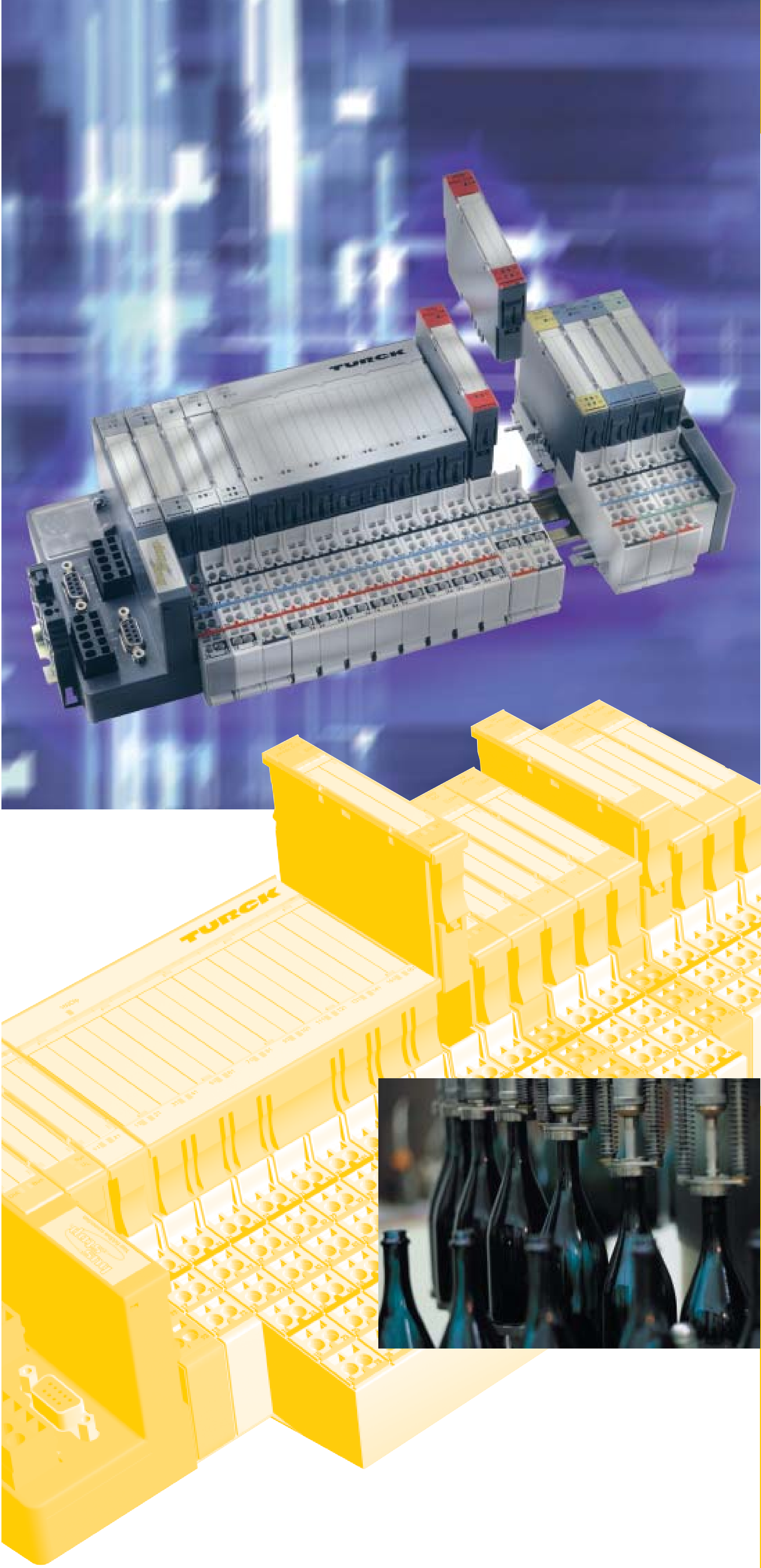
TURCK

Industrial
Automation



BL20 –

USER MANUAL FOR CANopen

Edition 07/2007

Safety Notes!

Before starting 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 (AWA) 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.

Table of Contents

About this Manual

Documentation Concept

This manual contains all information about the BL20-gateway for CANopen.

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

The bus-independent I/O-modules 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 contains a short description of the project planning and diagnostics software for TURCK I/O-systems, the software I/O-ASSISTANT.

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 products. It has been specially conceived for personnel with the necessary qualifications.

Prescribed Use

Warning

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.

Notes Concerning Planning /Installation of this Product

Warning

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

Description of Symbols Used

Warning

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 BL20 Philosophy

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.

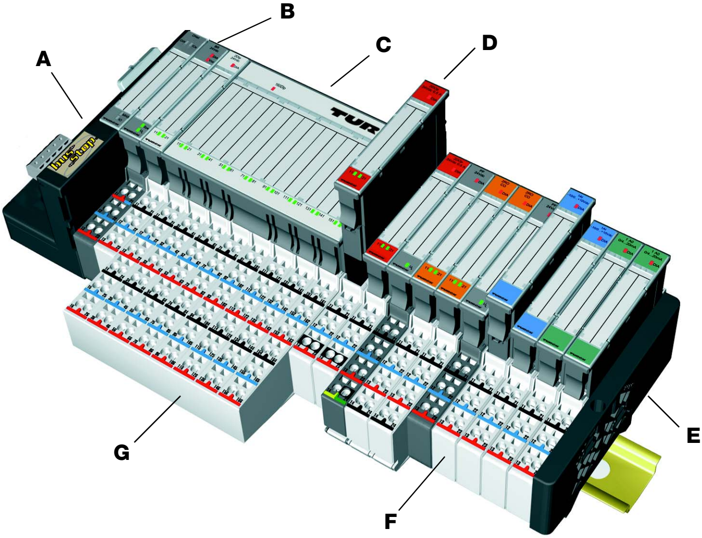


Figure 1: Example of a BL20 station

A *Gateway*
B *Power distribution module*
C *Electronics module in block design*
D *Electronics module in slice design*
E *End plate*
F *Base module in slice design*
G *Base module in block design*

Flexibility

All BL20 stations can be planned to accommodate the exact number of channels to suit your needs, because the modules are available 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 (gateway 50.4 mm / 1.98 inch, slice 12.6 mm / 0.49 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, 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 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.

BL20 Components

For a detailed explanation of the individual BL20 components, please refer to chapter 2 and chapter 4. The "Appendix" to this manual contains (amongst others) a list of all BL20 components and the assignment of electronics modules to base modules.

Gateways

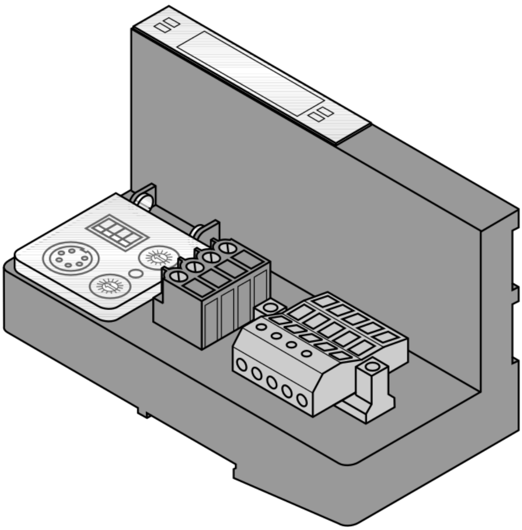
The gateway connects the fieldbus to the I/O modules. It is responsible for handling the entire process data and generates diagnostic information for the higher-level master and the software tool I/Oassistant.

Gateways with integrated power supply

The BL20 gateway BL20-GWBR-CANOPEN offers 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: Gateway BL20-GWBR-CANOPEN



Gateways without power supply

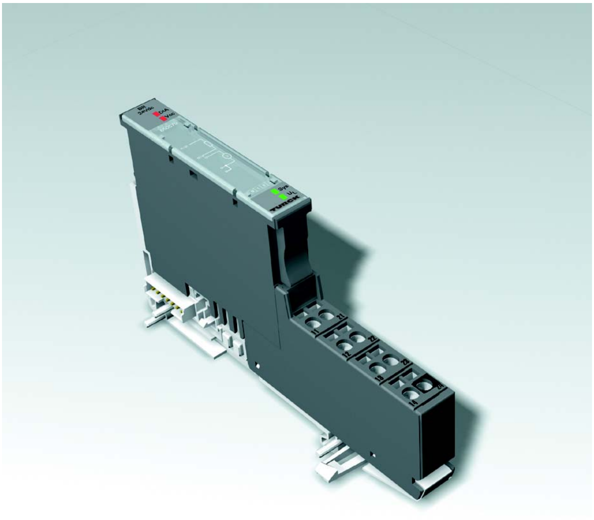
Note

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.

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 3: Power distribution module



Electronics Modules

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

Electronics modules are plugged onto the base modules and are not directly connected to the wiring. The assignment table in the Section "Ordering Information" of the "Appendix" shows the possible combinations of electronics and base modules. They can be plugged or pulled when the station is being commissioned or for maintenance purposes, without having to disconnect the field wiring from the base modules.

Figure 4: Electronics module in slice design

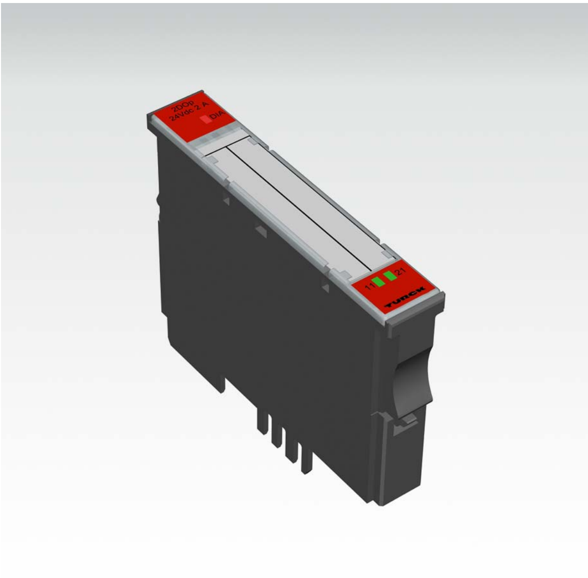
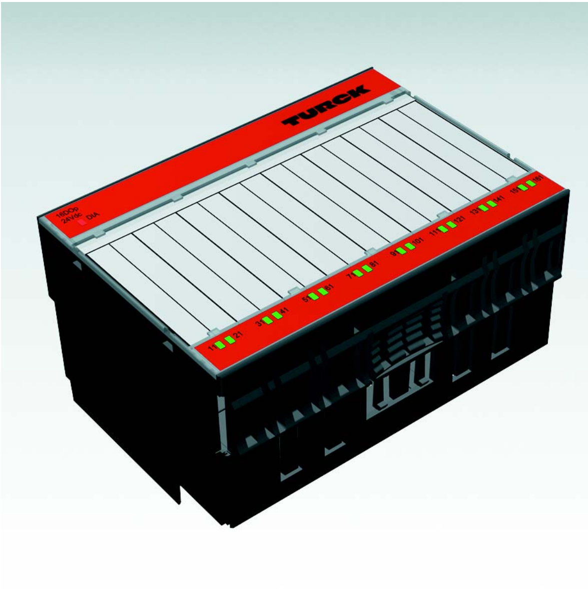


Figure 5: Electronics module in block design



Base Modules

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

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

Figure 6: Base module with tension clamp connection

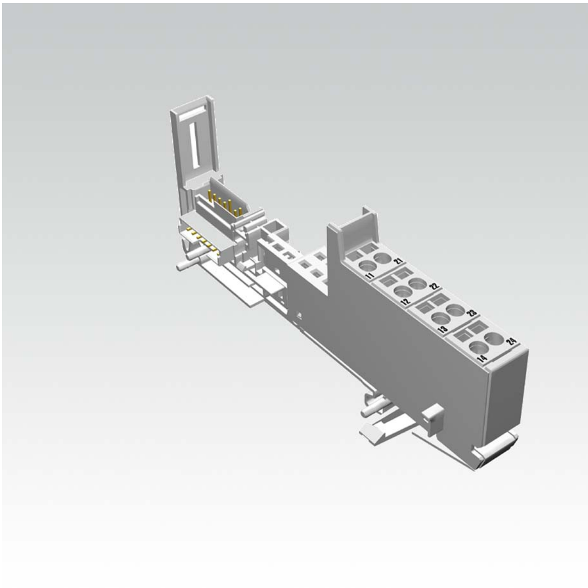


Figure 7:
Base module with screw connection

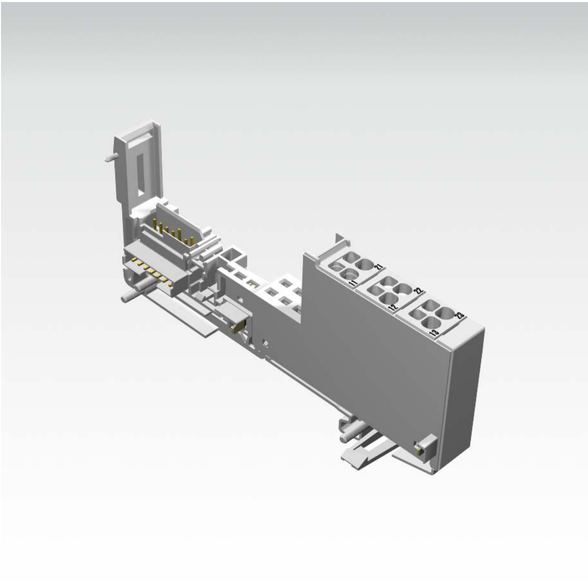
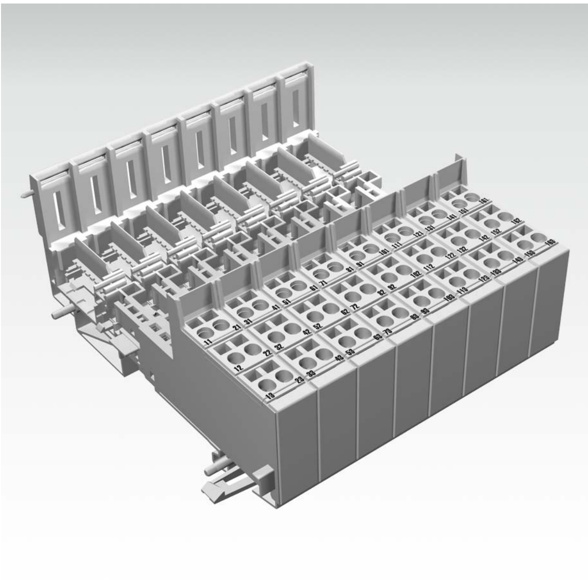


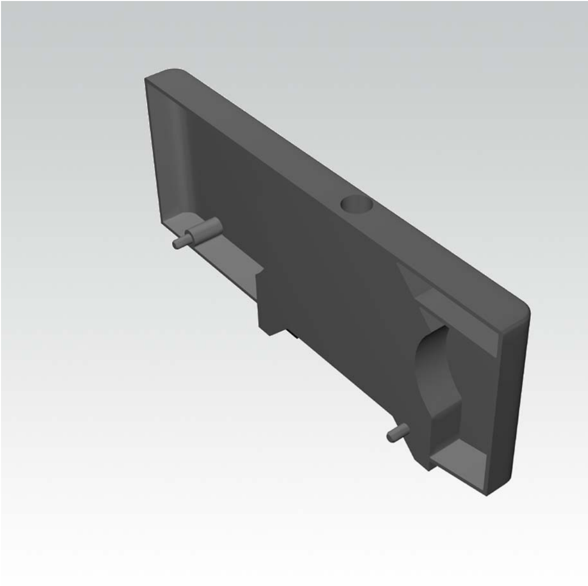
Figure 8:
Base module in block design



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.

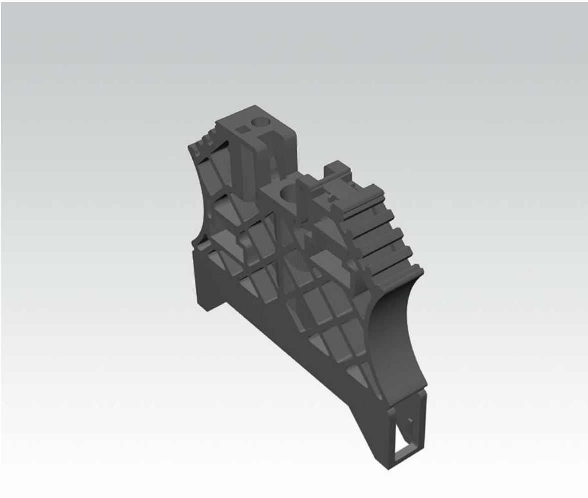
Figure 9: End plate



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 10: End bracket



Note

The end plate an the end bracket are delivered together with each gateway.

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.

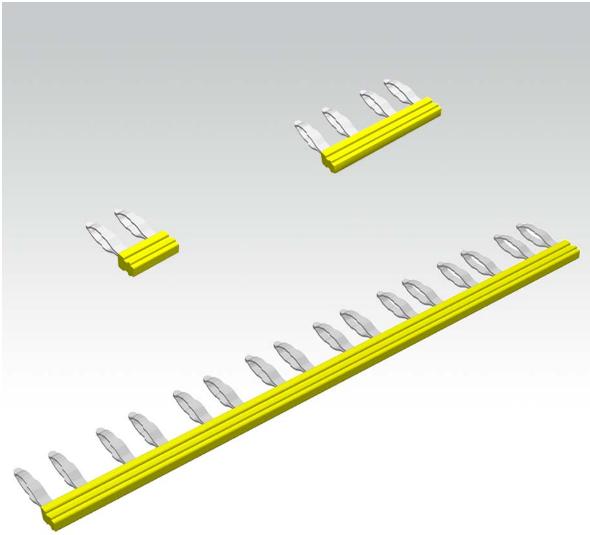
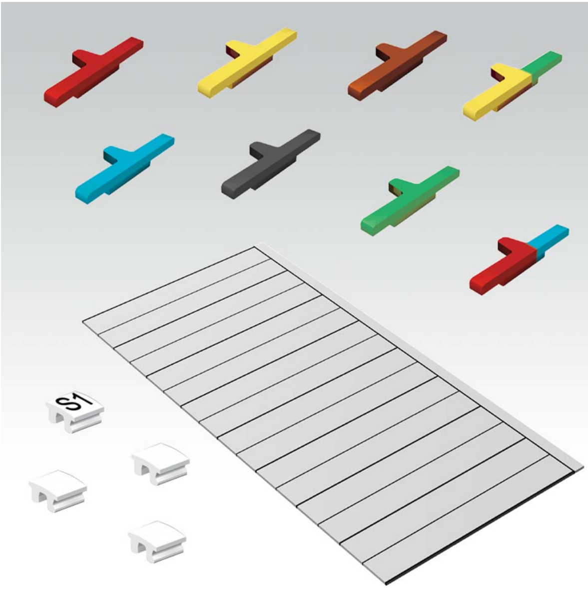


Figure 11: Jumpers

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.

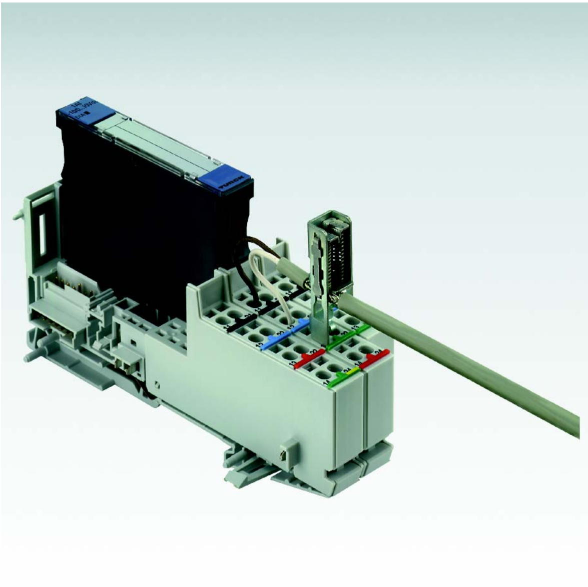
Figure 12: Marking material



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 13: Shield connection



2 Short description of CANopen

CANopen

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

General

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

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

CANopen is based on the following standards:

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

Communication

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

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

4 different types of telegram message are defined for CANopen:

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

Network Management Messages

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

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

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

The NMT message is mapped to a single CAN frame with a data length of 2 byte. Its identifier is 0. The first byte contains the command specifier and the second contains the Node-ID of the device that must perform the command (in the case of Node-ID 0 all nodes have to perform the command). The NMT message transmitted by the NMT master forces the nodes to transit to another NMT state. The CANopen state machine specifies the states Initialization, Pre-Operational, Operational and Stopped. After power-on, each CANopen device is in the state Initialization and automatically transits to the state Pre-operational. In this state, transmission of SDOs is allowed. If the NMT master has set one or more nodes into the state Operational, they are allowed to transmit and to receive PDOs. In the state Stopped no communication is allowed except that of NMT objects.

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

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

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

Service Data Objects (SDOs)

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

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

Process Data Objects (PDOs)

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

PDO transmissions

PDO transmissions may be driven by an internal event, by an internal timer, by remote requests and by the Sync message received:

- Event- or timer-driven:
  An event (specified in the device profile) triggers message transmission. An elapsed timer additionally triggers the periodically transmitting nodes.
- Remotely requested:
  Another device may initiate the transmission of an asynchronous PDO by sending a remote transmission request (remote frame).
- Synchronous transmission:
  In order to initiate simultaneous sampling of input values of all nodes, a periodically transmitted Sync message is required. Synchronous transmission of PDOs takes place in cyclic and acyclic transmission mode. Cyclic transmission means that the node waits for the Sync message, after which it sends its measured values. Acyclically transmitted synchronous PDOs are triggered by a defined application-specific event.

Special Function Objects

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

- **Synchronization object (Sync)**
  The Sync Object is broadcast periodically by the Sync Producer. The time period between Sync messages is defined by the Communication Cycle Period, which may be reset by a configuration tool to the application devices during the boot-up process. There can be a time jitter in transmission by the Sync Producer due to some other objects with higher prior identifiers or by one frame being transmitted just before the Sync message. The Sync message is mapped to a single CAN frame with the identifier 128 by default. The Sync message does not carry any data.
- **Emergency object (Emcy)**
  The Emergency message is triggered by the occurrence of a device internal error situation and are transmitted from an Emergency producer on the concerned application device. This makes them suitable for interrupt type error alerts. An Emergency message is transmitted only once per ‘error event’. As long as no new errors occurs on a device, no further Emergency message can be transmitted. Zero or more Emergency consumers may receive these. The reaction of the Emergency consumer is application-specific. CANopen defines several Emergency Error Codes to be transmitted in the Emergency message, which is a single CAN frame with 8 data byte.
- **Time stamp object (Time)**
  By means of Time-Stamp, a common time frame reference is provided to application devices. It contains a value of the type Time-of-Day. This object transmission follows the producer/consumer push model. The associated CAN frame has the predefined identifier 256 and a data field of 6-byte length.

BL20 and CANopen

BL20 supports the following CANopen functions:

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

Electronic data sheet – EDS file

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

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

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

3 BL20 - Gateway for CANopen

Introduction

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

Attention

Please note, SWIRE-modules can only be used with the gateways BL20-GW-CANOPEN with firmware version ≥ 4.02 and BL20-GWBR-CANOPEN with firmware version ≥ 2.02.

