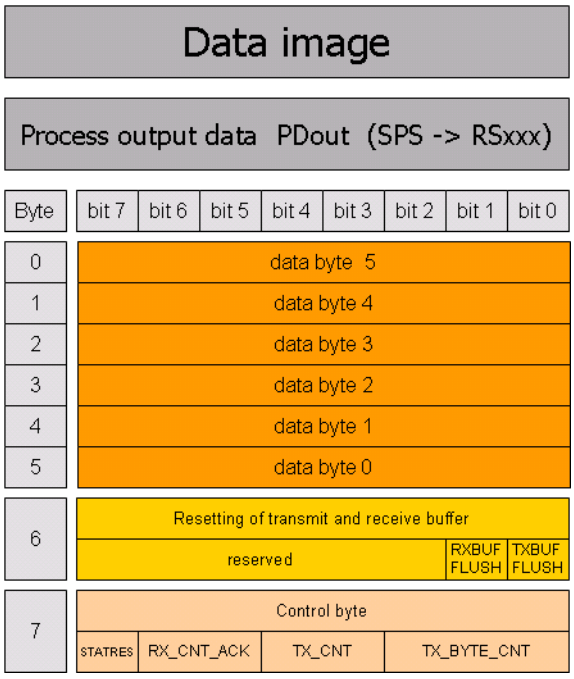


Table 8-17: Meaning of the data bits (process output)

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 transceive-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.

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

8.3.1 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 8-7: Data image PLC input data

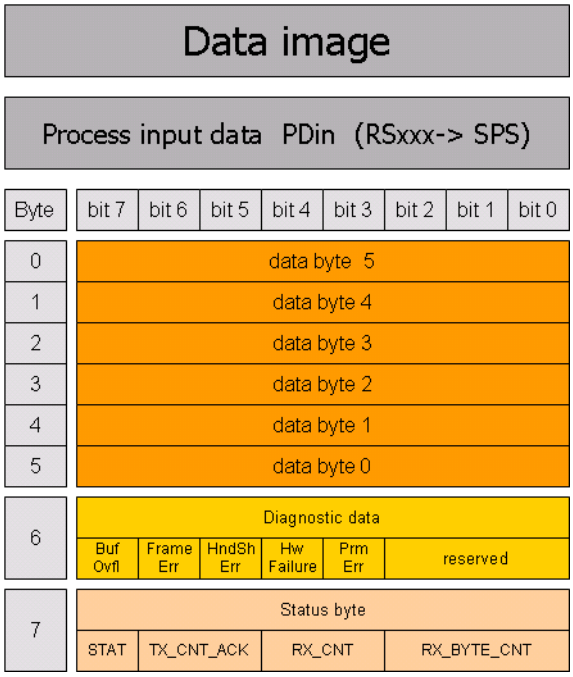


Table 8-18: Meaning of the data bits (process input)

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 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 8-18: 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 8-8: Process output data

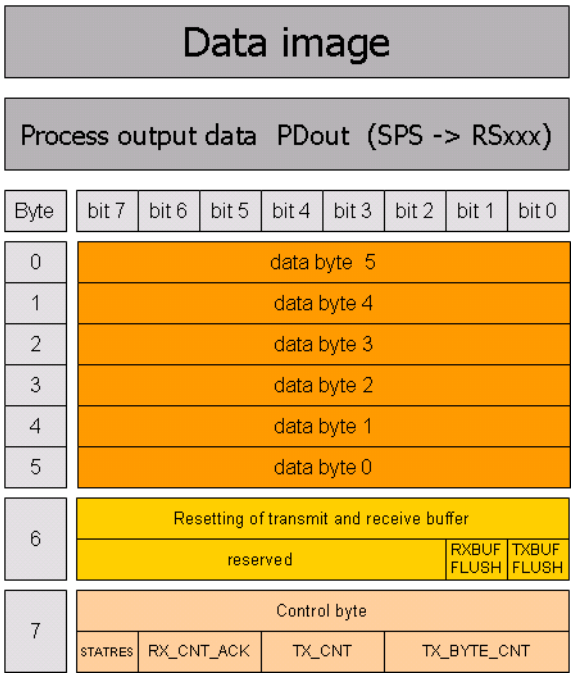


Table 8-19: Meaning of the data bits (process output)

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 transceive-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.

8.4 Integration of the SSI module BL20-1SSI

8.4.1 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 8-9: Process input data

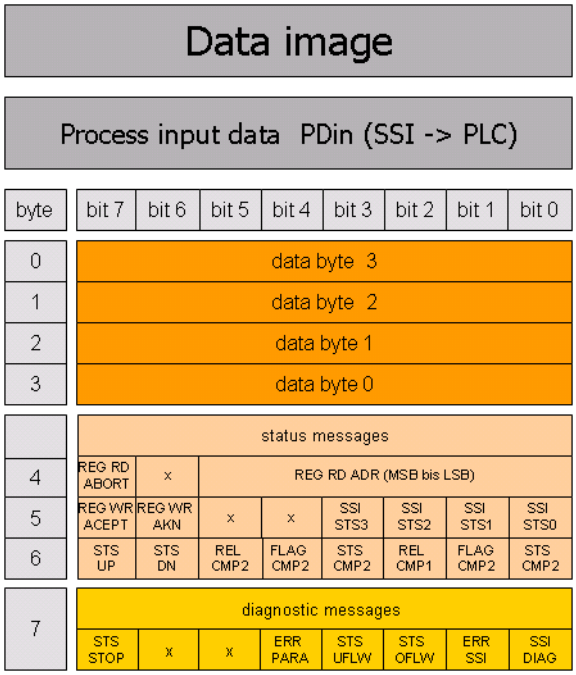


Table 8-20: Meaning of the data bits (process input)

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.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.