Warning

The behavior of the analog inputs is now adapted to the actual CANopen standard DS401.
The firmware versions ≥ 4.02 for BL20-GW-CANOPEN and version ≥ 2.02 for BL20-GWBR-CANOPEN are thus not compatible with older firmware versions relating to the behavior of the analog inputs.

Function

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

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

Technical Information

Figure 1: BL20-GW-CANOPEN

A *Service interface*
B *Type designation*
C *LEDs for module bus*
D *DIP-switch for transfer rate*
E *Rotary encoding switch for Node-ID*
F *SET button*
G *CANopen, SUB-D plug*
H *CANopen, direct wiring*
I *LEDs for CANopen*
J *CANopen, SUB-D socket*

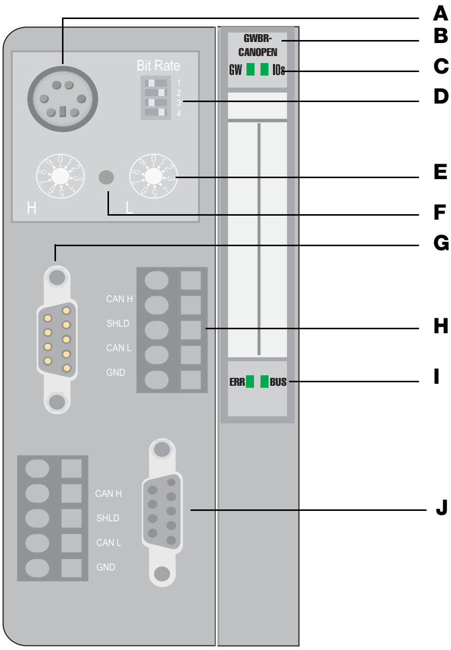
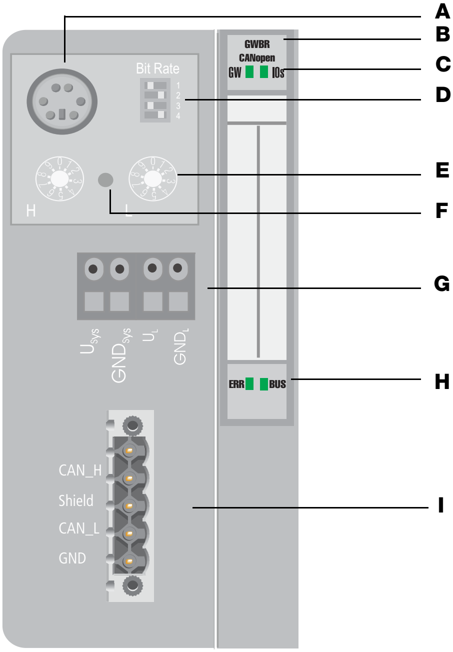


Figure 2: BL20-GWBR-CANOPEN

A *Service interface*
B *Type designation*
C *LEDs for module bus*
D *DIP-switch for transfer rate*
E *Rotary encoding switch for Node-ID*
F *SET button*
G *Screw terminals for field supply and system supply*
H *CANopen, direct wiring*
I *Open Style connector*



Technical Data

General Technical Data Relating to a Station

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

Table 1: General technical data (station)

Supply voltage/ auxiliary voltage	
Nominal value (provision for other modules)	24 V DC
Permissible range	according to EN 61131-2 (18 to 30 V DC)
Residual ripple	according to EN 61131-2
Potential isolation	Yes, via optocoupler
Ambient conditions	
Ambient temperature	
– $t_{Ambient}$	0 to +55 °C / 32 to 131 °F
– t_{Store}	-25 to +85 °C / 13 to 185 °F
Relative humidity	according to IEC 61 131-2/ EN 50 178
Climatic tests	according to IEC 61131-2
Noxious gas	– SO^2: 10 ppm (rel. humidity < 75 %, non-condensing) – H_2S: 1.0 ppm (rel. humidity < 75 %, non-condensing)

Resistance to vibration according to IEC 61131-2	
10 to 57 Hz, Constant amplitude 0.075 mm / 0.003 inch, 1g	Yes
57 to 150 Hz, Constant acceleration 1 g	Yes
Mode of vibration	Frequency sweeps with a change in speed of 1 Octave/min
Period of oscillation	20 frequency sweeps per axis of coordinate
Shock resistant according to IEC 68-2-27	18 shocks, sinusoidal half-wave 15 g peak value/11 ms, in each case in +/- direction per space coordinate
Resistance to repetitive shock according to IEC 68-2-29	1 000 shocks, half-sinus 25 g peak value/6 ms, in each case in +/- direction per space coordinate
Topple and fall according to IEC 68-2-31 and free fall according to IEC 68-2-32	
Weight	< 10 kg
Height of fall	1.0 m / 39.37 inch
Weight	10 to 40 kg
Height of fall	0.5 m / 19.69 inch
Test runs	7
Device with packaging, electrically tested printed-circuit board	

Electromagnetic compatibility (EMC) according to EN 50 082-2 (Industry)	
Static electricity according to EN 61 000-4-2	
– Discharge through air (direct)	8 kV
– Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to EN 61 000-4-3 and ENV 50 204	10 V/m
Conducted interferences induced by HF fields according to EN 61 000-4-6	10 V
Fast transients (Burst) according to EN 61 000-4-4	
Interference criteria A: unrestricted operation, normal operating behavior	1 kV
Interference criteria B: temporary interference, normal operation possible	2 kV
Emitted interference according to EN 50 081-2 (Industry)	according to EN 55 011 Class A, Group 1

Reliability	
Operational life MTBF	min. 120000 h
Electronic modules pull/ plug cycles	20
Tests according to EN 61 131-2	
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
Temperature change	DIN IEC 68-2-14, temperature 0 to +55 °C / 32 to 131 °F, duration 2 cycles, temperature change per minute; device in use
Pollution severity according to IEC 664 (EN 61 131-2)	
Protection class according to IEC 529	IP20

Warning

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

Approvals

Table 2: Approvals

CE
CSA
UL

Base Modules

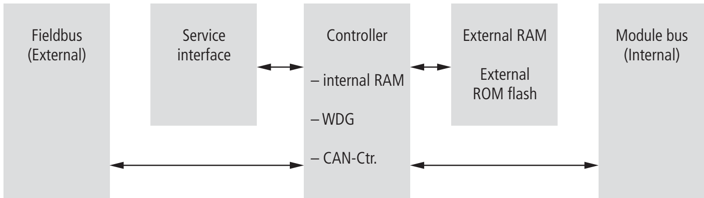
Table 3: Technical data for base modules

Protection class	IP 20
Measurement data according to VDE 0611 Part 1/8.92/ IEC 947-7-1/1989	
Insulation stripping length	8 mm / 0.32 inch
Max. wire range	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$ / 20 to 12 AWG
Crimpable wire	
"e" solid core H 07V-U	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$ / 20 to 12 AWG
"f" flexible core H 07V-K	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$ / 20 to 16 AWG
"f" with ferrules according to DIN 46228/1 (ferrules crimped gas-tight)	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$ / 20 to 16 AWG
Plug gauge according to IEC 947-1/1988	A1
TOP connection technology	Tension clamp or screw connection

Structure Diagram of a Gateway

The BL20 CANopen gateway has the following structure:

Figure 3: Gateway structure



Technical Data BL20-GW-CANOPEN

Table 4: Technical data BL20-GW-CANOPEN

Designation	Value
Supply voltage(as per EN 61131-2)	
Nominal value (supply from bus refreshing module)	5 V DC (4.8 to 5.2 V DC)
Restriction on EN 61131-2	The supply energy required to bridge a supply interruption up to 10 ms is not stored. Please secure the U_{sys} for BL20-BR-24VDC-D modules by using an appropriate power supply unit!
Current drawn from the module bus	
Without service/without fieldbus	≈ 280 mA
Without service/with fieldbus (12 Mbps)	≈ 410 mA
With service/without fieldbus	≈ 300 mA
Maximum	≈ 350 mA
Dimensions	
Width/length/height (mm)	50.6 x 114.8 x 74.4 mm

Designation	**Value**
Service	
Connections	PS/2 socket
Fieldbus terminations	1x 9-pole SUB-D socket, 1x 9-pole SUB-D plug, 2 x tension spring connector type LPZF, 5.08, 5-pole
Fieldbus shielding connection	via BL20-SCH-1
Transfer rate	10, 20, 50, 125, 250, 500, 800 and 1000 kbps
Fieldbus termination	SUB-D plug connector or external resistors
2 rotary hex encoder switches with labeling for the Node-ID setting.	

Technical Data BL20-GWBR-CANOPEN

Table 5: Technical data BL20-GWBR-CANOPEN

Designation	Value
Supply	
Field supply	
U_L Nominal value (range)	24 V DC (18 to 30 V DC)
I_L max. field current	10 A
Isolation voltage (U_L to U_{SYS}/ U_L to fieldbus/U_L to FE)	$500V_{eff}$
Connections	2-pole screw terminal
System supply	
U_{SYS} nominal value (range)	24 V DC (18 to 30 V DC)
I_{SYS} (for I_{MB} = 1.2 A/U_{SYS} = 18 V DC)	max. 900 mA
I_{MB} (supply to the module bus stations)	1.5 A
Isolation voltage (U_{SYS} to U_L/ U_{SYS} to fieldbus/U_{SYS} to FE)	$500V_{eff}$
Connections	2-pole screw terminal
Physical interfaces	
Fieldbus	
Transfer rate	10 kbps to 1 Mbps
Isolation voltage (fieldbus to U_{SYS}/ fieldbus to U_L/fieldbus to FE)	$500V_{eff}$

Designation	Value
Fieldbus connections	Socket: MSTBV 2,5/5-GF-5.08 GY AU/ Phoenix Contact
	Plug: TMSTBP 2,5/5-STF-5.08 AB GY AU/ Phoenix Contact (included in delivery)
Fieldbus shielding connection	Via connector
Node-ID setting	2 rotary decimal encoding switches
Service	
Connections	PS/2 socket

Warning

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

Connections for data cables to BL20-GW-CANOPEN

Fieldbus connection via SUB-D socket

SUB-D connectors are provided for communication with the BL20-GW-CANOPEN gateway through the CANopen fieldbus.

The passive bus termination must be applied externally if the BL20 gateway is the last station in the bus structure. This external application can be implemented either through separate termination resistors or through a special SUB-D plug which has an integrated bus termination.

The pin assignments for the plug and socket are identical – the socket is shown as an example:

Figure 4: SUB-D socket on the gateway (top view)

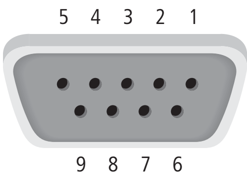


Table 6: Pin assignments for gateway SUB-D plug/socket

Pin No.	Designation	Meaning
1	not used	
2	CAN_L	inverted data signal (dominant low)
3	CAN_GND	ground (optional for CAN data signals)
4	not used	
5	(CAN_SHLD) **A**	
6	(GND)	
7	CAN_H	non-inverted data signal (dominant high)
8	not used	
9	(CAN_V+)	

A *The shielding of the fieldbus is connected through the metal housing of the SUB-D connector and the contact with the mounting rails (see Page 3-16)*

Fieldbus connection through direct wiring

For making connections to the fieldbus you can choose between a SUB-D connection and direct wiring. Direct wiring of the BL20-GW-CANOPEN to the CANopen fieldbus can be made through the two terminal blocks with tension spring connectors.

The passive bus termination must be applied externally if the BL20 gateway is the last station in the bus structure.

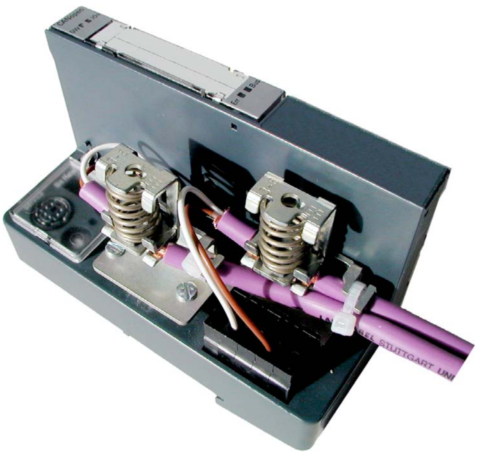
Table 7: List of connecting leads for direct wiring

Designation	Meaning
CAN_L	Inverted data signal (dominant low)
GND	Ground (optional)
SHLD	Shielding (see below)
CAN_H	Non-inverted data signal (dominant high)

Attention

If the gateway is wired up directly, then the bus connection must be shielded (e.g. with the help of a BL20-SCH-1 clamp).

Figure 5: Shielding connection for an BL20-GW-CANOPEN



Attention

No compensating current should flow through the shielding.

To achieve this, a reliable system of equipotential bonding must be installed.

Note

Equipotential bonding impedance ≤ 1/10 shielding impedance

Connections of the data cables to BL20-GWBR-CANopen

Fieldbus connection via Open Style connector

An Open Style Connector (5-pole) is available for connecting the BL20-GWBR-CANOPEN to the CANopen fieldbus.

The passive bus termination must be applied externally if the BL20 gateway is the last station in the bus structure.

Table 8: Pin assignment for the socket

1,2 - red		
3,4 - white	CAN_H	Non-inverted data signal (dominant high)
5,6 - grey	Shield,	Shielding braid, not insulated
7,8 - blue	CAN_L	Inverted data signal (dominant low)
9,10 - black	GND	Ground reference (optional)

Figure 6: Open Style connector (female/ top)

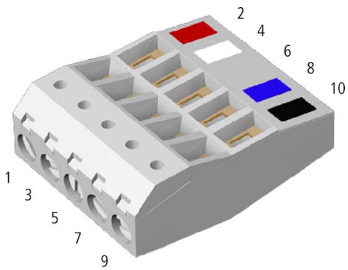


Figure 7: Open Style connector (female/ bottom)

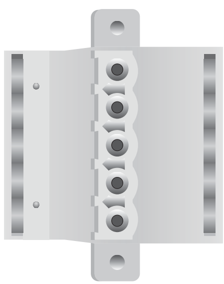


Figure 8: Open Style connector (male)

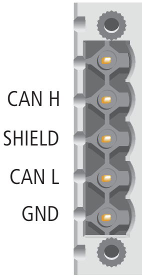
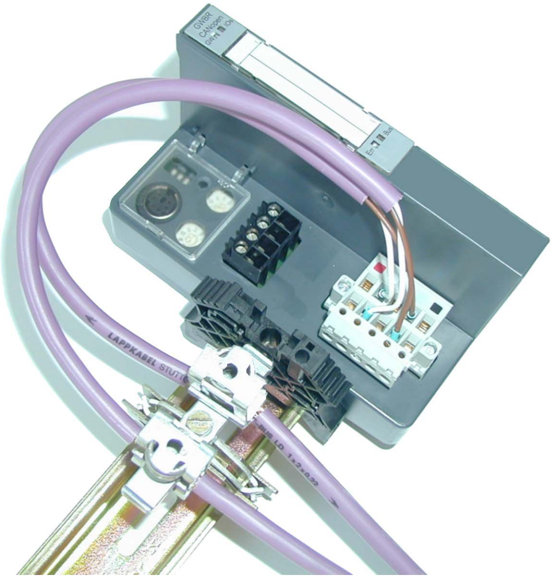


Figure 9: Shielding connection for an BL20-GWBR-CANOPEN



Attention

No compensating current should flow through the shielding.

To achieve this, a reliable system of equipotential bonding must be installed.

Service Interface Connection

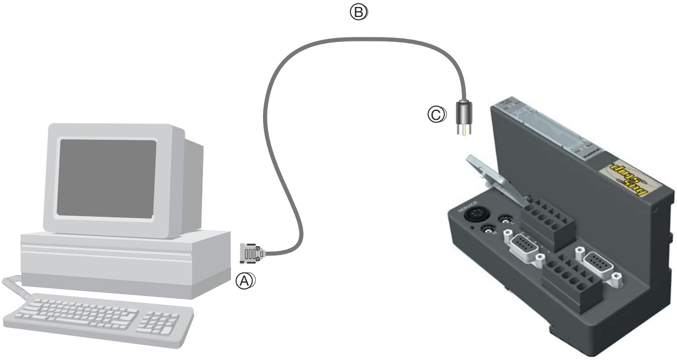
The following cable can be used to connect the service interface (female PS/2 connector) to a PC for the purpose of using I/O-ASSISTANT (project planning and diagnostic software).

- special I/O-ASSISTANT-connection cable from TURCK (IOASSISTANT-ADAPTERKABEL-BL20/BL67; Ident-no.: 6827133)

Connection with I/O-ASSISTANT-Connection Cable

Figure 10: BL20-gateway connected to PC via special cable

A *SUB-D socket*
B *BL20 connecting cable*
C *PS/2 plug*



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

Figure 11: PS/2 male connector on the connection cable to the gateway (top view)

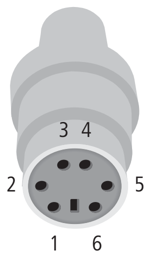


Figure 12: 9-pole SUB-D female connector on the cable for connecting to PC (top view)

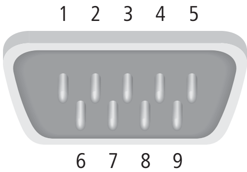


Table 9: Pin assignments for PS/2 and SUB-D interfaces

Pin	BL20 gateway PS/2 socket	SUB-D interface on PC	Pin
1	+5V Gw	DTR, DSR	4, 6
2	GND	GND	5
3	–	–	–
4	TxD	RxD	2
5	/CtrlMode	RTS	7
6	RxD	TxD	3

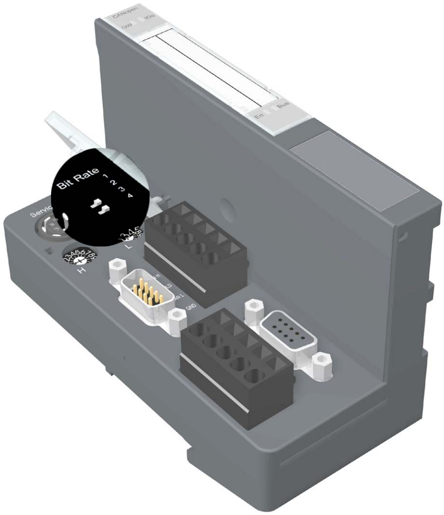
Setting the bit transfer rate through DIP-switches

The BL20 gateway can communicate with other CANopen nodes at the following transfer rates:

- 10 kbps
- 20 kbps
- 50 kbps
- 125 kbps
- 250 kbps
- 500 kbps
- 800 kbps
- 1000 kbps

The default transfer rate is 125 kbps.
The transfer rate can be set through the DIP-switches under the cover of the BL20 gateway.

Figure 13: DIP-switch to set the transfer rate



Note
All the nodes in a CANopen network must be set to the same transfer rate.

To set a bit transfer rate that is supported by CANopen, proceed as follows:

- Switch off the supply voltage for the BL20 gateway.
- Set the DIP-switches for the required transfer rate according to the following table:

Table 10: Setting the transfer rate

Bit transfer rate (kbps)	DIP-switches (setting)			
	1	2	3	4
1 000	0	0	0	0
800	1	0	0	0
500	0	1	0	0
250	1	1	0	0
125	0	0	1	0
50	1	0	1	0
20	0	1	1	0
10	1	1	1	0
reserved	x	x	x	1

Note

The DIP-switches are in the “1” position when they are set to the right, as viewed from the front.

- Switch on the supply voltage for the gateway again

Node-ID Setting

A Node-ID is assigned to every BL20 gateway in the CANopen structure.

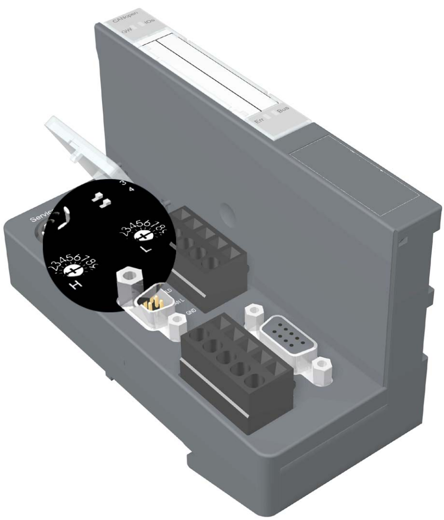
The setting for the Node-ID of the BL20-GW-CANOPEN in a CANopen structure is made through the two rotary hex encoding switches. The setting for the Node-ID of the BL20-GWBR-CANOPEN is made through the two rotary decimal encoding switches. The switches can be found beneath a cover, below the service interface.

The BL20 gateway can be used as a CANopen node at any point in the bus structure.

Attention

If the BL20 gateway is used as the the last node in the bus communication, then a special bus connector with a built-in or add-on termination resistor is absolutely necessary!

Figure 14: Rotary hex encoding switch for the CANopen address setting of the BL20-GW-CANOPEN



Attention

A maximum of 127 Node-IDs (1 to 127) can be assigned in a CANopen structure. Each Node-ID can only be assigned once in the complete bus structure.

The Node-ID 000 must not be assigned. It is reserved for telegrams that are directed to all the other bus nodes.

The rotary encoding switches are marked with H for High (more significant digit) and L für Low (less significant digit).

BL20-GW-CANOPEN:
The L switch is used to set L × ^{0} (L = 0 to F).
The H switch is used to set L × 16^{1} (H = 0 to F).

BL20-GWBR-CANOPEN:
The L switch is used to set L × 10^{0} (L = 0 to 9).
The H switch is used to set L × 10^{1} (H = 0 to 9).

Note

The NODE-ID switch on the BL20-GWBR-CANOPEN can be used to assign Node-IDs from 1 to 99!

Note

After setting the Node-ID, the protective cover over the switches must be closed again.

See Chapter 6, "Maximum System Extension", Page 6-2.

Note

BL20 does not support the assignment of Node-IDs across the bus network.

Acceptance of the BL20 Station Configuration

When making a new configuration of the BL20 station or an alteration of the existing station structure (“Module list”), the current configuration must be accepted in the CANopen mirror of the BL20 gateway. This is done through the configuration button between the two rotary encoding switches.

Note

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

Pressing the set button with a pointed object for at least 2 seconds saves the current station configuration in non-volatile memory. A hardware reset will then be carried out automatically. With this reset, all the CANopen parameters will be restored to their default values, if the newly saved configuration is different to the old one.

Attention

When saving the BL20 configuration, all the CANopen objects must be parameterized again, if their parameter values differ from the default values. The complete parameterization of the station must subsequently be reloaded into the BL20 station.

The actuation of the button is indicated by a rapid (4 Hz) green blinking of the "IOs" LED. After 2 seconds, the LED changes to yellow blinking at 4 Hz, thus indicating that the station configuration is being saved. When the storage procedure is completed, the LED changes to a continuous green light.

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 CANopen and the status of the gateway.

Diagnostic messages are displayed in two ways:

- via individual LEDs
- via the software of the respective host system (see Chapter 5, Section “Diagnostics - Emergency Frames“, Page 5-1 ff.)

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 CANopen communication (fieldbus LEDs): **ERR** and **Bus**

The LED diagnoses shown below apply to both gateway versions:

- BL20-GW-CANOPEN
- BL20-GWBR-CANOPEN

An additional diagnosis indication is shown for the BL20-GWBR-CANOPEN.

Table 11: LED indicators

LED	Status	Meaning	Remedy
GW	OFF	CPU not supplied.	
	Green	5 V DC operating voltage is present; firmware is active; gateway is ready for operation and transfer	-
	GW: green, flashing, 1 Hz IOs: red	Firmware not active	Reload the firmware!
	Green, flashing, 4 Hz	Firmware active, gateway hardware is defect	Replace the gateway.
Additional diagnosis indication for BL20-GWBR-CANOPEN			
GW	green, blinking, 1 Hz	U_{SYS}: undervoltage or overvoltage U_L: undervoltage	Check that the supply voltage is within the permissible range.
IOs	-	CPU not supplied.	– Check the voltage supply at the gateway.
	Green	Module bus is running, the configured module bus station corresponds to the physically connected station, communication is active.	-
	Green, flashing 1 Hz	Station is in the I/O-ASSISTANT Force Mode.	– Deactivate the I/O-ASSISTANT Force Mode.

Table 11: LED indicators

LED	Status	Meaning	Remedy
IOs	Red and LED "**GW**" off	Controller is not ready, V_{CC} level is not within the required range → possible reasons: – too many modules connected to the gateway – short circuit in connected module – hardware error in – gateway	– Check wiring at the gateway and the voltage supply. – Dismount modules – Replace the gateway.
	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 flashing, 4 Hz	no module bus communication	– At least one module has to be plugged and has to be able to communicate with the gateway.
	Red/ green flashing, 1 Hz	Adaptable modification of the physically connected station; data transfer possible	– Check the physical station for pulled or new but not planned modules.
	Red	Short circuit or overload at sensor supply → sensor supply is switched off	– Automatic restart when debugging.
	Off	No voltage supply.	– Check the wiring of the voltage supply at the gateway

Table 11: LED indicators

LED	Status	Meaning	Remedy
ERR	Off	No errors in communication between the BL20-CANopen gateway and other CANopen nodes	–
	Red	Faulty or interrupted communication between BL20-CANopen gateway and other CANopen. Possible causes: – CAN-BusOff – Heartbeat error – Guarding error – Transmit timeout	– Check that the fieldbus ends with a termination resistor, if the BL20-CANopen gateway is the last node in the bus topology. – Check the seating of the CANopen bus connector (or the joints in the case of direct wiring). All connections must be correct and properly seated. – Check the CANopen cable for possible damage, and for correct connections. – Check that the correct bit rate has been set. – Check that the NMT-master is still functioning properly.

Table 11: LED indicators

LED	Status	Meaning	Remedy
Bus	OFF	Fieldbus not operating	Wait until the firmware download is finished. If the download is finished: hardware error; replace the gateway.
	red	NMT-slave state of the BL20-CANopen gateway is "Stopped"	–
	orange	NMT-slave state of the BL20-CANopen gateway is "Pre-Operational"	–
	green	NMT-slave state of the BL20-CANopen gateway is "Operational"	–
ERR + BUS	red, blinking alternately, 4 Hz	Invalid Node-ID has been set	Set the correct Node-ID with the rotary $_{hex}$ or decimal encoding switches.

4 BL20 - Communication in CANopen

Industrial Automation

4

Setting up communication

Minimum Boot-up

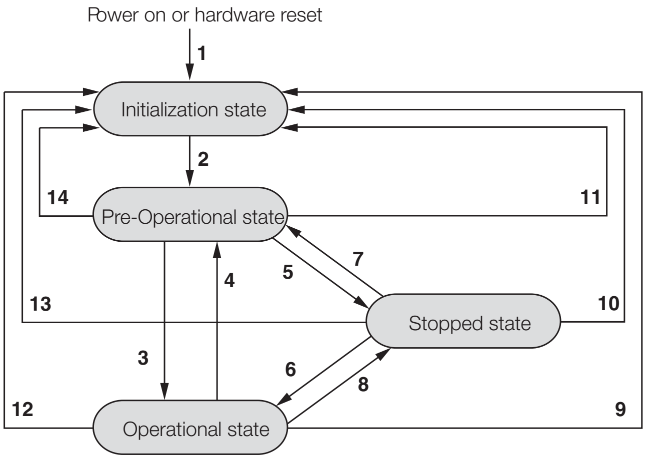
BL20 supports the Minimum Boot-up function described in CiA DS-301.

Table 1: Meaning of the abbreviations

Abbreviation	Meaning	Explanation
cs	NMT command specifier	A designation label for the required service
Node-ID	Node identifier	Identifier for the node; an identification byte that is set through the rotary decimal encoding switches for the CAN node. Possible values for CANopen are 01_{hex} to $7F_{hex}$ (1 to 127).

Booting with the Minimum Boot-up function is the typical application option for CANopen, and runs according to the following state diagram:

Figure 1: Boot procedure with Minimum Boot-up



1 Power-on (automatic change of state to the "Initialization" condition)

2 Initialization Finished (automatic change of state to "Pre-Operational")

3 Start Remote Node (start the CAN node)

4 Enter Pre-Operational (change over to "Pre-Operational")

5 Stop Remote Node (stop the CAN node)

6 Start Remote Node (start the CAN node)

7 Enter Pre-Operational (change to "Pre-Operational")

8 Stop Remote Node (stop the CAN node)

9 Reset Node (reset the complete CAN node)

10 Reset Node (reset the complete CAN node)

11 Reset Node (reset the complete CAN node)

12 Reset Communication (reset communication for the CAN node)

13 Reset Communication (reset communication for the CAN node)

14 Reset Communication (reset communication for the CAN node)

The following messages are exchanged in the states mentioned:

- Operational: PDO and SDO communication
- Pre-Operational: only SDO communication

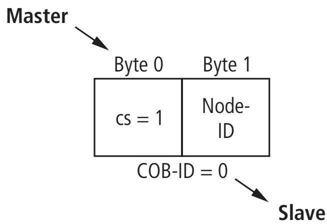
The services listed above (1 to 14) are required by CANopen or performed independently by the nodes in order to change from one state to another.

The "Stopped" state can be skipped when using Minimum Boot-up.

1 Power-on (automatic change of state to the "Initialization" state)

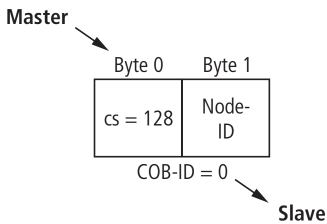
2 Initialization finished (automatic change of state to the "Pre-Operational" state)

3, 6 Start Remote Node (start the CAN node)



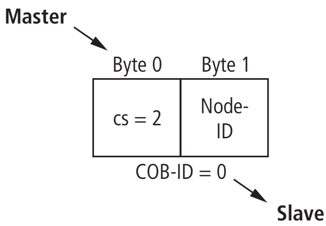
The internal change of state of the CANopen slave now requires a pause of at least 20 ms, before another request may be made by the master.

4, 7 Enter Pre-Operational (change over to "Pre-Operational")



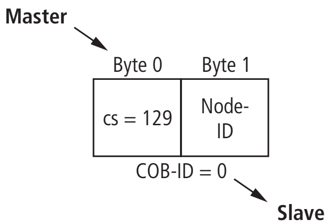
The internal change of state of the CANopen slave now requires a pause of at least 20 ms, before another request may be made by the master.

5, 8 Stop Remote Node (stop the CAN node)



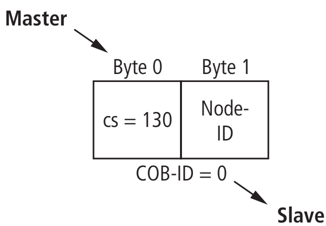
The internal change of state of the CANopen slave now requires a pause of at least 20 ms, before another request may be made by the master.

9, 10, 11 Reset Node (reset the complete CAN node)



The execution of this command is confirmed by a boot-up message. This is in the form of a guard frame with the data contents 00_{hex}.

12, 13, 14 Reset Communication (reset communication for the CAN node)



The execution of this command is confirmed by a boot-up message. This is in the form of a guard frame with the data contents 00_{hex}.

Identifier for the Standard Objects

Node-ID

The identifier for each device in a CANopen network is the Node-ID. The CANopen slaves can be assigned the Node-IDs 1 to 127 ("Node-ID Setting", page 3-24).

COB-ID (Communication Object Identifier)

The identifier for each communication object in a CANopen network is the COB-ID.

The COB-IDs for the standard objects (digital input, digital output, analog input, analog output) are assigned automatically.
The ranges for the COB-IDs are defined by the "Predefined Master-Slave Connection Set".

Each range for the COB-IDs has 127 numerical values.

The COB-IDs are calculated according to the following rule:

COB-ID = Base-ID + Node-ID

Base-ID (decimal): 128; 384; 512; 640; 768; 896; 1024; 1152; 1280; 1408; 1536; 1792

Node-ID (decimal): 1 to 127

Table 2: Identifiers for basic objects

COB-ID dec.	hex.	Function	Application
0	000_{hex}	Network Management (NMT)	Broadcast object
01 to 127	001_{hex} to $07F_{hex}$	free	
128	080_{hex}	Synchronization (SYNC)	Broadcast object
129 to 255	081_{hex} to $0FF_{hex}$	Emergency Message	
256	100_{hex}	Timestamp	Message Broad-cast object
257 to 384	101_{hex} to 180_{hex}	free	

Table 2: Identifiers for basic objects

COB-ID dec.	hex.	Function	Application
385 to 511	181_{hex} to $1FF_{hex}$	Transmit PDO 1	Digital input
512	200_{hex}	free	
513 to 639	201_{hex} to $27F_{hex}$	Receive PDO 1	Digital output
640	280_{hex}	free	
641 to 767	281_{hex} to $2FF_{hex}$	Transmit PDO 2	Analog input
768	300_{hex}	free	
769 to 895	301_{hex} to $37F_{hex}$	Receive PDO 2	Analog output
896	380_{hex}	free	
897 to 1023	381_{hex} to $3FF_{hex}$	Transmit PDO 3	Analog input
1024	400_{hex}	free	
1025 to 1151	401_{hex} to $47F_{hex}$	Receive PDO 3	Analog output
1152	480_{hex}	free	
1153 to 1279	481_{hex} to $4FF_{hex}$	Transmit PDO 4	Analog input
1280	500_{hex}	free	
1281 to 1407	501_{hex} to $57F_{hex}$	Receive PDO 4	Analog output
1408	580_{hex}	free	
1409 to 1535	581_{hex} to $5FF_{hex}$	Transmit SDO	
1536	600_{hex}	free	

Table 2: Identifiers for basic objects

COB-ID dec.	hex.	Function	Application
1537 to 1663	601_{hex} to $67F_{hex}$	Receive SDO	
1664 to 1772	680_{hex} to $6EC_{hex}$	free	
1793 to 1919	701_{hex} to $77F_{hex}$	NMT Error (Node Guarding, Heartbeat, Boot-up)	
1920 to 2014	800_{hex} to $7DE_{hex}$	free	
2015 to 2031	$7DF_{hex}$ to $7EF_{hex}$	NMT, LMT, DBT	

Set up Node Guarding Protocol

Note
Further information on Node Guarding can be found in CiA DS-301.

Node Guarding is the name for the monitoring of network nodes by a network manager.

In addition, the CANopen network nodes check that their network manager is operating correctly and that the network is functioning reliably.

In the default state, Node Guarding is inactive. To activate the Node Guarding protocol for a node, various parameters must be set for the Object Dictionary:

- [100C] = Guard time
  Given in milliseconds; the query interval (polling) that is to be expected by the network slave
  Default = 0
- [100D] = Lifetime factor
  This factor, multiplied by the Guard time, is the time that should elapse after a Node Guarding protocol error before the network slave generates an error message via EMCY. In this way, a temporary communication problem, such as may be caused by heavy bus loading, can be bridged without a Guarding Error.
  Default = 0
- Guard-ID
  This is fixed and cannot be changed.

Guarding is initiated with the first Guard-Remote frame (Guarding-RTR) from the CANopen network manager.

The Guarding Frame of the network manager has the COBID "1793 - 1 + Node-ID" and does not have a data field.

Furthermore, the RTR bit in the message header must be set and the Data Length code = 1.

The node answers the telegram sent out by the network manager within the preset time (Guard time) in the "Operational" state, with the data contents **5**. The gateway answers the next polling query with the contents **133**. The following response from the gateway is with **5** again, and so on. This means that the gateway changes the state of the most significant bit after every query (i.e. the bit is toggled).
If the node is in the "Pre-Operational" state, then the value of the data contents of the response telegram toggles between 127 and 255. If the node is in the "Stop" state, the value toggles between 4 and 132.

If there is no query from the network manager within the preset time, then the gateway changes to the state "Guard Fail". If output modules are fitted in the BL20 station, then their outputs will be put into defined states, depending on the objects "Error mode output" and "Error state output", or will retain the last state that was received. Any RxPDOs that are received will still be processed and output again. If the Guarding starts up again, the BL20 gateway leaves the "Guard Fail" state, but remains in the Pre-Operational state.
A "Start Node" command must be generated by the network manager in order to restart the BL20 gateway (see CiA DS-301).

If the setting is Guard time = 0, then "passive Guarding" will occur. This means that the gateway answers the Guard Remote frames, without starting its own internal Guard timer and without changing into the "Guard fail" state.

As an alternative to Node-/Life-Guarding, the Heartbeat mechanism newly introduced with DS301 V4.0 is supported, which, unlike Guarding, does not require Remote frames.

Boot-up Message

After initialization (after Power-On, Reset-Node and Reset-Communication), a Boot-up message as per CiA DS-301 V4.0 is sent out. This is in the form of a guard frame with the contents 00_{hex}.

Under certain circumstances, a network manager may fail to detect a short drop-out of an BL20 gateway (for example, as a result of voltage variations). This could occur under the following conditions:

- The drop-out and initialization of the gateway happen in the time between two Guarding-Frames
- The gateway was already in the Pre-Operational state beforehand
- The last state of the toggle bit was 1

If a Boot-up message is sent out after a reset or initialization, then the drop-out mentioned above will also not be missed by the network manager.

Parameterization through Service Data Objects (SDO)

SDO (= Service Data Object) is a confirmed CANopen service that is primarily used for parameterization and configuration of the CANopen slaves (BL20) and less frequently for transmitting process data. "Confirmed" means that an BL20-CANopen gateway (SDO server) that is addressed by this procedure must acknowledge it through a response. In this way, the SDO client obtains information about whether the BL20 gateway that it addressed was contacted, and whether the access was achieved without any errors (error code in the response from the SDO server). SDO access means that the contents of the Object Dictionary entries for an SDO server can be read or written, and that the settings for a BL20 station can be made in this way.

Four parallel SDO servers are supported. There are three "additional" SDOs, as well as the default SDO. As a default, these are inactive, but can be parameterized and enabled through the Object Dictionary entries 1201_{hex} to 1203_{hex}.

The communication parameters for the default SDO follow the Predefined Connection Set, and cannot be modified (see CiA DS-301, V4.01)

In the following representations of the messages, the identifier of the CANopen message that is to be sent can be found below the frame, and the contents of the data byte to be transmitted are within the frame.

The following representations use the Expedited SDO Transfer, i.e. a maximum of 4 bytes of user data can be transferred within one telegram.

Note

CANopen also offers the possibility of segmented SDO-transfer of data with data length of more than 4 bytes.

Read (Read from Object Dictionary)

Client

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
CCS = 40h	Index lsb	Index msb	Sub-Index	0	0	0	0

COB-ID = 1537 + Node-ID - 1

Server

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
SCS = 4xh	Index lsb	Index msb	Sub-Index	Data			

COB-ID = 1409 + Node-ID - 1

Client

x... depending on the length of data read

LSB = Least Significant Byte → lowest value byte

MSB = Most Significant Byte → highest value byte

SCS = Server Command Specifier

CCS = Client Command Specifier

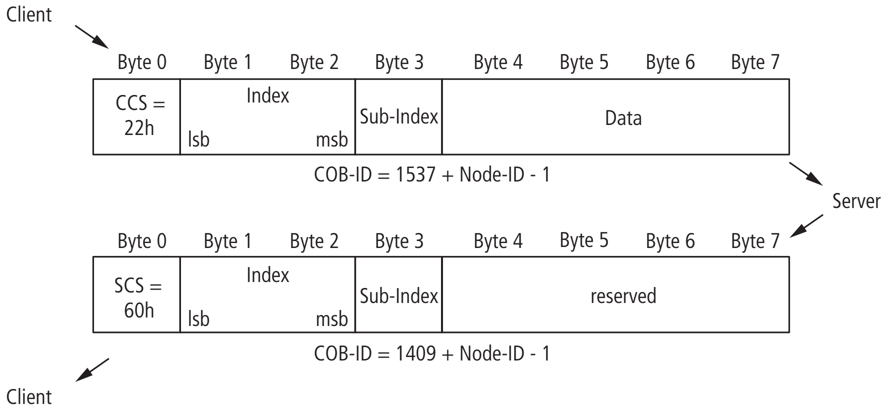
(see CiA DS-301)

The stated COB-ID refers to the default SDO server.

Note

The BL20 gateway generates length information as to how many data bytes are to be read (see CiA DS-301, Page 9-24 ff). This information is found in byte 0 "CCS = 4xh". The value x depends on the length of data read.

Write (Write to Object Dictionary)



LSB = Least Significant Byte → lowest value byte

MSB = Most Significant Byte → highest value byte

SCS = Server Command

CCS = Client Command

(see CiA DS-301)

The stated COB-ID refers to the default SDO server.

Note

The information in byte 0 "SCS = 2xh" can optionally contain the length information for the transmitted data bytes (see CiA DS-301, Page 9-21 ff). The information in byte 0 "SCS = 22_{hex}" means that no length information is present.

Attention

If an incorrect data length is given, the error code "Abort SDO Transfer Service" will be generated (see CiA DS-301, Page 9-26).

Table 3: Abort codes for errors in SDO transfer

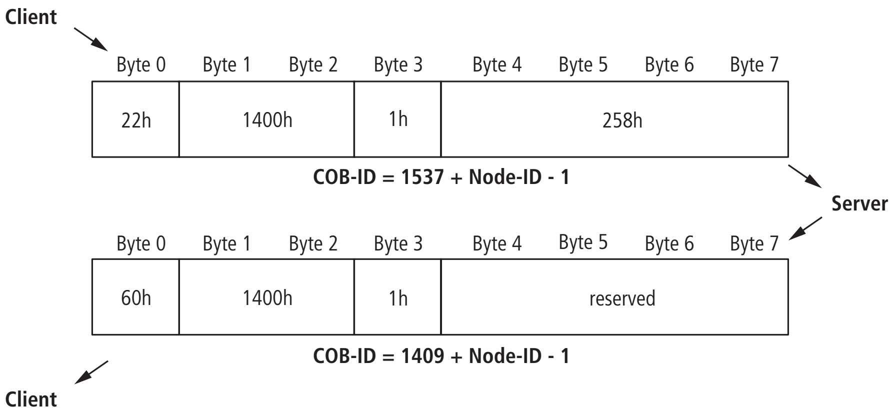
Abort code	Description
0503 0000_{hex}	Toggle bit not altered.
0504 0001_{hex}	Client server command specifier not valid or unknown.
0601 0000_{hex}	Unsupported access to an object.
0601 0001_{hex}	Attempt to write a read only object.
0601 0002_{hex}	Attempt to read a write only object.
0602 0000_{hex}	Object does not exist in the object dictionary.
06040041_{hex}	Object cannot be mapped to the PDO.
06040042_{hex}	The number and length of objects exceeds PDO length.
06040043_{hex}	General parameter incompatibility reason.
06040047_{hex}	General internal incompatibility in the device.
06070010_{hex}	Data type does not match - wrong length.
0607 0012_{hex}	Data type does not match- length too high.
0607 0013_{hex}	Data type does not match- length too low.
06090011_{hex}	Sub-index does not exist.
06090030_{hex}	Value range of parameter exceeded.
06090031_{hex}	Value range of parameter written too high.
06090032_{hex}	Value range of parameter written too low.
06090036_{hex}	Maximum value is less than minimum value.
08000000_{hex}	Other error
08000020_{hex}	Data cannot be stored to the application.

Table 3: Abort codes for errors in SDO transfer

Abort code	Description
08000021_{hex}	Data cannot be stored to the app. because of local control.
08000022_{hex}	Data cannot be stored to the app. because of device state.

Example:

Write a new COB-ID for RxPDO 1 (ID = 258_{hex})



Commanded Parameter Storing/Restoring

Saving of communication and application parameters is executed by a command. This means that the parameters transferred through an SDO are held in volatile memory, until they are saved by using the command "Store parameters" (Object 1010_{hex}, Sub-indices 0 to 3). All the communication and application parameters that are supported by the gateway will be saved.

The command "Restore Default parameters" (Object 1011_{hex}, Sub-indices 0 to 3) is also supported. This command resets all the communication and/or application parameters to the default values.

Transmission of Process Data Objects (PDO)

CANopen provides PDO communication (PDO = Process Data Object). PDOs are fast real-time process data that are handled as unconfirmed services without a protocol overhead. PDOs can contain a maximum of 8 bytes of data. They can be assembled and configured by the user to suit the specific requirements. In addition, there are a number of transmission/transfer settings (Transmission types) for process data.

The following attributes can be set for each PDO through the object "PDO communication parameter":

Communication Parameter COB-ID

The COB-ID is the CAN identifier that is used for the transmission of a PDO (object 1400_{hex} ff and 1800_{hex} ff).

COB-IDs are used to define the priority of the message telegrams. The lowest COB-ID has the highest priority.

For communication between 2 nodes, the COB-ID of the transmit PDO must be the same as the COB-ID of the receive PDO.

Note

As delivered, each BL20 gateway has from none to eight active PDOs, with COB-IDs that are taken from the Predefined Master-Slave Connection Set.

All other PDOs are inactive. This state can be seen from the invalid bit (Bit 31) of the COB-ID.

Transmission Type

The Transmission type determines under which circumstances a PDO can be transmitted or received.

The following PDO Transmission types are supported by BL20:

- Type 0 (sync, acyclic)
- Type 1 (sync, cyclic)
- Type 253 (remote request)
- Type 255 (event-driven)

Table 4: Transmission type of BL20

Transmission type	PDO transmission				
	cyclic	acyclic	synchr.	asynchr.	only with RTR
0		×	×		
1	×		×		
253				×	×
255				×	

Type 0
The PDO will always be transmitted (TPDO) or evaluated (RPDO) if this is permitted by a Sync-Frame transmitted by the SYNC producer and the mapped contents of the BL20-CANopen gateway have changed since the last transmission.

Type 1
Immediately after receiving each Sync-Frame, the BL20-CANopen gateway puts out the mapped contents as a PDO on the network, even if they have not changed since the last transmission.

Type 253
The PDO is only transmitted if a transmitted Remote-Frame requests this from the BL20-CANopen gateway.

Attention

The following Transmission type (Type 255) is only permissible for TPDOs.

Type 255

In this mode of operation, the BL20-CANopen gateway does not depend on any Sync or Remote-Request for PDO communication. Whenever this is envisaged for an internal event within the BL20-CANopen gateway, the gateway will transmit a PDO to the CANopen network.