Table 8-20: Meaning of the data bits (process input)

Designation	Value	Meaning
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 8-20: 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 8-10: Process output data

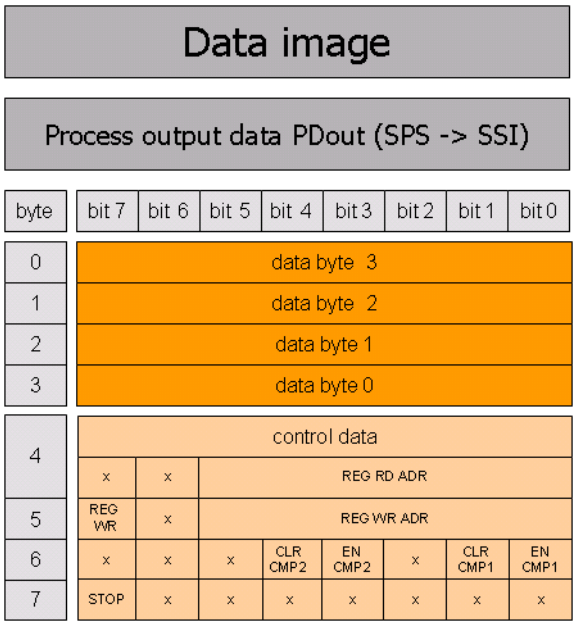


Table 8-21: Meaning of the data bits (process output)

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 with 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.
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

Table 8-21: Meaning of the data bits (process output)

Designation	Value	Meaning
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

8.5 Integration of the SWIRE Module BL20-E-1SWIRE

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

8.5.1 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 8-22: 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 8-23: 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 8-24: 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 8-25: 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 8-26: 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 8-27: Data bits

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

Table 8-28: Diagnostics

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	GENERAL$_{ERR}$	U$_{SWERR}$	free	COM$_{ERR}$	free	RDY$_{ERR}$	free	SW$_{ERR}$
Byte 2	free	U$_{AUXERR}$	TYP$_{ERR}$	free	PKZ$_{ERR}$	free	SD$_{ERR}$	free
TYP$_{ERR}$ field								
Byte 3	TYP$_{ERR}$S8	TYP$_{ERR}$S7	TYP$_{ERR}$S6	TYP$_{ERR}$S5	TYP$_{ERR}$S4	TYP$_{ERR}$S3	TYP$_{ERR}$S2	TYP$_{ERR}$S1
Byte 4	TYP$_{ERR}$ S16	TYP$_{ERR}$ S15	TYP$_{ERR}$ S14	TYP$_{ERR}$ S13	TYP$_{ERR}$ S12	TYP$_{ERR}$ S11	TYP$_{ERR}$ S10	TYP$_{ERR}$S9
Slave diagnostics bit field								
Byte 5	SD$_{ERR}$S8	SD$_{ERR}$S7	SD$_{ERR}$S6	SD$_{ERR}$S5	SD$_{ERR}$S4	SD$_{ERR}$S3	SD$_{ERR}$S2	SD$_{ERR}$S1
Byte 6	SD$_{ERR}$ S16	SD$_{ERR}$ S15	SD$_{ERR}$ S14	SD$_{ERR}$ S13	SD$_{ERR}$ S12	SD$_{ERR}$ S11	SD$_{ERR}$ S10	SD$_{ERR}$S9
PKZ field								
Byte 7	PKZ$_{ERR}$ S8	PKZ$_{ERR}$ S7	PKZ$_{ERR}$ S6	PKZ$_{ERR}$ S5	PKZ$_{ERR}$ S4	PKZ$_{ERR}$ S3	PKZ$_{ERR}$ S2	PKZ$_{ERR}$ S1
Byte 8	PKZ$_{ERR}$S16	PKZ$_{ERR}$ S15	PKZ$_{ERR}$ S14	PKZ$_{ERR}$ S13	PKZ$_{ERR}$ S12	PKZ$_{ERR}$ S11	PKZ$_{ERR}$ S10	PKZ$_{ERR}$ S9

The following table shows the meaning of the diagnostics bits:

Table 8-29: 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 8-29: 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
$GENERAL_{ERR}$	Error message		
	The creation of a function block shows that systems / function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.		
	0	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.

Table 8-29: Meaning of diagnostics data bits

Designation	Value	Meaning	
Byte 2			
$TYPE_{ERR}$	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 8-29: 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 $U_{AUX}ERR$, $TYPE_{ERR}$, $TYPE_{ERR}Sx$, PKZ_{ERR}, $PKZ_{ERR}Sx$, SD_{ERR} and $SD_{ERR}Sx$ can be deactivated via the parameter setting.

Parameters

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

Table 8-30: Parameters

	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 8-31: 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 push-button 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.

Table 8-31: Meaning of the parameter bits

Designation	Status	
Byte 2		
SD_{INFO}	Slave error field	
	Activate slave diagnostics info field $SD_{ERR}Sx$. As soon as a slave on the bus sets its error bit, this is indicated individually as an error depending on the parameter setting.	
	0 = Active **A**	Single diagnostics is activated
	1 = Inactive	Single diagnostics is not activated
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

Table 8-31: Meaning of the parameter bits

Designation	Status	
Byte 2		
$TYPE_{ERR}$	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
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	
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)	

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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