The Transmission types of the individual PDOs are independent, which means that a freely mixed operation with synchronous and asynchronous PDOs is possible.

Inhibit Time

The setting of an Inhibit time for the PDOs (Object 1800_{hex} ff, Sub-Index 03_{hex}) is only supported for TPDOs. Unlike the other time values, which are given as multiples of 1 ms, the Inhibit time is defined as a multiple of 100 µs. However, since the time resolution of the system clock in the BL20-CANopen gateway is 1 ms, Inhibit time values below 10 x 100 µs are pointless.

Event Timer

The Event timer (Object 1800_{hex} ff, Sub-Index 05_{hex}) defines the maximum interval after which a TPDO will be transmitted, even though no event has occurred. This means that the Event timer determines the maximum interval between two transmissions of a TPDO.

The expiry of the interval set for the Event timer is detected as an event. If any other event occurs, the Event timer is reset and restarted.

The value of the object is interpreted as a multiple of 1 ms.

Available PDOs

64 PDOs are supported:

- 32 Receive PDOs: TPDO1 to TPDO32 (Index 1800_{hex} to $181F_{hex}$)
- 32 Transmit PDOs: RPDO1 to RPDO32 (Index 1400_{hex} to $141F_{hex}$)

The corresponding Default Master-Slave Connection Set is supported for each of the PDOs 1 to 4, so that a COB-ID distribution is not necessary for these PDOs.

If one of the COB-IDs from xPDO1 to xPDO4 is reconfigured, then the use of a COB-ID from the Default Master-Slave Connection Set can be achieved by setting this COB-ID to 0.

Mapping Objects in PDOs

Mapping is the assignment of objects from an Object Dictionary in a PDO for transmission/reception through the CAN-bus. More than one object can be transmitted in a single PDO.

The Mapping parameters determine which items of information are transmitted in a PDO:

Table 5: Object Dictionary for mapping parameters

PDO		**Object Dictionary entries**
Type	Range	Range
Transmit-PDOs	TPDO1 to TPDO32	$1A00_{hex}$ to $1A1F_{hex}$
Receive-PDOs	RPDO1 to RPDO32	1600_{hex} to $161F_{hex}$

Default-PDOs and PDO-Mappings

The 4 Transmit and 4 Receive-PDOs which are specified by the Communication Profile CiA DS-301 are supported by BL20. The mapping of these PDOs and their Transmission types are specified by the I/O-Device Profile CiA DS-401.

Note

The Default-PDOs are only activated if the planned objects and sub-indices actually exist for the corresponding PDO. If, for instance, no analog I/Os are used in a BL20 station, then the PDOs 2 to 4 are set to "Invalid" and no mapping entries will be present.

In addition to the default PDOs which are standardized by the CiA DS-301 and DS-401 profiles, other PDOs for an BL20-CANopen gateway may be provided with mapping entries and communication parameters. These additional PDOs (5 to 16) will be set to "Invalid" as a default.

Default-PDOs as per CiA DS-301 and DS-401

The TPDOs in the following table have the following characteristics:

- The COB-ID is part of sub-index 01_{hex}
- The PDO is active!
  The first digit of the 8-digit $_{hex}$adecimal COB-ID-number shows amongst others, if the PDO is valid. Active PDOs are marked by a $_{hex}$-digit < 7. Normally, the digit is 0 or 4 →page 4-84.

Overview of the Default-TPDOs as per CiA DS-301 and DS-401

Meaning	TPDO	Sub-Index 01_{hex} - "COB-ID"
1st group, digital input channels, (Bits 0 to 63)	PDO1 1800_{hex}	0000 0180_{hex} + Node-ID
1st group, analog input channels, (Channel 0 to 3)	PDO2 1801_{hex}	0000 0280_{hex} + Node-ID
2nd group, analog input channels, (Channel 4 to 7)	PDO3 1802_{hex}	0000 0380_{hex} + Node-ID
3rd group, analog input channels, (Channel 8 to 11)	PDO4 1803_{hex}	0000 0480_{hex} + Node-ID

Overview of the Default-RPDOs as per CiA DS-301 and DS-401

Meaning	TPDO	COB-ID
1st group, digital output channels, (Bits 0 to 63)	PDO1 1400_{hex}	0000 0200_{hex} + Node-ID
1st group, analog output channels, (Channel 0 to 3)	PDO2 1401_{hex}	0000 0300_{hex} + Node-ID
2nd group, analog output channels, (Channel 4 to 7)	PDO3 1402_{hex}	0000 0400_{hex} + Node-ID
3rd group, analog output channels, (Channel 8 to 11)	PDO4 1403_{hex}	0000 0500_{hex} + Node-ID

BL20-Specific Default-PDOs

These additional PDOs are always set to "Invalid" as a default.

Before enabling these PDOs, the corresponding parameters must be checked. This applies especially to the COB-IDs, since these are taken from the Default Master-Slave Connection Set, and are assigned to other Node-IDs. For this reason, other nodes with the corresponding Node-ID must not be present in the network, or such nodes must not use the corresponding COB-IDs.

The Transmission type of these PDOs is generally 255.

Overview of the BL20-specific TPDOs

Note

The COB-ID definition for the TPDOs depends on the gateway used in the application (see EDS file for the gateways).

Meaning	TPDOs	COB-ID TPDO
2nd group, digital input channels (Bits 64 to 127)	PDO5 1804_{hex}	8000 $01C0_{hex}$ + Node-ID
3rd group, digital input channels (Bits 128 to 191)	PDO6 1805_{hex}	8000 $02C0_{hex}$ + Node-ID
4th group, digital input channels (Bits 192 to 255)	PDO7 1806_{hex}	C000 $03C0_{hex}$ + Node-ID
5th group, digital input channels (Bits 256 to 319)	PDO8 1807_{hex}	C000 $04C0_{hex}$ + Node-ID
1st group, encoders (Channels 0 + 1)	PDO9 1808_{hex}	C000 $01E0_{hex}$ + Node-ID
2nd group, encoders (Channels 2 + 3)	PDO10 1809_{hex}	C000 $02E0_{hex}$ + Node-ID
3rd group, encoders (Channels 4 + 5)	PDO11 $180A_{hex}$	C000 $03E0_{hex}$ + Node-ID
4th group, encoders (Channels 6 + 7)	PDO12 $180B_{hex}$	C000 $04E0_{hex}$ + Node-ID

Meaning	TPDOs	COB-ID TPDO
4th group, analog input channels (Channels 12 to 15)	PDO13 $180C_{hex}$	C000 $01A0_{hex}$ + Node-ID
5th group, analog input channels (Channels 16 to 19)	PDO14 $180D_{hex}$	C000 $02A0_{hex}$ + Node-ID
6th group, analog input channels (Channels 20 to 23)	PDO15 $180E_{hex}$	C000 $03A0_{hex}$ + Node-ID
7th group, analog input channels (Channels 24 to 27)	PDO16 $180F_{hex}$	C000 $04A0_{hex}$ + Node-ID
1st group, RS×× I/Os (Channel 0)	PDO18 1811_{hex}	C000 0000_{hex}
1st group, RS×× I/Os (Channel 1)	PDO19 1812_{hex}	C000 0000_{hex}

Overview of the BL20-specific RPDOs

Meaning	RPDOs	COB-ID RPDO
2nd group, digital output channels (Bits 64 to 127)	PDO5 1804_{hex}	8000 0240_{hex} + Node-ID
3rd group, digital output channels (Bits 128 to 191)	PDO6 1805_{hex}	8000 0340_{hex} + Node-ID
4th group, digital output channels (Bits 192 to 255)	PDO7 1806_{hex}	8000 0440_{hex} + Node-ID
5th group, digital output channels (Bits 256 to 319)	PDO8 1807_{hex}	8000 0540_{hex} + Node-ID
1st group, encoders (Channels 0 + 1)	PDO9 1808_{hex}	8000 0260_{hex} + Node-ID
2nd group, encoders (Channels 2 + 3)	PDO10 1809_{hex}	8000 0360_{hex} + Node-ID
3rd group, encoders (Channels 4 + 5)	PDO11 $180A_{hex}$	8000 0460_{hex} + Node-ID

Meaning	RPDOs	COB-ID RPDO
4th group, encoders (Channels 6 + 7)	PDO12 $180B_{hex}$	8000 0560_{hex} + Node-ID
4th group, analog output channels (Channels 12 to 15)	PDO13 $180C_{hex}$	8000 0220_{hex} + Node-ID
5th group, analog output channels (Channels 16 to 19)	PDO14 $180D_{hex}$	8000 0320_{hex} + Node-ID
6th group, analog output channels (Channels 20 to 23)	PDO15 $180E_{hex}$	8000 0420_{hex} + Node-ID
7th group, analog output channels (Channels 24 to 27)	PDO16 $180F_{hex}$	8000 0520_{hex} + Node-ID
1st group, RS×× I/Os (Channel 0)	PDO18 1811_{hex}	8000 0000_{hex}
1st group, RS×× I/Os (Channel 1)	PDO19 1812_{hex}	8000 0000_{hex}

Attention

The COB-IDs for the RS×××-Module must be defined by the user!

Example

The own Node-ID of an BL20-CANopen gateway is 1. There are more than 12 analog input channels. As a result, appropriate mapping entries are set up for TPDO13 (Object $1A0C_{hex}$), and the COB-ID (Object 180C, Sub-Index 1) is pre-loaded with the value 8000 $01A1_{hex}$. This PDO can only be enabled without alteration if a node with the Node-ID 33 (own Node-ID + 32) does not exist, or at least its TPDO1 is not used.

The following table illustrates the systematic relationship:

Table 6: Relationship between a Node-ID and BL20-specific PDOs

PDO	Node-ID assigned to this COB-ID in the Default Master-Slave Connection Set	Original PDO, to which this COB-ID is assigned in the Default Master-Slave Connection Set
PDO5	own Node-ID + 64 (40_{hex})	PDO1
PDO6	own Node-ID + 64 (40_{hex})	PDO2
PDO7	own Node-ID + 64 (40_{hex})	PDO3
PDO8	own Node-ID + 64 (40_{hex})	PDO4
PDO9	own Node-ID + 96 (60_{hex})	PDO1
PDO10	own Node-ID + 96 (60_{hex})	PDO2
PDO11	own Node-ID + 96 (60_{hex})	PDO3
PDO12	own Node-ID + 96 (60_{hex})	PDO4
PDO13	own Node-ID + 32 (20_{hex})	PDO1
PDO14	own Node-ID + 32 (20_{hex})	PDO2
PDO15	own Node-ID + 32 (20_{hex})	PDO3
PDO16	own Node-ID + 32 (20_{hex})	PDO4

Mappable Objects

The maximum of 64 mapping entries per PDO that is specified by Communication Profile CiA DS-301 is supported.

The following objects from the Object Dictionary can be mapped:

Table 7: Overview of mappable objects

A *Objects ×××1 and ×××2 will be generated if the number of digital input or output channels exceeds the value 128 or 256 respectively.*

Name	Index	Sub-index	Direction
Dummy mapping Boolean	0001_{hex}	-	Receive
Dummy mapping Boolean Integer8	0002_{hex}	-	Receive
Dummy mapping Boolean Integer16	0003_{hex}	-	Receive
Dummy mapping Boolean Integer32	0004_{hex}	-	Receive
Dummy mapping Boolean Unsigned8	0005_{hex}	-	Receive
Dummy mapping Boolean Unsigned16	0006_{hex}	-	Receive
Dummy mapping Boolean Unsigned32	0007_{hex}	-	Receive
Error register	1001_{hex}	–	Transmit
Manu Spec Analog Input Range	5420_{hex}	1 to n	Transmit
RS232/RS4xx RxD	5601_{hex}	1 to n	Receive
RS232/RS4xx TxD	5602_{hex}	1 to n	Transmit
Encoder status	5802_{hex}	1 to n	Transmit
Encoder flags	5803_{hex}	1 to n	Transmit
SSI Native status	5805_{hex}	1 to n	Transmit

Table 7: Overview of mappable objects

A *Objects ×××1 and ×××2 will be generated if the number of digital input or output channels exceeds the value 128 or 256 respectively.*

Name	Index	Sub-index	Direction
SSI Optional encoder status	5806_{hex}	1 to n	Transmit
Encoder control	5808_{hex}	1 to n	Receive
Read input 8 bit	6000_{hex}	1 to n	Transmit
Read input bit (1 to 128) **A**	6020_{hex}	1 to n	Transmit
Read input 16 bit	6100_{hex}	1 to n	Transmit
Read input 32 bit	6120_{hex}	1 to n	Transmit
Write output 8 bit	6200_{hex}	1 to n	Receive
Write output bit (1 to 128) **A**	6220_{hex}	1 to n	Receive
Write output 16 bit	6300_{hex}	1 to n	Receive
Write output 32 bit	6320_{hex}	1 to n	Receive
Read analog input 16 bit	6401_{hex}	1 to n	Transmit
Write analog output 16 bit	6411_{hex}	1 to n	Receive
Position Value for Multi-Sensor Devices	6820_{hex}	1 to n	Transmit
CAM1 State register	$6B00_{hex}$	1 to n	Transmit
Area State register	$6C00_{hex}$	1 to n	Transmit

Procedure for Altering PDO-Mappings

The Communication Profile CiA DS-301 Version 4 defines a detailed procedure for altering PDO-mappings.

For the BL20 gateway, this results in the following method for modifying PDO-mappings:

- The node state of the gateway must be "Pre-Operational".
- The number of mapping entries (Sub-index 0) for a PDO must be set to 0.
- The mapping entries (Sub-index 1 to 64) can be written.
- The number of mapping entries (Sub-index 0) must now be set to the valid number of mapped objects.
- Alternatively, the new mapping can be saved in non-volatile memory (Store Communication parameters).

The following abort codes (Abort-Domain-Protocol) may be sent back by the gateway in case of an error:

Table 8: Abort codes

Abort code	Description as per CiA DS-301	Possible cause
0604 0041$_{hex}$	Object cannot be mapped	Invalid object-index transferred while writing the mapping entries.
0604 0042$_{hex}$	Number or length of the objects exceeds the PDO length	Attempted to map too many or excessively long objects to a PDO. This will be returned on writing to the sub-index 0.
0609 0011$_{hex}$	Sub-index does not exist	A sub-index > 64 was addressed.
0800 0022$_{hex}$	Access not possible in this node state	Write access is only possible in the "Pre-Operational" node state. Write access to Sub-indices 1 to 64 is only possible if sub-index 0 is written with value 0.

Object Dictionary

Overview of all Objects

The following table provides an overview of all the objects that are supported by the BL20 CANopen gateway.

Table 9: Overview of all objects

Index	Name	Page
CANopen Standard Objects		
1000_{hex}	Device type	page 4-47
1001_{hex}	Error register	page 4-48
1005_{hex}	SYNC COB-ID	page 4-49
1008_{hex}	Device name	page 4-48
1009_{hex}	Manufacturer hardware version	page 4-52
$100A_{hex}$	Manufacturer software version	page 4-53
$100C_{hex}$	Guard time	page 4-53
$100D_{hex}$	Lifetime factor	page 4-55
1010_{hex}	Store parameters	page 4-56
1011_{hex}	Restore default parameters	page 4-58
1014_{hex}	Emcy COB-ID	page 4-60
1016_{hex}	Consumer heartbeat time	page 4-62
1017_{hex}	Producer heartbeat time	page 4-64
1018_{hex}	Identity object	page 4-64
1020_{hex}	Verify configuration	page 4-68
1027_{hex}	Module list	page 4-70

Table 9: Overview of all objects

Index	Name	Page
1200_{hex} to 1203_{hex}	Server SDO parameters	page 4-72
1400_{hex} to $141F_{hex}$	Receive PDO Communication parameters	page 4-75
1600_{hex} to $161F_{hex}$	Receive PDO-mapping parameters	page 4-79
1800_{hex} to $181F_{hex}$	Transmit PDO-parameters	page 4-83
$1A00_{hex}$ to $1A1F_{hex}$	Transmit PDO-mapping parameters	page 4-89
$1F80_{hex}$	NMT startup	page 4-92
$1F81_{hex}$	Slave assignment	page 4-94
$1F82_{hex}$	Request NMT	page 4-98
$1F83_{hex}$	Request guarding	page 4-101
Manufacturer specific objects		
2000_{hex}	Serial number	page 4-103
2010_{hex}	Behavior Modifiers	page 4-104
2400_{hex}	System Voltages	page 4-108
2401_{hex}	System Currents	page 4-109

Table 9: Overview of all objects

Index	Name	Page
Objects for BL20 I/O-modules		
5420_{hex}	Analog Input Mode	page 4-139
5440_{hex}	Analog Output Mode	page 4-161
5801_{hex}	Encoder config	page 4-180
5802_{hex}	Encoder status	page 4-180
5803_{hex}	Encoder flags	page 4-181
5804_{hex}	Encoder diag	page 4-183
5805_{hex}	SSI Native status	page 4-185
5806_{hex}	SSI Optional encoder	page 4-189
5808_{hex}	Encoder control	page 4-190
6000_{hex}	Read input 8 bit	page 4-117
6020_{hex}	Read input bit 1 to 128	page 4-118
6021_{hex}	Read input bit 129 to 256	page 4-118
6022_{hex}	Read input bit 257 to 288	page 4-118
6100_{hex}	Read input 16 bit	page 4-119
6120_{hex}	Read input 32 bit	page 4-120
6200_{hex}	Write output 8 bit	page 4-123
6206_{hex}	Error mode output 8 bit	page 4-127
6207_{hex}	Error value output 8 bit	page 4-128
6220_{hex} to 6222_{hex}	Write output bit 1 to 128 to Write output bit 257 to 288	page 4-124
6250_{hex} to 6252_{hex}	Error mode output Bit 1 to 128 to Error mode output Bit 257 to 288	page 4-129

Table 9: Overview of all objects

Index	Name	Page
6260_{hex} to 6262_{hex}	Error value output Bit 1 to 128 to Error value output Bit 257 to 288	page 4-131
6300_{hex}	Write output 16 bit	page 4-125
6306_{hex}	Error mode output 16 bit	page 4-133
6307_{hex}	Error value output 16 bit	page 4-134
6320_{hex}	Write output 32 bit	page 4-126
6326_{hex}	Error mode output 32 bit	page 4-135
6327_{hex}	Error value output 32 bit	page 4-136
6401_{hex}	Read Analog Input 16 bit	page 4-144
6411_{hex}	Write analog Output 16 bit	page 4-157
6421_{hex}	Analog input interrupt Trigger Selection	page 4-145
6422_{hex}	Analog input interrupt source	page 4-148
6423_{hex}	Analog input global interrupt enable	page 4-149
6424_{hex}	Analog input interrupt upper limit Integer	page 4-150
6425_{hex}	Analog input interrupt lower limit Integer	page 4-151
6426_{hex}	Analog input interrupt delta Unsigned	page 4-152
6427_{hex}	Analog input interrupt negative delta Unsigned	page 4-153
6428_{hex}	Analog input interrupt Positive Delta Unsigned	page 4-154
6443_{hex}	Analog output error mode	page 4-157
6444_{hex}	Analog output error value Integer	page 4-160
$67FF_{hex}$	Device type	page 4-113
6800_{hex}	Operating parameters	page 4-193

Table 9: Overview of all objects

Index	Name	Page
6810_{hex}	Preset value for multi-sensor devices	page 4-193
6820_{hex}	Position value for multi-sensor devices	page 4-194
$6B00_{hex}$	CAM State register	page 4-195
$6B01_{hex}$	CAM Enable register	page 4-196
$6B02_{hex}$	CAM Polarity register	page 4-197
$6B10_{hex}$	CAM1 Low limit	page 4-198
$6B20_{hex}$	CAM1 High limit	page 4-198

Commands for "Parameter Save" and "Restore Defaults"

Parameter changes that are made through SDO access are only stored in volatile memory. All alterations that are made by the user will be replaced by default values at the next Reset Communication, Reset Node or Power-ON-Boot-Up.

With BL20, it is possible to use a command to make a permanent save of the communication and/or application parameters. This is done through the "Store parameters" command (Object 1010_{hex} sub-index 1 to 3). The command is executed by using an SDO to write the data contents 0x6576 6173 ("save") to one of the following entries:

- 1010_{hex} sub-index 1 saves all parameters
- 1010_{hex} sub-index 2 saves all communication parameters
- 1010_{hex} sub-index 3 saves all device parameters (see CiA DS-301 V4.01)

Table 10: Data contents 0x6576 6173 ("save")

	MSB			LSB
ASCII	e	v	a	s
HEX	65_{hex}	76_{hex}	61_{hex}	73_{hex}

Since in some circumstances it may not be possible to restore the original memory contents after a lot of alterations, BL20 supports the "Restore default Parameter" command (Object 1011_{hex} sub-index 1 to 3) with the following data contents: 0x6461 6F6C ("load").

Table 11: Data contents 0x6461 6F6C ("load")

	MSB			LSB
ASCII	d	a	o	l
HEX	64_{hex}	61_{hex}	$6F_{hex}$	$6C_{hex}$

The division of the Sub-entries corresponds to that for the "Store parameters" command.

After the command "Restore default parameters", a Reset Node must be carried out, followed by a "Store parameters" command. The default values are only saved again when this last command is executed.

Objects for the Communication Profile

The following table provides an overview of the supported entries in the Object Dictionary which are defined by the Communication Profile CiA DS-301:

The column **Index ($_{hex}$)** describes the position of the entry in the Object Dictionary.

The column **Object** shows the Type of the object.

The column **Name** shows a predefined symbolic name for the entry.

The column **Type** shows the data type for the entry, as defined by CiA DS-301.

The column **Access** shows the access options for the entry. These are:

- rw (read/write)
- ro (read only)
- const (constant) = a read-only constant

The column **M/O** shows whether the entry is mandatory or optional.

Table 12: Object overview for the communication profile

Index ($_{hex}$)	Object	Name	Type	Access	M/O
1000_{hex}	VAR	Device type (page 4-47)	Unsigned32	const	M
1001_{hex}	ARRAY	Error register (page 4-48)	Unsigned8	ro	M
1005_{hex}	VAR	SYNC COB-ID (page 4-49)	Unsigned32	rw	O
1008_{hex}	VAR	Device name (page 4-51)	Vis-String	const	O
1009_{hex}	VAR	Manufacturer hardware version (page 4-52)	Vis-String	const	O

Table 12: Object overview for the communication profile

Index ($_{hex}$)	Object	Name	Type	Access	M/O
$100A_{hex}$	VAR	Manufacturer software version (page 4-53)	Vis-String	const	O
$100C_{hex}$	VAR	Guard time (page 4-53)	Unsigned32	rw	O
$100D_{hex}$	VAR	Lifetime factor (page 4-55)	Unsigned32	rw	O
1010_{hex}	ARRAY	Store parameters (page 4-56)	Unsigned32	rw	O
1011_{hex}	ARRAY	Restore default parameters (page 4-58)	Unsigned32	rw	O
1014_{hex}	VAR	Emcy COB-ID (page 4-60)	Unsigned32	rw	O
1016_{hex}	ARRAY	Consumer heartbeat time (page 4-62)	Unsigned32	rw	O
1017_{hex}	VAR	Producer heartbeat time (page 4-64)	Unsigned16	rw	O
1018_{hex}	RECORD	Identity object (page 4-64)	Identity	ro	O
1020_{hex}	ARRAY	Verify configuration (page 4-68)	Unsigned32	rw	O
1027_{hex}	ARRAY	Module list (page 4-70)	Unsigned16	ro	M

Table 12: Object overview for the communication profile

Index ($_{hex}$)	Object	Name	Type	Access	M/O
Server SDO parameter					
1200_{hex}	RECORD	1st Server SDO parameter (page 4-72)	SDO parameter	ro	O
1201_{hex}	RECORD	2nd Server SDO parameter (page 4-72)	SDO parameter	rw	O
1202_{hex}	RECORD	3rd Server SDO parameter (page 4-72)	SDO parameter	rw	O
1203_{hex}	RECORD	4th Server SDO parameter (page 4-72)	SDO parameter	rw	O
Receive PDO communication parameter					
1400_{hex}	RECORD	1st receive PDO parameter (page 4-75)	PDO CommPar	rw	O
1401_{hex}	RECORD	2nd receive PDO parameter (page 4-75)	PDO CommPar	rw	O
1402_{hex}	RECORD	3rd receive PDO parameter (page 4-75)	PDO CommPar	rw	O
...	...	...	...	...	...
$141F_{hex}$	RECORD	32nd receive PDO parameter (page 4-75)	PDO CommPar	rw	O

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Table 12: Object overview for the communication profile

Index ($_{hex}$)	Object	Name	Type	Access	M/O
Receive PDO-mapping parameter					
1600_{hex}	ARRAY	1st receive PDO-mapping (page 4-79)	PDO mapping	rw	O
1601_{hex}	ARRAY	2nd receive PDO-mapping (page 4-79)	PDO mapping	rw	O
1602_{hex}	ARRAY	3rd receive PDO-mapping (page 4-79)	PDO mapping	rw	O
...	...	...	...	...	...
$161F_{hex}$	ARRAY	32nd receive PDO-mapping (page 4-79)	PDO mapping	rw	O
Transmit PDO communication parameter					
1800_{hex}	RECORD	1st transmit PDO parameter (page 4-83)	PDO CommPar	rw	O
1801_{hex}	RECORD	2nd transmit PDO parameter (page 4-83)	PDO CommPar	rw	O
1802_{hex}	RECORD	3rd transmit PDO parameter (page 4-83)	PDO CommPar	rw	O
...	...	...	...	...	...
$181F_{hex}$	RECORD	32nd transmit PDO parameter (page 4-83)	PDO CommPar	rw	O

Table 12: Object overview for the communication profile

Index ($_{hex}$)	Object	Name	Type	Access	M/O
Transmit PDO-mapping parameter					
$1A00_{hex}$	ARRAY	1nd transmit PDO-mapping (page 4-89)	PDO mapping	rw	O
$1A01_{hex}$	ARRAY	2nd transmit PDO-mapping (page 4-89)	PDO mapping	rw	O
$1A02_{hex}$	ARRAY	3rd transmit PDO-mapping (page 4-89)	PDO mapping	rw	O
...	...	...	...	...	...
$1A1F_{hex}$	ARRAY	32nd transmit PDO mapping (page 4-89)	PDO mapping	rw	O
NMT Master related Objects					
$1F80_{hex}$	VAR	NMT startup (page 4-92)	Unsigned32	rw	O
$1F81_{hex}$	ARRAY	Slave assignment (page 4-94)	Unsigned32	rw	O
$1F82_{hex}$	ARRAY	Request NMT (page 4-98)	Unsigned8	rw	O
$1F83_{hex}$	ARRAY	Request guarding (page 4-101)	Unsigned8	rw	O

Object 1000_{hex} - Device Type

Object 1000_{hex} contains the Type and the Function of the BL20 station.

The value FFFF 0191_{hex} indicates that all Device Profiles are supported.

Table 13: Object 1000_{hex}

Object description	
INDEX	1000_{hex}
Name	Device type
Object code	VAR
Data Type	Unsigned32
Value range	
Access	ro
PDO-mapping	No
Value range	Unsigned32
Default value, BL20	FFFF 0191_{hex}

Object 1001_{hex} - Error Register

Object 1001_{hex} contains the Error register for the BL20-CANopen gateway. It thus contains, in one byte, the internal errors that occur.

Table 14: Object 1001_{hex}

Object description	
INDEX	1001_{hex}
Name	Error register
Object code	VAR
Data Type	Unsigned8
Value range	
Access	ro
PDO-mapping	Optional
Value range	Unsigned8
Default value, BL20	00_{hex}

Error register

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
generic	current	voltage	0	Comm.	0	0	Manu.

Abbreviations:

Abbr.	Meaning	Valid for Modules
generic	General error	all
current.	Output short-circuit/ Current error	DO, AI,TC
voltage	Voltage error	PF, DO, AI, AO
Comm.	Communication error	all
Manu.	Manufacturer-specific error	all

Object 1005_{hex} - SYNC COB-ID

Object 1005_{hex} defines the COB-ID for the Synchronization Object (SYNC). The BL20-CANopen gateway not generate SYNC messages, only receive them.

Structure of the SYNC COB-ID entry (Unsigned32):

	MSB				LSB
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID	×	0	0	00 0000 0000 0000 0000	11-bit identifier
29-bit ID	×	0	1	29-bit identifier	

Table 15: Description of the SYNC COB-ID entry

Bit number	Value	Description
31 (MSB)	X	fixed
30	0 1	Module does not generate a SYNC message Module generates a SYNC message
29	0 1	11-bit ID (CAN 2.0A) → for BL20 29-bit ID (CAN 2.0B)
28 to 11	0 X	if Bit 29 = 0 if Bit 29 = 1: Bits 28 to 11 of the SYNC-COB-ID
10 to 0 (LSB)	X	Bit 10 to 0 of the SYNC-COB-ID

Note

Bit 30 is static, i.e. cannot be changed.

Table 16: Object 1005_{hex}

Object description	
INDEX	1005_{hex}
Name	COB-ID Sync
Object code	VAR
Data Type	Unsigned32
Value range	
Access	rw
PDO-mapping	No
Value range	Unsigned32
Default value, BL20	0000 0080h

Object 1008_{hex} - Device Name

Object 1008_{hex} contains the manufacturer-specific device name

Table 17: Object 1008_{hex}

Object description	
INDEX	1008_{hex}
Name	Device name from the manufacturer
Object code	VAR
Data Type	Visible String
Value range	
Access	const.
PDO-mapping	No
Value range, BL20	–
Default value, BL20	BL20-GW-CO

Object 1009_{hex} - Manufacturer Hardware Version

Object 1009_{hex} contains the designation for the Hardware Version.

Table 18: Object 1009_{hex}

Object description	
INDEX	1009_{hex}
Name	Hardware version
Object code	VAR
Data Type	Visible String
Value range	
Access	const.
PDO-mapping	No
Value range, BL20	–
Default value, BL20	X/01

Object $100A_{hex}$ - Manufacturer Software Version

Object $100A_{hex}$ contains the designation for the software version.

Table 19: Object $100A_{hex}$

Object description	
INDEX	$100A_{hex}$
Name	software version
Object code	VAR
Data Type	Visible String
Value range	
Access	const.
PDO-mapping	No
Value range, BL20	–
Default value, BL20	1.01

Note
The value description corresponds to the state as delivered at the time this manual was printed.

Object $100C_{hex}$ - Guard Time

Object $100C_{hex}$ contains the Guard time in ms. The product of "Lifetime factor" (Object $100D_{hex}$) and Guard time is the "Lifetime" for Node Guarding.

Table 20: Object $100C_{hex}$

Object description	
INDEX	$100C_{hex}$
Name	Guard time
Object code	VAR
Data Type	Unsigned16

Table 20: Object 100C$_{hex}$

Object description	
Value range	
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned16
Default value, BL20	0

Object $100D_{hex}$ - Lifetime Factor

If the Lifetime factor is multiplied by the Guard time, the result is the Lifetime for Node Guarding.

Example:

Guard time: 100 ms

Lifetime factor: 3

The Guard time of 100 ms means that the network nodes expect a Guard Frame from the master every 100 ms. The Lifetime factor enables a setting to be made in the BL20-CANopen gateway for how often a Guard Frame from the Master can be missed before an error condition is recognized.

In this example, the relevant time would be 300 ms. The evaluation would only become active after the message had been missing for 300 ms.

Table 21: Object $100D_{hex}$

Object description	
INDEX	$100D_{hex}$
Name	Lifetime factor
Object code	VAR
Data Type	Unsigned8
Value range	
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	0

Object 1010_{hex} - Store Parameters

The object 1010_{hex} can be used to save parameter changes in non-volatile memory. The command is executed by writing the data contents 0x6576 6173 ("save") to one of the Sub-indices.

Table 22: Object 1010_{hex}

Object description	
INDEX	1010_{hex}
Name	Store parameters
Object code	3_{hex}
Data Type	Unsigned32
Value description	
Sub-index	00_{hex}
Description	highest supported sub-index
Access	ro
PDO-mapping	No
Sub-index	01_{hex}
Description	Save all parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Table 22: Object 1010_{hex}

Object description

Value description	
Sub-index	02_{hex}
Description	Save communication parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Sub-index	03_{hex}
Description	Save application parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Object 1011_{hex} - Restore Default Parameters

Object 1011_{hex} can be used to restore the default parameters. The command is executed by writing the data contents 0x6461 6F6C ("load") to one of the Sub-indices.

Table 23: Object 1011_{hex}

Object description	
INDEX	1011_{hex}
Name	Restore default parameters
Object code	ARRAY
Data Type	3_{hex}
Value description	
Sub-index	00_{hex}
Description	Highest supported sub-index
Access	ro
PDO-mapping	No
Sub-index	01_{hex}
Description	Restore all parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Table 23: Object 1011_{hex}

Object description

Value description

Sub-index	02_{hex}
Description	Restore communication parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Sub-index	03_{hex}
Description	Restore application parameters
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	1_{hex}

Object 1014_{hex} - Emcy COB-ID

Object 1014_{hex} contains the Identifier for the emergency messages.

	MSB				LSB
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID	0/1	0	0	00 0000 0000 0000 0000	11-bit identifier
29-bit ID	0/1	0	1	29-bit identifier	

Table 24: Description of the Emcy COB-ID entry

Bit number	Value	Description
31 (MSB)	0 1	EMCY exists/ is valid EMCY does not exist/ is not valid
30	0	reserved (always 0)
29	0 1	11-bit ID (CAN 2.0A) → for BL20 29-bit ID (CAN 2.0B)
28 to 11	0 X	if bit 29=0 if bit 29=1: bits 28 to 11 of 29-bit-COB-ID
10 to 0 (LSB)	X	Bit 10 to 0 of COB-ID

Note
Bit 30 is static, i.e. cannot be changed.

Table 25: Object 1014_{hex}

Object description	
INDEX	1014_{hex}
Name	Emcy COB-ID
Object code	VAR
Data Type	Unsigned32

Table 25: Object 1014_{hex}

Object description	
Value description	
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	0000 0080_{hex} + Node-ID

Object 1016$_{hex}$ - Consumer Heartbeat Time

The Heartbeat Protocol is used to monitor the operational capability of other CANopen bus nodes. The Heartbeat Protocol must be seen as an alternative to Node-/Life-Guarding, which, unlike Guarding, does not use Remote-Frames.

A device generates the Heartbeat with a specific cycle time (see object 1017$_{hex}$ "Producer heartbeat time"). Another device receives the Heartbeat and monitors the cycle time.

Object 1016$_{hex}$ defines the cycle time (interval) at which the Heartbeat is expected. This cycle time should be longer than the corresponding cycle time for the transmitter (see object 1017$_{hex}$). The monitoring of the Heartbeat starts when the first Heartbeat Frame is received. If the Consumer heartbeat time = 0, then the corresponding entry will not be used. The time is set as a multiple of 1 ms.

Structure of the entry for Consumer heartbeat time (Unsigned32):

	MSB		**LSB**
Bits	31 to 24	23 to 16	15 to 0
Value	reserved (default: 00$_{hex}$)	Node-ID	Heartbeat Time
Data Type	–	Unsigned8	Unsigned16

Table 26: Object 1016$_{hex}$

Object description	
INDEX	1016$_{hex}$
Name	Consumer heartbeat time
Object code	ARRAY
Data Type	Unsigned32
Value description	
Sub-index	00$_{hex}$
Description	Number of entries
Category	Mandatory
Access	ro

Table 26: Object 1016_{hex}

Object description

PDO-mapping	No
Value range, BL20	1
Default value, BL20	1

Sub-index	01_{hex}
Description	Consumer heartbeat time
Category	Mandatory
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	0

Object 1017_{hex} - Producer Heartbeat Time

The object 1017_{hex} defines the cycle time for the Heartbeat of the generating device.

If the cycle time = 0, then Heartbeat will not be used. The content of the object is interpreted as a multiple of 1 ms.

Table 27: Object 1017_{hex}

Object description	
INDEX	1017_{hex}
Name	Producer heartbeat time
Object code	VAR
Data Type	Unsigned16
Value description	
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned16
Default value, BL20	0

Object 1018_{hex} - Identity Object

Object 1018_{hex} contains general information about the BL20 gateway.

The Vendor-ID (Sub-index 01_{hex}) is a unique ID which precisely identifies the manufacturer. The manufacturer-specific Product-Code (Sub-index 02_{hex}) identifies a specific device version. The manufacturer-specific Revision-Number (Sub-index 03_{hex}) consists of a major revision number and a minor revision number. The major revision number defines a special CANopen functionality. If the CANopen functionality is expanded, then the major revision number must be incremented. The minor revision number identifies various versions that have the same CANopen functionality.

	MSB	**LSB**
Bits	31 to 16	15 to 0
Value	Major revision number	minor revision number

Table 28: Object 1018_{hex}

Object description	
INDEX	1018_{hex}
Name	Device specification
Object code	RECORD
Data Type	Identity
Value description	
Sub-index	00_{hex}
Description	Number of entries
Category	Mandatory
Access	ro
PDO-mapping	No
Default value, BL20	4

Table 28: Object 1018_{hex}

Object description	
Sub-index	01_{hex}
Description	Manufacturer-ID
Category	Mandatory
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	0000 0003_{hex}
Sub-index	02_{hex}
Description	Product Code
Category	Option
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	6827200
Value description	
Sub-index	03_{hex}
Description	Revision-Number
Category	Option
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Table 28: Object 1018_{hex}

Object description	
Sub-index	04_{hex}
Description	Serial number
Category	Option
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	6827200

Object 1020_{hex} - Verify Configuration

Object 1020_{hex} is used to check the station configuration after a device reset.

The BL20-CANopen gateway supports the non-volatile storage of parameters. A network configuration tool or an CANopen Manager can use object 1020_{hex} to test the station configuration after a reset, and so check whether a reconfiguration is necessary. The configuration tool saves the time and date simultaneously in object 1020_{hex} and the corresponding DCF file. After a reset, the most recent configuration and the signature will be restored, either automatically on request. If the configuration values are altered by some other command, then the object will be set to 0.

The Configuration Manager compares the signature and the configuration with the values from the DCF file. If it discovers any deviations, a reconfiguration will be necessary.

Table 29: Object 1020_{hex}

Object description	
INDEX	1020_{hex}
Name	Verify Configuration
Object code	ARRAY
Data Type	Unsigned16
Value description	
Sub-index	00_{hex}
Description	Number of entries
Access	rw
PDO-mapping	No
Default value, BL20	02_{hex}

Table 29: Object 1020_{hex}

Object description

Sub-index	01_{hex}
Description	Configuration date
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Sub-index	02_{hex}
Description	Configuration time
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Note

The configuration date contains the number of days since January 01 1984.
The configuration time contains the number of milliseconds since midnight.

Object 1027_{hex} - Module List

Object 1027_{hex} describes all the actually installed modules in an BL20 station.

Table 30: Object 1027_{hex}

Object description	
INDEX	1027_{hex}
Name	Module list
Object code	ARRAY
Data Type	Unsigned16
Access	ro
Value description	
Sub-index	00_{hex}
Description	Number of modules connected
Access	ro
PDO-mapping	No
Value range, BL20	00_{hex} to $4A_{hex}$
Default value, BL20	No
Sub-index	01_{hex}
Description	Module 1
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned16
Default value, BL20	No
...	...

Table 30: Object 1027$_{hex}$

Object description

Sub-index	4A$_{hex}$
Description	Module 74
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned16
Default value, BL20	No

The sequential Sub-indices 01$_{hex}$ to 4A$_{hex}$ describe the corresponding BL20 modules in the sequence in which they are installed in the BL20 station. Each entry contains a number that identifies the particular module.

Note

There is one identifier for each type of BL20 module.

In the EDS-file, the individual extensions to object 1027$_{hex}$ for all the optional BL20 module types are listed in the section [Supported Modules]. The default values correspond to the identifiers for the particular module types.

Objects for the Transfer of Service Data

Object 1200_{hex} to 1203_{hex} - Server SDO Default Parameters

Objects 1200_{hex} to 1203_{hex} contain the parameters for the SDOs.

Table 31: Object 1200_{hex} to 1203_{hex}

Object description

INDEX	1200_{hex} to 1203_{hex}
Name	Server SDO-parameters
Object code	RECORD
Number of Elements	3_{hex}
Data Type	SDO-parameters
Value description	
Sub-index	00_{hex}
Description	Number of entries
Access	ro
PDO-mapping	No
Default value, BL20	02_{hex}

Sub-index	01_{hex}
Description	COB-ID Client > Server (rx)
Access	Index 1200_{hex}:ro Index 1201_{hex} to 1203_{hex}:rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	Index 1200_{hex}: 0000 0600_{hex} + Node-ID Index 1201_{hex} to 1203_{hex}:No

Table 31: Object 1200_{hex} to 1203_{hex}

Object description

Sub-index	02_{hex}
Description	COB-ID Server > Client (rx)
Access	Index 1200_{hex}:ro Index 1201_{hex} to 1203_{hex}:rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	Index 1200_{hex}: 0000 0580_{hex} + Node-ID Index 1201_{hex} to 1203_{hex}:No

Objects for the Transfer of Process Output Data

The objects 1400_{hex} to $141F_{hex}$ define, together with objects 1600_{hex} to $161F_{hex}$, which output data have to be transferred via RPDO. In addition to that, the priority and the transmission type for the RPDO-transfer are defined.

Object 1400_{hex} defines the priority and the transmission type for the RPDO**1**. object 1600_{hex} defines the object-index, the sub-index and the data length for the data which have to be transferred via RPDO**1**.

Objects 1401_{hex} and 1601_{hex} thus define the RPDO**2**, objects 1402_{hex} and 1602_{hex} define RPDO**3**, etc.

The priority of the data is defined by the identifier/COB-ID.

The values are already entered by default for objects 1400hex to 1403hex and 1600hex to 1603hex .

A station with up to 64 digital outputs and 12 analog outputs therefore transfers the process output data automatically via RPDOs.

Object 1400_{hex} to $141F_{hex}$ - Receive PDO Comm. Default Parameters

Objects 1400_{hex} to $141F_{hex}$ define the priority and the transmission type or RPDO1 to RPDO32.

The priority is defined via the identifier/COB-ID (see "Identifier for the Standard Objects", page 4-10) in sub-index 01_{hex}. With the highest bit of sub-index 01_{hex}, the further content can be defined as valid/invalid. The corresponding most significant hexadecimal number is then >8.

The transmission type is defined with the sub-index 02hex.

Which data content is to be transferred with the RPDO1 to RPDO32 is defined with the objects 1600hex to 161Fhex .

Table 32: Object 1400_{hex} to $141F_{hex}$

Object description	
INDEX	1400_{hex} to $141F_{hex}$
Name	Receive PDO parameters
Object code	RECORD
Data Type	PDO CommPar
Value description	
Sub-index	00_{hex}
Description	maximum number of entries
Access	ro
PDO-mapping	No
Value range, BL20	2
Default value, BL20	02_{hex}
Sub-index	01_{hex}
Description	COB-ID for the PDOs (see Table 33:)
Access	rw

Table 32: Object 1400_{hex} to $141F_{hex}$

Object description		
	PDO-mapping	No
	Value range, BL20	Unsigned32
	Default value, BL20	– Index 1400_{hex}: $0000\ 0200_{hex}$ + Node-ID – Index 1401_{hex}: $0000\ 0300_{hex}$ + Node-ID – Index 1402_{hex}: $0000\ 0400_{hex}$ + Node-ID – Index 1403_{hex}: $0000\ 0500_{hex}$ + Node-ID – Index 1404_{hex} to $141F_{hex}$: blocked
Sub-index		02_{hex}
	Description	Transmission type (see Table 34:)
	Access	rw
	PDO-mapping	No
	Value range, BL20	Unsigned8
	Default value, BL20	FF_{hex}

Structure of the COB-ID entry:

	MSB				LSB
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID	0/1	0/1	0	00 0000 0000 0000 0000	11-bit identifier
29-bit ID	0/1	0/1	1	29-bit identifier	

Table 33: Description of the COB-ID entry

Bit number	Value	Meaning
31 (msb)	0	PDO exists / is valid
	1	PDO does not exist / is invalid
30	0	RTR is possible in this PDO
	1	RTR is not possible in this PDO
29	0	11-bit-ID (CAN 2.0A) (Standard application)
	1	29-bit-ID (CAN 2.0B)
28 to 11	0	if bit 29=0 (Standard application)
	X	if bit 29=1: bits 28 to 11 of COB-ID
10 to 0 (lsb)	X	Bit 10 to 0 of COB-ID

The Transmission type (Sub-index 02_{hex}) can have the following values:

Table 34: Description of the Transmission type

Transmission type	PDO transmission				
	cyclic	acyclic	synchr.	asynchr.	only with RTR
0		×	×		
1	×		×		
2 to 254	reserved				
255				×	

Object 1600_{hex} to $161F_{hex}$ - Receive PDO-Mapping Parameter

Objects 1600_{hex} to $161F_{hex}$ define, which data have to be transferred with RPDO1 to RPDO32.

The data content (here: process output data) is represented by product specific mappable objects.

→ "Mappable Objects", page 4-32.

For example, the process output data for the digital channels are entered in objects 6200_{hex}, 6220_{hex} etc.

The description of these objects can be found in section "I/O-Module Objects", page 4-110 ff..

Sub-indices 01_{hex} to 40_{hex} of the objects 1600_{hex} to $161F_{hex}$ contain the object number, the sub-index and the length of the data that have to be transferred via the respective RPDO.

An RPDO can transfer a maximum number of 8 bytes (64 bit).

Objects 1600_{hex} to 1603_{hex} (RPDO1 to RPDO4) references by default the values for the first 64 digital output channels and for the first 12 analog output channels, provided that the values are represented by the objects 6200_{hex} (digital values) and 6411_{hex} (analog values).

Table 35: Object 1600_{hex} to $161F_{hex}$

Object description	
INDEX	1600_{hex} to $161F_{hex}$
Name	Receive PDO-mapping parameter
Object code	RECORD
Data Type	PDO-mapping
Value description	
Sub-index	00_{hex}
Description	highest sub-index used
Access	rw
PDO-mapping	No
Value range, BL20	0 to 64

Table 35: Object 1600_{hex} to $161F_{hex}$

Object description

Default value, BL20	see Table 12:
Sub-index	01_{hex}
Description	1st mapping object
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	see Table 12:
...	
Sub-index	40_{hex}
Description	64th mapping object
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

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> **Note**
> The number of mapping objects, which are automatically generated by the gateway during start-up, depends on the actual physical structure of the BL20-station.

Possible default values for objects 1600_{hex} to 1603_{hex}:

Table 36: Possible default values for objects 1600_{hex} to 1603_{hex}

Object	Sub-index	Default value,BL20	Description	applies to
1600_{hex}	01_{hex}	6200 0108_{hex}	1st mapping object (digital output)	RPDO1
	...	...	...	
	08_{hex}	6200 0808_{hex}	8th mapping object (digital output)	
1601_{hex}	01_{hex}	6411 0110_{hex}	1st mapping object (analog output)	RPDO2
	...	...	...	
	04_{hex}	6411 0410_{hex}	4th mapping object (analog output)	
1602_{hex}	01_{hex}	6411 0510_{hex}	1st mapping object (analog output)	RPDO3
	...	...	...	
	04_{hex}	6411 0810_{hex}	4th mapping object (analog output)	
1603_{hex}	01_{hex}	6411 0910_{hex}	1st mapping object (analog output)	RPDO4
	...	...	...	
	04_{hex}	6411 $0C10_{hex}$	4th mapping object (analog output)	

The following structure applies to the parameters for sub-index 01_{hex} to 40_{hex}:

Structure of the PDO-mapping entries:

MSB		LSB
Index (16 bit)	Sub-index (8 bit)	Object Length (8 bit)

Note

To change the number of mapping entries, follow the instructions in Section "Procedure for Altering PDO-Mappings".

Objects for the Transfer of Process Input data

Objects 1800_{hex} to $181F_{hex}$ define, together with objects $1A00_{hex}$ to $1A1F_{hex}$, which input data are transferred. Additionally they define the priority and the mode for the data transfer via TPDO.

Object 1800_{hex} defines the priority, the minimum inhibit time, the event timer and the transmission type for TPDO**1**. object $1A00_{hex}$ defines the object-index, the sub-index and the data length for the data which have to be transferred via TPDO**1**.

The object 1801hex together with object 1A01hex provides this information accordingly for the TPDO2 etc.

The priority of the data is defined by the identifier/COB-ID.

The values are already entered by default for objects 1800hex to 1803hex and 1A00hex to 1A03hex .

A station with up to 64 digital inputs and 12 analog inputs therefore transfers the process input data automatically via TPDOs.

Object 1800_{hex} to $181F_{hex}$ - Transmit PDO-Parameters

Objects 1800_{hex} to $181F_{hex}$ define the priority, the transmission type, the inhibit time and the event timer for TPDO1 to TPDO32.

The priority is defined via the identifier/COB-ID (see "Identifier for the Standard Objects", page 4-10) in sub-index 01_{hex}. With the highest bit of sub-index 01_{hex}, the further content can be defined as valid/invalid.

The transmission type is defined in sub-index 02_{hex}. Possible transmission type can be found in Table 39:.

The inhibit time is defined in sub-index 03_{hex}.

The event timer is defined in sub-index 05_{hex}.

Which data content is to be transferred with the RPDO1 to RPDO32 is defined with the objects 1A00hex to 1A1Fhex.

Table 37: Object 1800_{hex} to $181F_{hex}$

Object description

INDEX	1800_{hex} to $181F_{hex}$
Name	Transmit PDO-parameters
Object code	RECORD

Table 37: Object 1800_{hex} to $181F_{hex}$

Object description	
Data Type	PDO CommPar
Value description	
Sub-index	00_{hex}
Description	highest sub-index used
Access	ro
PDO-mapping	No
Value range, BL20	5
Default value, BL20	No

Sub-index	01_{hex}
Description	COB-ID of the PDO
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	– Index 1800_{hex}: $0000\ 0180_{hex}$ + Node-ID – Index 1801_{hex}: $0000\ 0280_{hex}$ + Node-ID – Index 1802_{hex}: $0000\ 0380_{hex}$ + Node-ID – Index 1803_{hex}: $0000\ 0480_{hex}$ + Node-ID – Index 1804_{hex} to $181F_{hex}$: invalid

Table 37: Object 1800_{hex} to $181F_{hex}$

Object description

Value description

Sub-index	02_{hex}
– Description	Transmission type
– Access	rw
– PDO-mapping	No
– Value range, BL20	Unsigned8
– Default value, BL20	FFh

Sub-index	03_{hex}
Description	Inhibit time
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned16
Default value, BL20	0

Sub-index	04_{hex}
Description	reserved

Table 37: Object 1800_{hex} to $181F_{hex}$

Object description	
Value description	
Sub-index	05_{hex}
Description	Event timer
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned16 (0 is not used)
Default value, BL20	0

The COB-ID (Sub-index 01_{hex}) shows the following structure:

	MSB	**LSB**			
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID	0/1	0/1	0	00 0000 0000 0000 0000	11-bit identifier
29-bit ID	0/1	0/1	1	29-bit identifier	

Table 38: Description of the COB-ID entry (Sub-index 01_{hex})

Bit number	Value	Description
31 (MSB)	0	PDO exists/is valid
	1	PDO does not exist/is invalid
30	0	RTR is possible with this PDO
	1	RTR is not possible with this PDO
29	0	11-bit ID (CAN 2.0A)
	1	29-bit ID (CAN 2.0B)
28 to 11	0	if bit 29=0
	X	if bit 29=1: bits 28 to 11 of the COB-ID
10 to 0 (LSB)	X	Bit 10 to 0 of the COB-ID

The Transmission type (Sub-index 02_{hex}) can have the following values:

Table 39: Transmission type of BL20

Transmission type	PDO transmission				
	cyclic	acyclic	synchr.	asynchr.	only with RTR
0		×	×		
1	×		×		
2 to 252			reserved		
253				×	×
254			reserved		
255				×	

Inhibit time

The setting of an Inhibit time for the PDOs (Object 1800_{hex} ff, Sub-Index 03_{hex}) is only supported for TPDOs. Unlike the other time values, which are given as multiples of 1 ms, the Inhibit time is defined as a multiple of 100 ms. However, since the time resolution of the system clock in the BL20-CANopen gateway is 1 ms, Inhibit time values below 10 x 100 ms are pointless.

Event timer

The Event timer (Object 1800_{hex} ff, Sub-Index 05_{hex}) defines the maximum interval after which a TPDO will be transmitted, even though no event has occurred. This means that the Event timer determines the maximum interval between two transmissions of a TPDO.

The expiry of the interval set for the Event timer is detected as an event. If any other event occurs, the Event timer is reset and restarted.

The value of the object is interpreted as a multiple of 1 ms.

Object 1A00$_{hex}$ to 1A1Fh - Transmit PDO-Mapping Param.

Objects 1A00$_{hex}$ to 1A1F$_{hex}$ define, which data have to be transferred with TPDO1 to TPDO32.

The data content (here: process input data) is represented by product specific mappable objects.

→ "Mappable Objects", page 4-32.

For example, the process input data for the digital channels are entered in objects 6000$_{hex}$, 6020$_{hex}$ etc.

The description of these objects can be found in section "I/O-Module Objects", page 4-110 ff..

Sub-indices 01$_{hex}$ to 40$_{hex}$ of the objects 1A00$_{hex}$ to 1A1F$_{hex}$ contain the object number, the sub-index and the length of the data that have to be transferred via the respective TPDO.

A TPDO can transfer a maximum number of 8 bytes (64 bit).

The number of sub-indices depends on the data length and must be calculated and entered by the user for larger projects (see below).

8 sub-indices are required for a data length of 8 bits in order to represent a total of 64 bits. A data length of 1 bit requires 64 sub-indices for a total of 64 bits.

Objects 1A00$_{hex}$ to 1A03$_{hex}$ (TPDO1 to TPDO4) references by default the values for the first 64 digital output channels and for the first 12 analog output channels, provided that the values are represented by the objects 6000$_{hex}$ (digital values) and 6401$_{hex}$ (analog values).

Table 40: Object 1A00$_{hex}$ to 1A1F$_{hex}$

Object description

INDEX	1A00$_{hex}$ to 1A1Fh
Name	Transmit PDO-mapping parameters
Object code	RECORD
Data Type	PDO-mapping

Table 40: Object $1A00_{hex}$ to $1A1F_{hex}$

Object description

Value description

Sub-index	00_{hex}
Description	Number of mapped application objects in the PDO
Access	rw
PDO-mapping	No
Value range, BL20	0: deactivate 1 to 64:activated
Default value, BL20	see Table 34:

Sub-index	01_{hex}
Description	1st mapping object
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	see page 4-91
...	
Sub-index	40_{hex}
Description	64th mapping object
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Note

The number of mapping objects, which are automatically generated by the gateway during start-up, depends on the actual physical structure of the BL20-station.

Possible default values for objects $1A00_{hex}$ to $1A03_{hex}$:

Table 41: Possible default values for objects $1A00_{hex}$ to $1A03_{hex}$

Object	Sub-index	Default value, BL20	Description	applies to
$1A00_{hex}$	01_{hex}	$6000\ 0108_{hex}$	1st mapping object (digital input)	TPDO1
	...	...	...	
	08_{hex}	$6000\ 0808_{hex}$	8th mapping object (digital input)	
$1A01_{hex}$	01_{hex}	$6401\ 0110_{hex}$	1st mapping object (analog input)	TPDO2
	...	...	...	
	04_{hex}	$6401\ 0410_{hex}$	4th mapping object (analog input)	
$1A02_{hex}$	01_{hex}	$6401\ 0510_{hex}$	1st mapping object (analog input)	TPDO3
	...	...	...	
	04_{hex}	$6401\ 0810_{hex}$	4th mapping object (analog input)	
$1A03_{hex}$	01_{hex}	$6401\ 0910_{hex}$	1st mapping object (analog input)	TPDO4
	...	...	...	
	04_{hex}	$6401\ 0C10_{hex}$	4th mapping object (analog input)	

The following structure applies to the parameters for sub-index 01_{hex} to 40_{hex}:

MSB		LSB
Index (16 bit)	Sub-index (8 bit)	Object Length (8 bit)

Note
To change the number of mapping entries, please observe the instructions in the Section "Procedure for altering PDO-mappings" in this chapter.

Objects for Network Management

Objects $1F80_{hex}$ to $1F83_{hex}$ are only relevant, if the BL20-Station is to work as NMT-master. The activation is done via bit0 of object $1F80_{hex}$.

Object $1F80_{hex}$ - NMT Startup

Object $1F80_{hex}$ describes the startup behavior of BL20 in NMT (Network-Management).

Table 42: Object $1F80_{hex}$ to $1A1F_{hex}$

Object description

INDEX	$1F80_{hex}$
Name	NMT startup
Object code	VAR
Data Type	Unsigned32
Access	rw

Table 43: Structure of NMT startup

Bit	Value	Meaning
0	0	BL20 is not the NMT-Master. All other bits will be ignored. The objects in the network list will be ignored.
	1	BL20 is the NMT-Master
1	0	Only the explicitly selected slaves will be started.
	1	After boot-up, the service "NMT Start Remote Node All Nodes" will be performed.
2	0	BL20 moves automatically to the "Operational" state.
	1	BL20 does not move automatically to the "Operational" state. The change of state is decided by the particular application.
3	0	Starting of the slave is permitted.
	1	Starting of the slave is not permitted.
4	0	An error event in an obligatory slave deals with the slave individually.
	1	An error event in an obligatory slave triggers an NMT Reset All Nodes (see object $1F81_{hex}$, bit 3).
5 to 31		Reserved; set to 0

Object $1F81_{hex}$ - Slave Assignment

Object $1F81_{hex}$ describes, as per CiA DSP-302, all the slaves that are coupled to the NMT-Master. It contains information on error control parameters and actions that are triggered by error events. All other parameters for a slave are only valid if this slave is described in object $1F81_{hex}$.

Note

Object $1F81_{hex}$ is only valid if the BL20 is defined as the NMT-Master (see object $1F80_{hex}$, bit 0).

Table 44: Object $1F81_{hex}$

Object description	
INDEX	$1F81_{hex}$
Name	Slave assignment
Object code	ARRAY
Data Type	Unsigned32
Access	rw
Value description	
Sub-index	00_{hex}
Description	Maximum number of slaves
Access	rw
PDO-mapping	No
Value range	1 to 127
Default value	127

Table 44: Object 1F81hex

Object description

Sub-index	01_{hex}
Description	Slave with Node-ID 1
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
...	
Sub-index	7Fh
Description	Slave with Node-ID 127
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Note

Each sub-index corresponds to the slave with the particular Node-ID. The Sub-Index with the Node-ID of the NMT-Master will be ignored.

Table 45: Structure of object $1F81_{hex}$ Slave assignment

Byte	Bit	Value	Meaning
0	0	0	The node with this ID is not a slave.
		1	The node with this ID is a slave. After configuration, the node will be put into the "Operational" state.
	1	0	An error event or other event detection by a slave during boot-up leads to information from the application.
		1	An error event or other event detection by a slave during boot-up leads to information from the application and to automatic start of Error Control Services.
	2	0	An error event or other event detection by a slave during boot-up does not lead to information from the application or automatic start of Error Control Services.
		1	An error event or other event detection by a slave during boot-up leads to the start of "Start Boot Slaves".
	3	0	Optional Slave: the network can also be started if this node is not connected.
		1	Obligatory slave: the network will not be started if this node is not connected during the slave boot-up.
	4	0	The slave can be reset by the "NMT Reset Communication" command, depending on its state.
		1	The NMT-Master does not have to send an "NMT Reset Communication" command for this slave, if the slave is in the "Operational" state.

Table 45: Structure of object $1F81_{hex}$ Slave assignment

Byte	Bit	Value	Meaning
0	5	0	Verification of the application software version is not required for this node.
		1	Verification of the application software version is required for this node.
	6	0	Automatic update of the application software (download) is not permitted.
		1	Automatic update of the application software (download) is permitted.
	7		Reserved; set to 0
1			8 bit value for the Retry Factor
2 to 3		0	16 bit value for the Guard time

Object 1F82$_{hex}$ - Request NMT

Object 1F82$_{hex}$ describes, as per CiA DSP-302, all the slaves that can present queries to the Network Management (NMT).

Table 46: Object 1F82$_{hex}$

Object description	
INDEX	1F82$_{hex}$
Name	Query NMT
Object code	ARRAY
Data Type	Unsigned8
Access	ro/rw
Value description	
Sub-index	00$_{hex}$
Description	Supported number of slaves
Access	ro
PDO-mapping	No
Value	128
Sub-index	01$_{hex}$
Description	Request NMT-Service for slave with Node-ID 1
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	No

Table 46: Object $1F82_{hex}$

Object description	
Sub-index	7Fh
Description	Request NMT-Service for slave with Node-ID 127
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	No
Sub-index	80_{hex}
Description	Request NMT-Service for all slaves
Access	wo
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	No

For a write access to this object, the value corresponds to the state for the node to which the query is directed. For read access, the object contains the present state of the node.

Table 47: Value ranges

Status	Value for write access	Value for read access
Stopped	4	4
Operational	5	5
Reset Node	6	–
Reset Communication	7	–
Pre-Operational	127	127

Table 47: Value ranges

Status	Value for write access	Value for read access
unknown	–	0
Node missing	–	1

Object 1F83$_{hex}$ - Request Guarding

Object 1F83$_{hex}$ describes, as per CiA DSP-302, all the slaves that can be monitored through the Network Management (NMT).

Note

Object 1F83$_{hex}$ is only valid if the BL20 is configured as the NMT-Master (see object 1F80$_{hex}$, bit 0).

Table 48: Object 1F83$_{hex}$

Object description	
INDEX	1F83$_{hex}$
Name	Request guarding
Object code	ARRAY
Data Type	Unsigned8
Access	ro/rw
Value description	
Sub-index	00$_{hex}$
Description	Supported number of slaves
Access	ro
PDO-mapping	No
Value	128

Sub-index	01$_{hex}$
Description	Request guarding for slave with Node-ID 1
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned8

Table 48: Object 1F83$_{hex}$

Object description	
Value	0 = Slave being monitored at present 1 = Slave not being monitored at present
...	
Sub-index	7Fh
Description	Request guarding for slave with Node-ID 127
Access	rw
PDO-mapping	No
Value range	Unsigned8
Value	0 Slave being monitored at present 1 Slave not being monitored at present
Sub-index	80$_{hex}$
Description	Request Start/Stop Guarding for all slaves
Access	wo
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	No

Manufacturer Specific Objects

Object 2000_{hex} - Serial Number

Object 2000_{hex} corresponds to the sub-index 04_{hex} of object 1018_{hex} and contains the serial number of the BL20 gateway that is used.

Note

We recommend using object 1018_{hex}, sub-index 04_{hex} for the serial number.

Object 2010_{hex} - Reset Node Modifiers

Object 2010_{hex} is used for a temporary (volatile) modification to the module behavior.

Table 49: Object 2010_{hex}

Object description	
INDEX	2010_{hex}
Name	Reset Node Modifiers
Object code	ARRAY
Data Type	Unsigned32
Value description	
Sub-index	00_{hex}
Description	Number of entries
Access	ro
PDO-mapping	No
Value range, BL20	Unsigned8
Default value, BL20	No
Sub-index	01_{hex}
Description	Reset Node Identifier
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Table 49: Object 2010_{hex}

Object description

Sub-index	02_{hex}
Description	Save reference module list
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

Sub-index	03_{hex}
Description	Save current module list
Access	rw
PDO-mapping	No
Value range, BL20	Unsigned32
Default value, BL20	No

The Reset Node Identifier (**Sub-index 01**$_{hex}$) determines whether, in the event of a Reset Node command, a normal fast reset should be performed, or a hard processor reset, which can take several seconds to be carried out.

For writing, the value that is transferred in Unsigned32 format will be interpreted as a string:

Table 50: Hard Reset (processor reset) selection

MSB			**LSB**
t	s	r	h
74_{hex}	73_{hex}	72_{hex}	68_{hex}

Table 51: Normal Reset selection

MSB			LSB
t	s	r	s
74_{hex}	73_{hex}	72_{hex}	73_{hex}

After the next Reset-Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

The Index "Save reference module list" (**Sub-index 02**$_{hex}$) determines that, in the event of a Reset Node command, the BL20 reference module list (Objects 3080_{hex} and 3081_{hex}) will be saved in non-volatile memory, and then followed by a hard processor reset. This hardware reset is necessary, because changes to the BL20 reference module list cannot be dynamically accepted in the CANopen I/O mirror. If the module list is altered, all the CANopen parameters will be reset to the default values.

For writing, the value that is transferred in Unsigned32 format will be interpreted as a string:

Table 52: Save and Hardware-Reset selection

MSB			LSB
v	a	s	r
76_{hex}	61_{hex}	73_{hex}	72_{hex}

Table 53: Normal Reset selection

MSB			LSB
t	s	r	s
74_{hex}	73_{hex}	72_{hex}	73_{hex}

After the next Reset-Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

The Index "Save current module list" (**Sub-index 03**$_{hex}$) determines that, in the event of a Reset Node command, the present BL20 module list (Objects 3090$_{hex}$ and 3091$_{hex}$) will be saved in non-volatile memory, and then followed by a hard processor reset. This hardware reset is necessary, because changes to the BL20 reference module list cannot be dynamically accepted in the CANopen I/O mirror. If the module list is altered, all the CANopen parameters will be reset to the default values.

For writing, the value that is transferred in Unsigned32 format will be interpreted as a string:

Table 54: Save and Hardware-Reset selection

MSB			**LSB**
v	a	s	c
76$_{hex}$	61$_{hex}$	73$_{hex}$	63$_{hex}$

Table 55: Normal Reset selection

MSB			**LSB**
t	s	r	s
74$_{hex}$	73$_{hex}$	72$_{hex}$	73$_{hex}$

After the next Reset-Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

Object 2400_{hex} - System Voltages

The object System Voltages allows the reading of up to 4 system voltages from the gateway. At present, the BL20-GW-CO supports reading of U_{sys} to sub-index 1. Sub-indices 2...4 return the constant 0.

Table 56: Object 2400_{hex}

Object description

INDEX	2400_{hex}
Name	System Voltages
Object code	ARRAY
No. of Elements	4
Data Type	Unsigned16
Access	ro
Default Value	No
PDO-mapping	Yes

Object 2401_{hex} - System Currents

The object System Currents allows the reading of up to 4 system currents from the gateway.

Table 57: Object 2401_{hex}

Object description

INDEX	2401_{hex}
Name	System Currents
Object code	ARRAY
No. of Elements	4
Data Type	Unsigned16
Access	ro
Default Value	No
PDO-mapping	Yes

I/O-Module Objects

Overview of the I/O-Module Objects

The following table provides an overview of all the I/O module objects that are supported by the BL20 CANopen gateway.

Table 58: Overview of all BL20 I/O-module objects

Index	Name	Page
3000_{hex} to 3097_{hex}	Manufacturer specific objects for parameter access for modules which are not defined in the device profile (e.g. digital input modules with parameters, combi modules,...).	page 4-193
5420_{hex}	Analog input mode (manufacturer specific object)	page 4-117
5440_{hex}	Analog output mode (manufacturer specific object)	page 4-117
5801_{hex}	Encoder config	page 4-177
5802_{hex}	Encoder status	page 4-180
5803_{hex}	Encoder flags	page 4-181
5804_{hex}	Encoder diag	page 4-183
5805_{hex}	SSI Native status	page 4-185
5806_{hex}	SSI Optional encoder status	page 4-189
5808_{hex}	Encoder control	page 4-190
5840_{hex}	SSI Diag mapping	page 4-191
6000_{hex}	Read input 8 bit	page 4-117
6020_{hex}	Read input bit 1 to 128	page 4-118
6021_{hex}	Read input bit 129 to 256	page 4-118
6022_{hex}	Read input bit 257 to 288	page 4-118

Table 58: Overview of all BL20 I/O-module objects

Index	Name	Page
6100_{hex}	Read input 16 bit	page 4-119
6120_{hex}	Read input 32 bit	page 4-120
6200_{hex}	Write output 8 bit	page 4-123
6206_{hex}	Error mode output 8 bit	page 4-127
6207_{hex}	Error state output 8 bit	page 4-128
6220_{hex} to 6222_{hex}	Write output bit 1 – 128 to Write output bit 257 – 288	page 4-124
6250_{hex} to 6252_{hex}	Error mode output bit 1 – 128 to Error mode output bit 257 – 288	page 4-129
6260_{hex} to 6262_{hex}	Error value output bit 1 – to Error value output bit 257 – 288	page 4-131
6300_{hex}	Write output 16 bit	page 4-125
6306_{hex}	Error mode output 16 bit	page 4-133
6307_{hex}	Error value output 16 bit	page 4-134
6320_{hex}	Write output 32 bit	page 4-126
6326_{hex}	Error mode output 32 bit	page 4-135
6327_{hex}	Error value output 32 bit	page 4-136
6401_{hex}	Read analog input 16 bit	page 4-144
6411_{hex}	Write analog output 16 bit	page 4-157
6421_{hex}	Analog input interrupt trigger selection	page 4-145
6422_{hex}	Analog input interrupt source	page 4-148
6423_{hex}	Analog input global interrupt enable	page 4-149

Table 58: Overview of all BL20 I/O-module objects

Index	Name	Page
6424_{hex}	Analog input interrupt upper limit Integer	page 4-150
6425_{hex}	Analog input interrupt lower limit Integer	page 4-151
6426_{hex}	Analog input interrupt delta Unsigned	page 4-152
6427_{hex}	Analog input interrupt negative delta Unsigned	page 4-153
6428_{hex}	Analog input interrupt positive delta Unsigned	page 4-154
6443_{hex}	Analog output error mode	page 4-157
6444_{hex}	Analog output error value Integer	page 4-160
$67FF_{hex}$	Device type	page 4-113
6800_{hex}	Operating parameters	page 4-193
6810_{hex}	Preset value for multi-sensor devices	page 4-193
6820_{hex}	Position value for multi-sensor devices	page 4-194
$6B00_{hex}$	CAM State register	page 4-195
$6B10_{hex}$	CAM1 Low limit	page 4-198
$6B20_{hex}$	CAM1 High limit	page 4-198

General I/O-Objects

Object 67FFh - Device Type

The object Device type sends the type of the first supported device profile.

It contains the value 000x0191$_{hex}$.

The low word (0191$_{hex}$) specifies the device profile (401 = I/O-modules), the high word (000xh) the I/O-types, see CANopen standard DS401.

Table 59: Object 67FF$_{hex}$

Feature	Description/ Value
Name	Device type
Object code	VAR
Data Type	Unsigned32
Access	ro
Default value	No
PDO-mapping	No

Objects for Digital Input Modules

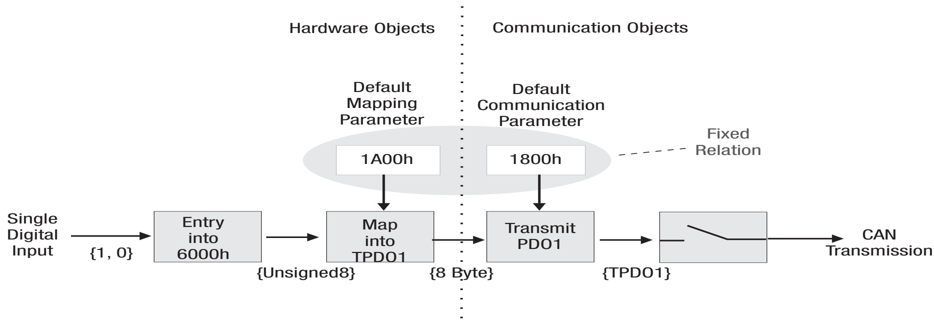
General Overview for Digital Input Objects

Table 60: General overview for digital input objects

Object	Name	Page
3064_{hex}	XBI Param Dword	4-115
6000_{hex}	Read input 8 bit	4-117
6020_{hex}	Read input 8 bit (1 to 128)	4-118
6021_{hex}	Read input 8 bit (129 to 256)	4-118
6022_{hex}	Read input 8 bit (257 to 288)	4-118
6100_{hex}	Read input 16 bit	4-119
6120_{hex}	Read input 32 bit	4-120

The following figure shows the relationship between the digital input objects for an 8-bit access:

Figure 2: Relationship between the digital input objects (according to CiA Draft Standard DS401)



Object 3064$_{hex}$ - XBI Param Dword

The object "XBI Param Dword" Reads the first parameter Dword (Byte 0 to 3) of a module.

Attention

The sub-index corresponds to the slot number of the respective module in a station.

Note

Objects 3000$_{hex}$ to 3097$_{hex}$ enable direct access to the internal module bus of the BL20 station.

Table 61: Object 3064$_{hex}$

Feature	Description/ Value
Name	XBI Param Dword
Object code	ARRAY
Data Type	Unsigned32
Access	rw
Default value	No
PDO-mapping	No

The structure of the 4 bytes of parameter data depends on the module concerned. A sub-index is assigned for each module. The following explains the structure for each module type:

- **BL20-4DI-NAMUR**

Tabelle 5: Parameters BL20-4DI-NAMUR

A *Default settings*

Byte	Bit	Name	Value	Description
0 to 3	0	Input filter x	0 1	– deactivated (input filter 0,25 ms) **A** – activated (input filter 2,5ms)
	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 diag-nostic x		– output substitute value **A** – hold current value
	7	Substitute value on diag x		– off **A** – on

Object 6000$_{hex}$ - Read Input 8 Bit

The object presents the values for the digital input modules in 8-bit groups. A total of 36 groups (each 8 bit) can be displayed (288 digital input channels).

A PDO-mapping of this object is always made automatically as a default for the first 8 Sub-indices. This corresponds to 64 digital input channels.

If more than 64 input channels are present, then the PDO-mapping must be carried out by the user.

Table 62: Object 6000$_{hex}$

Feature	Description/ Value
Name	Read input 8 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
...	...
Sub-index	24$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No

Object 6020$_{hex}$ - Read Input Bit (1 to 128)

Object 6021$_{hex}$ - Read Input Bit (129 to 256)

Object 6022$_{hex}$ - Read Input Bit (257 to 288)

The objects are a bit-wise representation of the values of the digital input modules. Each sub-index for these objects is a Boolean value.

A total of 128 bits can be represented (128 digital input channels).

If more than 128 input channels are present, then object 6021$_{hex}$ is used.

If more than 256 input channels are present, then object 6022$_{hex}$ is used.

Since the number of digital input channels in a station is limited to 288, it is not possible to make use of the complete range of the array in object 6022$_{hex}$.

Table 63: Objects 6020$_{hex}$, 6021$_{hex}$ and 6022$_{hex}$

Feature	Description/ Value
Name	Read input bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 80$_{hex}$
Data Type	Boolean
Access	ro
Default value, BL20	No

Object 6100_{hex} - Read Input 16 Bit

The object presents the values for the digital input modules in 16-bit groups.

A total of 18 groups (each 16 bit) can be displayed (288 digital input channels).

Table 64: Objects 6100_{hex}

Feature	Description/ Value
Name	Read input 16 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 12_{hex}
Data Type	Unsigned16
Access	ro
Default value, BL20	No

Object 6120_{hex} - Read Input 32 Bit

The object presents the values for the digital input modules in 32-bit groups.

A total of 9 groups (each 32 bit) can be displayed (288 digital input channels).

Table 65: Objects 6120_{hex}

Feature	Description/ Value
Name	Read input 32 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 09_{hex}
Data Type	Unsigned32
Access	ro
Default value, BL20	No

Objects for Digital Output Modules

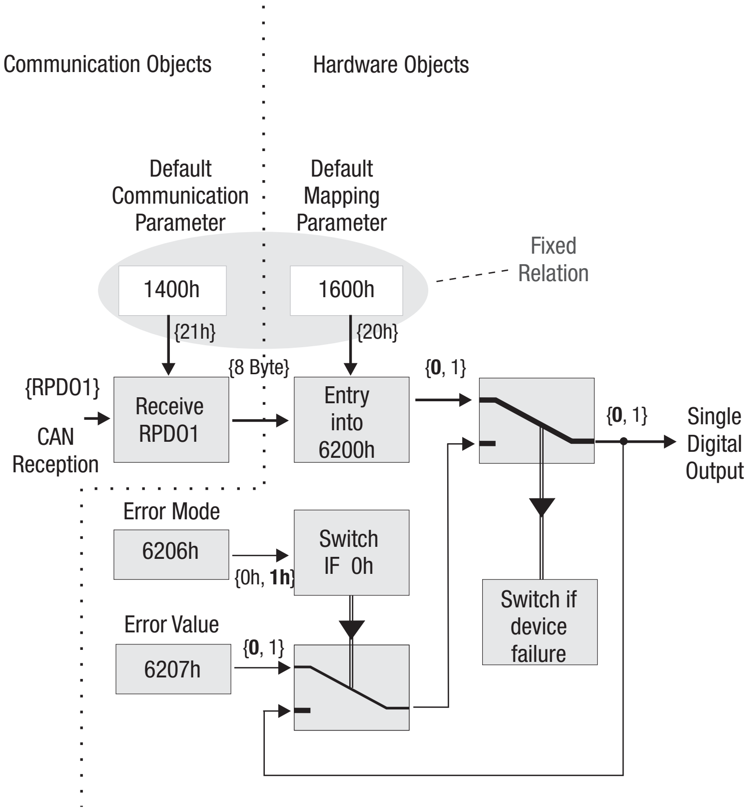
General Overview for Digital Output Objects

Table 66: General overview for digital output objects

Object	Name	Page
6200_{hex}	Write output 8 bit	4-123
6220_{hex}	Write output 8 bit (1 to 128)	4-124
6221_{hex}	Write output 8 bit (129 to 256)	4-124
6222_{hex}	Write output 8 bit (257 to 288)	4-124
6300_{hex}	Write output 16 bit	4-125
6320_{hex}	Write output 32 bit	4-126
6206_{hex}	Error mode output 8 Bit	4-127
6207_{hex}	Error state output 8 Bit	4-128
6250_{hex}	Error mode output Bit (1 to 128)	4-129
6251_{hex}	Error mode output Bit (129 to 256)	4-129
6252_{hex}	Error mode output Bit (257 to 288)	4-129
6260_{hex}	Error state output Bit (1 to 128)	4-131
6261_{hex}	Error state output Bit (129 to 256)	4-131
6262_{hex}	Error state output Bit (257 to 288)	4-131
6306_{hex}	Error mode output 16 bit	4-133
6307_{hex}	Error state output 16 bit	4-134
6326_{hex}	Error mode output 32 Bit	4-135
6327_{hex}	Error state output 32 Bit	4-136

The following figure shows the relationship between the digital output objects for an 8-bit access:

Figure 3: Relationship between the digital output objects (according to CiA Draft Standard DS401)



Object 6200_{hex} - Write Output 8 Bit

The object presents the values for the digital output modules in 8-bit groups.

A total of 36 groups (each 8 bit) can be defined (288 digital output channels).

A PDO-mapping of this object is always made automatically as a default for the first 8 Sub-indices. This corresponds to 64 digital output channels.

If more than 64 output channels are present, then the PDO-mapping must be carried out by the user.

Table 67: Objects 6200_{hex}

Feature	Description/ Value
Name	Write output 8 Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 24_{hex}
Data Type	Unsigned8
Access	rw
Default value, BL20	0

Object 6220_{hex} - Write Output Bit (1 to 128)

Object 6221_{hex} - Write Output Bit (129 to 256)

Object 6222_{hex} - Write Output Bit (257 to 288)

The objects are a bit-wise representation of the values of the digital output modules. Each sub-index for these objects is a Boolean value.

A total of 128 bits can be represented (128 digital output channels).

If more than 128 output channels are present, then object 6221_{hex} is used.

If more than 256 output channels are present, then object 6222_{hex} is used.

Since the number of digital input channels in a station is limited to 288, it is not possible to make use of the complete range of the array in object 6222_{hex}.

Table 68: Objects 6220_{hex}, 6221_{hex}, 6222_{hex}

Feature	Description/ Value
Name	Write output bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 80_{hex}
Data Type	Boolean
Access	rw
Default value, BL20	0

Object 6300_{hex} - Write Output 16 Bit

The object presents the values for the digital output modules in 16-bit groups.

A total of 18 groups (each 16 bit) can be defined (288 digital output channels).

Table 69: Objects 6300_{hex}

Feature	Description/ Value
Name	Write output 16 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 12_{hex}
Data Type	Unsigned16
Access	rw
Default value, BL20	0000_{hex}

Object 6320_{hex} - Write Output 32 Bit

The object presents the values for the digital output modules in 32-bit groups.

A total of 9 groups (each 32 bit) can be defined (288 digital output channels).

Table 70: Objects 6320_{hex}

Feature	Description/ Value
Name	Write output bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-Index	01_{hex} to 09_{hex}
Data Type	Unsigned32
Access	rw
Default value, BL20	0000 0000_{hex}

Object 6206$_{hex}$ - Error Mode Output 8 Bit

The object defines values in 8-bit groups. A total of 36 groups (each 8 bit) can be defined (288 digital output channels).

It defines (for each digital output channel) whether or not the output should take on a substitute value in the event of an error. The rule is:

0 = The output maintains its value if an error occurs.

1 = The output is set to a substitute value if an error occurs.

The substitute values for the digital output channels are defined by the Error state output object (e.g. 6207$_{hex}$).

Table 71: Objects 6206$_{hex}$

Feature	Description/ Value
Name	Error mode output 8 Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 24$_{hex}$
Data Type	Unsigned8
Access	rw
Default value, BL20	FF$_{hex}$

Object 6207_{hex} - Error State Output 8 Bit

The object defines values in 8-bit groups. A total of 36 groups (each 8 bit) can be defined (288 digital output channels).

The substitute value is defined for each digital output channel. The substitute values will only be used in the event of an error if a 1 is entered in an Error mode output object (e.g. 6206_{hex}) for the particular output channel.

Substitute values:

0 = The output will be switched off if an error occurs.

1 = The output will be switched onif an error occurs.

Table 72: Objects 6207_{hex}

Feature	Description/ Value
Name	Error state output 8 Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 24_{hex}
Data Type	Unsigned8
Access	rw
Default value, BL20	00_{hex}

Object 6250$_{hex}$ - Error Mode Output Bit (1 to 128)

Object 6251$_{hex}$ - Error Mode Output Bit (129 to 256)

Object 6252$_{hex}$ - Error Mode Output Bit (257 to 288)

The objects defined the values bit-wise. Each sub-index for these objects is a Boolean value.

A total of 128 bits can be represented (128 digital output channels).

If more than 128 output channels are present, then object 6251$_{hex}$ is used.

If more than 256 output channels are present, then object 6252$_{hex}$ is used.

Since the number of digital input channels in a station is limited to 288, it is not possible to make use of the complete range of the array in object 6522$_{hex}$.

It is possible to define, for each digital output channel, whether or not the output should take on a substitute value in the event of an error. The rule is:

0 = The output maintains its value if an error occurs.

1 = The output is set to a substitute value if an error occurs.

The substitute values for the digital output channels are defined by the Error state output objects (e.g. 6260$_{hex}$, 6261$_{hex}$ and 6262$_{hex}$).

Table 73: Objects 6250$_{hex}$, 6251$_{hex}$, 6252$_{hex}$

Feature	Description/ Value
Name	Error mode output Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No

Table 73: Objects 6250_{hex}, 6251_{hex}, 6252_{hex}

Feature	Description/ Value
Sub-index	01_{hex} to 80_{hex}
Data Type	Boolean
Access	rw
Default value, BL20	1

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Object 6260_{hex} - Error State Output Bit (1 to 128)

Object 6261_{hex} - Error State Output Bit (129 to 256)

Object 6262_{hex} - Error State Output Bit (257 to 288)

The objects defined the values bit-wise. Each sub-index for these objects is a Boolean value.

A total of 128 bits can be represented (128 digital output channels).

If more than 128 output channels are present, then object 6261_{hex} is used.

If more than 256 output channels are present, then object 6262_{hex} is used.

Since the number of digital input channels in a station is limited to 288, it is not possible to make use of the complete range of the array in object 6262_{hex}.

The substitute value is defined for each digital output channel. The substitute values will only be used in the event of an error if a 1 is entered in an Error mode output object (e.g. 6250_{hex}, 6251_{hex} and 6251_{hex}) for the particular output channel.

Substitute values:

0	= The output will be switched off if an error occurs.
1	= The output will be switched on if an error occurs.

Table 74: Objects 6260_{hex}, 6261_{hex}, 6262_{hex}

Feature	Description/ Value
Name	Error state output bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 80_{hex}
Data Type	Boolean
Access	rw
Default value, BL20	0

Object 6306_{hex} - Error Mode Output 16 Bit

The object defines values in 16 bit groups. A total of 18 groups (each 16 bit) can be defined (288 digital output channels).

It is possible to define, for each digital output channel, whether or not the output should take on a substitute value in the event of an error. The rule is:

0 = The output maintains its value if an error occurs.

1 = The output is set to a substitute value if an error occurs.

The substitute values for the digital output channels are defined by an Error state output object (e.g. 6307_{hex}).

Table 75: Objects 6306_{hex}

Feature	Description/ Value
Name	Error mode output 16 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 12_{hex}
Data Type	Unsigned16
Access	rw
Default value, BL20	$FFFF_{hex}$

Object 6307_{hex} - Error State Output 16 Bit

The object defines values in 16 bit groups. A total of 18 groups (each 16 bit) can be defined (288 digital output channels).

The substitute value is defined for each digital output channel. The substitute values will only be used in the event of an error if a 1 is entered in an Error mode output object (e.g. 6306_{hex}) for the particular output channel.

Substitute values:

0 = The output will be switched off if an error occurs.

1 = The output will be switched on if an error occurs.

Table 76: Objects 6307_{hex}

Feature	Description/ Value
Name	Error state output 16 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 12_{hex}
Data Type	Unsigned16
Access	rw
Default value, BL20	0000_{hex}

Object 6326_{hex} - Error Mode Output 32 Bit

The object defines values in 32-bit groups. A total of 9 groups (each 32 bit) can be defined (288 digital output channels).

It is possible to define, for each digital output channel, whether or not the output should take on a substitute value in the event of an error. The rule is:

0 = The output maintains its value if an error occurs.

1 = The output is set to a substitute value if an error occurs.

The substitute values for the digital output channels are defined by an Error state output object (e.g. 6327_{hex}).

Table 77: Objects 6326_{hex}

Feature	Description/ Value
Name	Error mode output 32 Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 09_{hex}
Data Type	Unsigned32
Access	rw
Default value, BL20	FFFF $FFFF_{hex}$

Object 6327_{hex} - Error State Output 32 Bit

The object defines values in 32-bit groups. A total of 9 groups (each 32 bit) can be defined (288 digital output channels).

The substitute value is defined for each digital output channel. The substitute values will only be used in the event of an error if a 1 is entered in an Error mode output object (e.g. 6326_{hex}) for the particular output channel.

Substitute values:

0 = The output will be switched off if an error occurs.

1 = The output will be switched on if an error occurs.

Table 78: Objects 6327_{hex}

Feature	Description/ Value
Name	Error state output 32Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to 09_{hex}
Data Type	Unsigned32
Access	rw
Default value, BL20	0000 0000_{hex}

Objects for Analog Input Modules

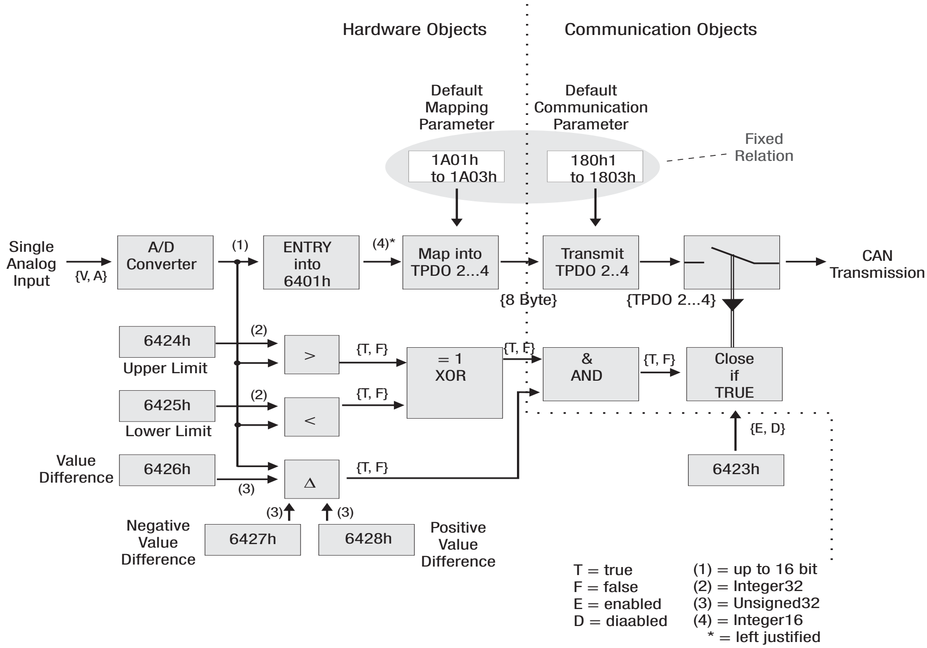
General Overview for Analog Input Objects

Table 79: General overview for analog input objects

Object	Name	Page
5420_{hex}	Manu Spec Analog Input Range	4-139
6401_{hex}	Read analog input 16 Bit	4-144
6421_{hex}	Analog input interrupt Trigger Selection	4-145
6422_{hex}	Analog input interrupt source	4-148
6423_{hex}	Analog input global interrupt enable	4-149
6424_{hex}	Analog input interrupt upper limit Integer	4-150
6425_{hex}	Analog input interrupt lower limit Integer	4-151
6426_{hex}	Analog input interrupt delta Unsigned	4-152
6427_{hex}	Analog input interrupt negative delta Unsigned	4-153
6428_{hex}	Analog input interrupt positive delta Unsigned	4-154

The following figure shows the relationship between the analog input objects for an Integer16 access:

Figure 4:
Relationship between the analog input objects (according to CiA Draft Standard DS401)



Object 5420$_{hex}$ - Manu Spec Analog Input Range

The object "Manu spec analog input range" defines the parameters of the analog input channels. Write accesses initiate a parameter update on the BL20- module bus.

The parameter is stored retentively in the gateway and in the appropriate module, and is restored with every node reset.

The Sub-indices 01$_{hex}$ – 8E$_{he}$ define the parameters for the analog input channel 1 to 142.

Table 80: Objects 5420$_{hex}$

Feature	Description/ Value
Name	Manu spec analog input range
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 8E$_{hex}$
Data Type	Unsigned16
Access	rw
Default value, BL20	No

The structure of the 2 bytes of parameter data depends on the module concerned. A sub-index is assigned for each channel. The following explains the structure for each module type:

- **BL20-1AI-I(0/4...20MA)**

Table 81: Parameters BL20-1AI-I(0/4...20MA)

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Current mode	0 = 0...20 mA **A** 1 = 4...20 mA
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved
	2	Diagnostic	0 = release **A** 1 = block
	3	Channel Kx	0 = activate **A** 1 = deactivate
	4 to 7	reserved	

- **BL20-1AI-U(-10/0...+10VDC)**

Table 82: Parameters BL20-1AI-U(-10/0...+10VDC)

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Voltage mode	0 = 0...10 V **A** 1 = -10...10 V
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved
	2	Diagnostic Kx	0 = release **A** 1 = block
	3	Channel	0 = activate **A** 1 = deactivate
	4 to 7	reserved	

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

Table 83: Parameter data BL20-2AI-PT/NI-2/3

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Mains suppression	0 = 50 Hz **A** 1 = 60 Hz
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved
	2	Diagnostic	0 = release **A** 1 = block
	3	Channel Kx	0 = activate **A** 1= deactivate
	4 to 7	Element	0000 = Pt100, -200...850 °C **A** 0001 = Pt100, -200...150 °C 0010 = Ni100, -60...250 °C 0011 = Ni100, -60...150 °C 0100 = Pt200, -200...850 °C 0101 = Pt200, -200...150 °C 0110 = Pt500, -200...850 °C 0111 = Pt500, -200...150 °C 1000 = Pt1000, -200...850 °C 1001= Pt1000, -200...150 °C 1010 = Ni1000, -60...250 °C 1011 = Ni1000, -60...150 °C 1100 = Resistance, 0...100 Ω 1101 = Resistance, 0...200 Ω 1110 = Resistance, 0...400 Ω 1111 = Resistance, 0...1000 Ω
n +1	0	measurement mode	0 = 2-wire **A** 1 = 3-wire

BL20-2AI-THERMO-PI

Table 84: Parameters BL20-2AI-THERMO-PI

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Mains suppression	0 = 50 Hz **A** 1 = 60 Hz
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved
	2	Diagnostic	0 = release **A** 1 = block
	3	Channel	0 = activate **A** 1= deactivate
	6 to 4	Element	0000 = type K, -270...1370 °C **A** 0001 = type B, +100....1820 °C 0010 = type E, -270...1000 °C 0011 = type J, -210...1200 °C 0100 = type N, -270...1300 °C 0101 = type R, -50...1760 °C 0110 = type S, -50...1540 °C 0111 = type T, -270...400 °C 1000 = ±50 mV 1001 = ±100 mV 1010 = ±500 mV 1011 = ±1000 mV
	7	reserved	

■ **BL20-4AI-U/I**

Table 85: Parameters BL20-4AI-U/I

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Range	0 = 0...10 V/0...20 mA **A** 1 = -10...10 V/4...20 mA
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved
	2	Diagnostic	0 = release **A** 1 = block
	3	Channel	0 = activate **A** 1 = deactivate
	4	Operation mode	0 = voltage **A** 1 = current
	5 to 7	reserved	

Object 6401_{hex} - Read Analog Input 16 Bit

The object represents the measured values for the analog input modules with 16 bits for each channel.

Attention

The process data traffic for the analog input values is not started until the object 6423_{hex} is switched from the default setting FALSE to TRUE!

Attention

The possibility of 12-bit value representation (left-justified) is not useful for CANopen since all reference values (upper limit, lower limit) must be defined with 16 bits.

Table 86: Objects 6401_{hex}

Feature	Description/ Value
Name	Read analog input 16 Bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Integer16
Access	ro
Default value, BL20	No

Object 6421_{hex} - Analog Input Interrupt Trigger Selection

Warning

The behavior of the analog inputs is now adapted to the actuall CANopen standard DS401.

This means, that the firmware versions ≥ 4.02 for BL20-GW-CANOPEN and version ≥ 2.02 for BL20-GWBR-CANOPEN are thus not compatible with older firmware versions relating to the behavior of the analog inputs.

Note

Objects 6421 – 6428_{hex} can be used to control the event-triggered transmission of the process input data. As well as these event-triggered control objects, the transmission frequency of the process input data is also controlled by means of objects 1800_{hex} to $181F_{hex}$.

Attention

Remember that the object a "6423_{hex} Analog input global interrupt enable", page 4-149 must be used in order to enable the possibility of transmitting the process input data using an interrupt signal!

The object defines which event is to trigger the transmitting of the analog input data (TPDOs) by means of an interrupt signal.

The triggering event is defined for each input channel using a corresponding sub-index of the object.

Table 87: Objects 6421$_{hex}$

Feature	Description/ Value
Name	Analog input interrupt trigger selection
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Unsigned8
Access	rw
Default value, BL20	Firmware: ≤ version 4.02/ 2.02 = 0 ≥ version 4.02/ 2.02 = 7

Table 88: Triggering events

A The upper/lower limit values and delta values are defined with the objects 6424_{hex}, 6425_{hex}, 6426_{hex}, 6427_{hex} and 6428_{hex}.

Bit	Triggering event
0	1: "upper limit" **A** exceeded - the value at the input has exceeded the upper limit.
1	1: Input below "lower limit"**A** - the value at the input is below the lower limit.
2	1: Input changed by more than "delta"**A** - the value at the input has changed by a defined "Delta" value.
3	1: Input reduced by more than "negative delta"**A** - the value at the input has reduced by a defined "Delta" value.
4	1: Input increased by more than "positive delta"**A** - the value at the input has increased by a defined "Delta" value.
5 – 7	reserved

Note

The transmitting of the analog input data (TPDOs) by means of an interrupt signal is triggered repeatedly with every change of the analog input value if the value stays above the upper limit or below the lower limit.

If another triggering event occurs at the same time (e.g. increase by "Delta value"), the repeated transmitting is aborted.

Note

Several bits can be set simultaneously so that the transmitting of the input process data can be triggered by several events.

Object 6422$_{hex}$ - Analog Input Interrupt Source

The object indicates if an analog input channel has fulfilled a condition for triggering an interrupt signal.

The conditions were defined with object 6421$_{hex}$.

If a condition for triggering an interrupt signal on a channel is fulfilled, the corresponding bit is set to 1. The corresponding bits for channels 0 to 31 are set in sub-index 01$_{hex}$ and the bits for channels 32 to 63 in sub-index 02$_{hex}$ etc.

The bits can be read using an SDO: The read operation causes the bits to be reset to 0.

Table 89: Objects 6422$_{hex}$

Feature	Description/ Value
Name	Analog input interrupt source
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 08$_{hex}$
Data Type	Unsigned32
Access	ro
Default value, BL20	00$_{hex}$

Object 6423_{hex} - Analog Input Global Interrupt Enable

This object enables the option for generating an interrupt signal. If the value of this object is set from the default setting FALSE to TRUE, the transmitting of the analog input data (TPDOs) can be triggered by means of an interrupt signal.

Table 90: Objects 6423_{hex}

Feature	Description/ Value
Name	Analog input global interrupt enable
Object code	VAR
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Boolean
Access	rw
Default value, BL20	FALSE

Object 6424_{hex} - Analog Input Interrupt Upper Limit Integer

The object 6424_{hex} defines the value for an upper limit.

Values above this "upper limit" can be defined as the condition for generating an interrupt signal.

→ "6421_{hex} Analog input interrupt trigger selection", page 4-145.

Table 91: Objects 6424_{hex}

Feature	Description/ Value
Name	Analog input interrupt upper limit Integer
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Integer32
Access	rw
Default value, BL20	00000000_{hex}

Note

The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Object 6425_{hex} - Analog Input Interrupt Lower Limit Integer

The object 6425_{hex} defines the value for a lower limit.

Values below this "lower limit" can be defined as the condition for generating an interrupt signal.

→ "6421_{hex} Analog input interrupt trigger selection", page 4-145.

Table 92: Objects 6425_{hex}

Feature	Description/ Value
Name	Analog input interrupt lower limit Integer
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Integer32
Access	rw
Default value, BL20	00000000_{hex}

Note

The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Object 6426_{hex} - Analog Input Interrupt Delta Unsigned

The object 6426_{hex} defines a Delta value.

Values that deviate from the input value by this "Delta value" can be defined as the condition for generating an interrupt signal.

→ "6421_{hex} Analog input interrupt trigger selection", page 4-145.

Table 93: Objects 6426_{hex}

Feature	Description/ Value
Name	Analog input interrupt delta Unsigned
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Unsigned32
Access	rw
Default value, BL20	00000000_{hex}

Note

The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Object 6427$_{hex}$ - Analog Input Interrupt Negative Delta Unsigned

The object 6427$_{hex}$ defines a Delta value.

Values lesser than the input value by this "Delta value" can be defined as the condition for generating an interrupt signal.

→ "6421$_{hex}$ Analog input interrupt trigger selection", page 4-145.

Table 94: Objects 6427$_{hex}$

Feature	Description/ Value
Name	Analog input interrupt negative delta Unsigned
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 8E$_{hex}$
Data Type	Unsigned32
Access	rw
Default value, BL20	0000 0000$_{hex}$

Note

The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Object 6428_{hex} - Analog Input Interrupt Positive Delta Unsigned

The object 6428_{hex} defines a Delta value.

Values greater than the input value by this "Delta value" can be defined as the condition for generating an interrupt signal.

→ "6421_{hex} Analog input interrupt trigger selection", page 4-145.

Table 95: Objects 6428_{hex}

Feature	Description/ Value
Name	Analog input interrupt positive delta Unsigned
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Unsigned32
Access	rw
Default value, BL20	00000000_{hex}

Note
The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Objects for Analog Output Modules

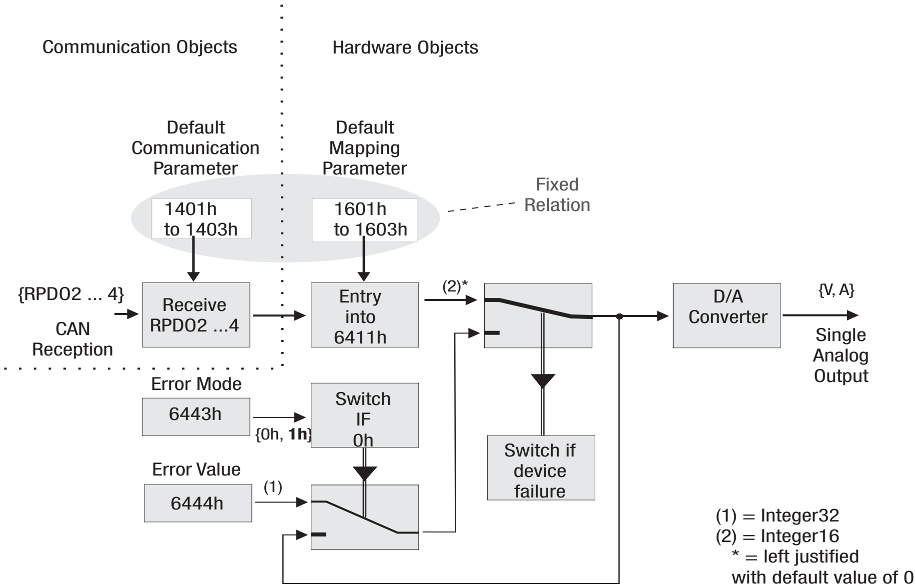
General Overview for Analog Output Objects

Table 96: General overview for analog output objects

Object	Name	Page
5440_{hex}	Manu spec analog output range	4-161
6411_{hex}	Write analog output 16 bit	4-157
6443_{hex}	Analog output error mode	4-158
6444_{hex}	Analog output error state	4-160

The following figure shows the relationship between the analog output objects for an Integer16 access:

Figure 5:
Relationship between the analog output objects (according to CiA Draft Standard 401)



Object 6411_{hex} - Write Analog Output 16 Bit

The object represents the values for the analog output modules with 16 bits for each channel.

The representation of the current and voltage values as numerical values is described in detail from a page 126 onward for each value range.

Table 97: Objects 6411_{hex}

Feature	Description/ Value
Name	Write analog output 16 bit
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Integer16
Access	rw
Default value, BL20	00_{hex}

Object 6443_{hex} - Analog Output Error Mode

It defines for each digital output channel whether or not the output should take on a substitute value in the event of an error. The Sub-indices of 01_{hex} – $8E_{he}$ define the mode of the analog output channels 1 to 142.

The following applies:

00_{hex} The output maintains its value if an error occurs.

01_{hex} The output is assigned a substitute value if an error occurs.

The substitute values for the analog output channels are defined with the object Analog output error state object (6444_{hex}).

Table 98: Objects 6443_{hex}

Feature	Description/ Value
Name	Analog output error mode
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} to $8E_{hex}$
Data Type	Unsigned16
Access	rw
Default value, BL20	00_{hex}

Note

The appropriate numerical values and number ranges for each input variable (current, voltage, temperature...) can be found in the Appendix of the manual for BL20 I/O-modules (D300529).

Object 6444$_{hex}$ - Analog Output Error State

The substitute value is defined for each analog output channel. The substitute values are only taken into account in the event of an error if a 01$_{hex}$ was entered for the relevant output channel in object Analog output error mode object (6443$_{hex}$).

The Sub-indices of 01$_{hex}$ to 8E$_{hex}$ define the value for the analog output channels 1 to 142.

Table 99: Object 6444$_{hex}$

Feature	Description/ Value
Name	Analog output error state
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01$_{hex}$ to 8E$_{hex}$
Data Type	Unsigned16
Access	rw
Default value, BL20	0000 0000$_{hex}$

Object 5440_{hex} - Manu spec Analog Output Range

The object "Manu spec analog output range" defines the parameters of the analog output channels. Write accesses initiate a parameter update on the BL20- module bus.

The parameter is stored retentively in the gateway and in the appropriate module, and is restored with every node reset.

The Sub-indices 01_{hex} – $8E_{hex}$ define the parameters for the analog input channel 1 to 142.

Table 100: Object 5440_{hex}

Feature	Description/ Value
Name	Manu spec analog output range
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} – $8E_{hex}$
Data Type	Unsigned16
Access	rw
Default value, BL20	No

The structure of the 2 bytes of parameter data depends on the module concerned. A sub-index is assigned for each channel. The following explains the structure for each module type:

- **BL20-1AO-I(0/4...20MA)/ BL20-2AO-I(0/4...20MA)**

Table 101: Parameters BL20-xAO-I(0/4...20MA)

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Current mode	0 = 0...20 mA **A** 1 = 4...20 mA
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved)
	Only for BL20-**2**AO-I(0/4...20MA):		
	3	Channel Kx	0 = activate **A** 1 = deactivate
n +1 and n + 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-U(-10/0...+10VDC)**

Table 102: Parameters BL20-2AO-U(-10/ 0...+10VDC)

A *default setting*

Byte	Bit	Parameter	Value/ Meaning
n	0	Voltage mode	0 = 0...10 V **A** 1 = -10...10 V
	1	Value representation	0 = Integer (15 bit + sign) **A** 1 = reserved)
	3	Channel Kx	0 = activate **A** 1 = deactivate
n +1 and n + 2		Substitute Value A1	The substitute value will be transmitted if the respective parameters of the gateway have been set to „output substitute value“.

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Objects for RS232/RS4xx-modules

General overview for RS232/RS4xx-objects

Table 103: General overview for RS232/RS4xx-objects

Object	Name	Page
5600_{hex}	RS232/RS4xx Parameters	4-164
5601_{hex}	RS232/RS4xx RxD	4-168
5602_{hex}	RS232/RS4xx TxD	4-172

Object 5600_{hex} – RS232/RS4xx Parameters

The parameter setting of the BL20-1RS××× module enables communication with different data terminal devices. The handshake procedure (software/hardware) can be selected. The number of data bits embedded in the telegram, the type of parity, the number of stop bits, the bit transmission rate and the XON/XOFF character used must be configured in the module with the appropriate parameters in order to adapt it to the data format of the data terminal device.

4 bytes are used for the module parameters.

Table 104: Objects 5600_{hex}

Feature	Description
Name	RS232/RS4xx Parameters
Object code	ARRAY
Data type	Unsigned32
Access	rw
Default value	No
PDO-mapping	No

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	Disable Diag-nostics	Disable Reduced Control	X	Select RS485	Bit Rate			
Byte 1	X	X	Flow Control		Data	Parity		Stop
Byte 2	XONChar							
Byte 3	XOFFChar							

■ **Parameter - BL20-1RS232**

Table 105: Parameters BL20-1RS×××

A *Default settings*

Parameter	Value/ Meaning
DisableDiagnostics	0 = Diagnostics activated
	1 = Diagnostics deactivated This controls the separate fieldbus-specific diagnostics signal - not the diagnostics signal embedded in the process input data (object 5601hex).
Disable ReducedCtrl	0 = The diagnostics messages are not part of the process input data (object 5601hex). Bytes1 to 7 can therefore be used for the user data.
	1 = The diagnostics messages are contained in byte 1 of the object 5601hex (irrespective of “DisableDiagnostics”). Byte 0 contains the status and control byte. Bytes 2 to 7 are available for the user data. The structure of the object 5602hex is also changed by this setting. At the location of the first data byte, byte 1 of the object 5602hex contains a byte with two control bits. These can initiate a clearing of the receive and transmit buffer.

Parameter	Value/ Meaning
BitRate	0000 = reserved 0001 = 300 bps 0010 = 600 bps 0011 = 1200 bps 0100 = 2400 bps 0101 = 4800 bps 0110 = 9600 bps**A** 0111 = 14400 bps 1000 = 19200 bps 1001 = 28800 bps 1010 = 38400 bps 1011 = 57600 bps 1100 = 115200 bps 1101 = reserved 1110 = reserved 1111 = reserved
FlowControl	00 = none **A** 01 = XON/XOFF 10 = RTS/CTS 11 = reserved
Data bits	0 = 7 **A** 1 = 8
Parity	00 = none 01 = odd (The parity bit is set so that the number of bits set to 1 (data and parity bit together) is odd.) **A** 10 = even (The parity bit is set so that the number of bits set to 1 (data and parity bit together) is even.)
Stop bits	0 = 1 1 = 2 **A**

Parameter	Value/ Meaning
XONChar (XON character)	0 to 255 XON character (17 **A**) This character is used to start the data transfer of the data terminal device with software handshake activated.
XOFFChar (XOFF character)	0 to 255 XOFF character (19 **A**) This character is used to start the data transfer of the data terminal device with software handshake activated.

Object 5601_{hex} - RS232/RS4xx RxD

Process input data is data that is transmitted from the connected field device via the BL20-1RS××× module to the communication partner (e.g. PLC). The data received from the device by the BL20-1RS××× module is entered in a 128 byte receive buffer and then transferred in segments to the communication partner via the module bus and the gateway.

This is transferred in an 8-byte format as follows:

- 6 bytes or 7 bytes are used to contain the user data.
- 1 byte contains the diagnostics data depending on the parameter setting.
- 1 status byte is required to ensure trouble-free transmission of the data.

Table 106: Objects 5601_{hex}

Feature	Description
Name	RS232/RS4xx RxD
Object code	ARRAY
Data type	Unsigned64
Access	ro
Default value	No
PDO-mapping	Yes

Structure of the data bytes with DisableReducedControl = 1 (in object 5600_{hex}):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
Byte 1 (Diagnostics)	BufOfl	Frame Err	HndSh Err	Hw_ Failure	PrmErr	X	X	X
Byte 2	Data byte 0							
...	...							
Byte 7	Data byte 5							

Structure of the data bytes with DisableReducedControl = 0 (in object 5600_{hex}):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STAT	TX_CNT_ACK		RX_CNT		RX_BYTE_CNT		
Byte 1	Data byte 0							
...	...							
Byte 7	Data byte 6							

Table 107: Meaning of the data bits for RS232/485-modules

Designation	Value	Description
STAT	0-1	1: Communication with the data terminal device is OK. 0: Communication with the data terminal device is faulty. A diagnostics signal is sent if DisableDiagnostics = 0 (diagnostics activated). The diagnostics data indicates the cause of the communication fault. This bit must be reset by the user with STATRES in the process output data field (object 5602_{hex}).
TX_CNT_ACK	0-3	The value TX_CNT_ACK is a copy of the value TX_CNT. The value TX_CNT was transferred together with the last data segment of the process output data. The value TX_CNT_ACK is a confirmation of successful acceptance of the data segment using TX_CNT.
RX_CNT	0-3	The value RX_CNT is linked and transferred together with every data segment of the process input data. The sequence of the RX_CNT values is: 00->01->10->11->00... (decimal: 0->1->2->3->0...) A faulty sequence indicates that data segments are missing.
RX_BYTE_CNT	0-7	Number of valid bytes in this data segment.
BufOvfl	Bit 7	0 = ok
		1 = Buffer overflow The receive buffer (RX buffer) has overflowed.

Table 107: Meaning of the data bits for RS232/485-modules

Designation	Value	Description
FrameErr	Bit 6	0 = ok
		1 = Frame error The BL20-1RS××× module parameters must be defined in order to be adapted to the data structure of the DTE. A frame error is output if the parameter setting (number of data bits, stop bits, type of parity) is not suitable.
HndShErr	Bit 5	0 = ok
		1 = Error in the data flow control The data terminal device connected to the BL20-1RS××× module is not responding to the XOFF or RTS handshake. The internal receive buffer can overflow (buffer overflow = 1).
HwFailure	Bit 4	0 = ok
		1 = Hardware error The module must be exchanged as the EEPROM or UART may, for example, be faulty.
PrmErr	Bit 3	0 = ok
		1 = Parameter error The set parameter values are not supported. Possible values are shown with the description of object 5600_{hex}.

Object 5602$_{hex}$ - RS232/RS4xx TxD

Process output data is data that is output from the communication partner (e.g. PLC) via the gateway and the BL20-1RS××× module to the field device.

The data received from the communication partner in the BL20-1RS××× module is entered in a 64 byte transmit buffer.

This is transferred in an 8-byte format as follows:

- 6 bytes or 7 bytes are used to contain the user data.
- With the corresponding parameters, 1 byte contains signals for triggering the clearing of the transmit and receive buffer.
- 1 control byte is required to ensure trouble-free transmission of the data.

Table 108: Objects 5602$_{hex}$

Feature	Description
Name	RS232/RS4xx TxD
Object code	ARRAY
Data type	Unsigned64
Access	ro
Default value	No
PDO-mapping	Yes

Structure of the data bytes with DisableReducedControl = 1 (in object 5600_{hex}):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STATRES	RX_CNT_ACK		TX_CNT		TX_BYTE_CNT		
Byte 1 (Diagnostics)	reserved						RXBUFFLUSH	TXBUFFLUSH
Byte 2	Data byte 0							
...	...							
Byte 7	Data byte 5							

Structure of the data bytes with DisableReducedControl = 0 (in object 5600_{hex}):

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STATRES	RX_CNT_ACK		TX_CNT		TX_BYTE_CNT		
Byte 1	Data byte 0							
...	...							
Byte 7	Data byte 6							

Table 109: Meaning of the data bits for RS232/485-modules

Designation	Value	Description
STATRES	0-1	The STATRES bit is used for resetting the STAT bit of the process input data (object 5601_{hex}) The STAT bit is reset (from 0 to 1) with the transition from 1 to 0 (falling edge). If this bit is 0, all changes in the data fields TX_BYTE_CNT, TX_CNT and RX_CNT_ACK are ignored. The clearing of the receive and transmit buffer by RXBUF FLUSH/TXBUF FLUSH is possible. The value 1 or the transition from 0 to 1 disables the clearing of the receive and transmit buffer by the RXBUF FLUSH/TXBUF FLUSH.
RX_CNT_ACK	0-3	The value RX_CNT_ACK is a copy of the value RX_CNT. The value RX_CNT was transferred together with the last data segment of the process input data (object 5601_{hex}). The value RX_CNT_ACK is a confirmation of successful acceptance of the data segment using RX_CNT.
TX_CNT	0-3	The value TX_CNT is transferred together with every data segment of the process output data. The sequence of the TX_CNT values is: 00 -> 01 -> 10 -> 11 -> 00... (decimal: 0 -> 1 -> 2 -> 3 -> 0...) A faulty sequence indicates that data segments are missing.
TX_BYTE_CNT	0-7	Number of valid user data bytes in this data segment.

Table 109: Meaning of the data bits for RS232/485-modules

Designation	Value	Description
RXBUF FLUSH	0-1	The RXBUF FLUSH bit is used for clearing the receive buffer. If STATRES = 1: A request with RXBUF FLUSH = 1 will be ignored. If STATRES = 0: RXBUF FLUSH = 1 will clear the receive buffer.
TXBUF FLUSH	0-1	The TXBUF FLUSH bit is used for clearing the transmit buffer. If STATRES = 1: A request with TXBUF FLUSH = 1 will be ignored. If STATRES = 0: TXBUF FLUSH = 1 will clear the receive buffer.

Objects for SSI-Modules

General Overview for SSI Objects

Table 110: General overview for SSI objects

Object	Name	Page
5801_{hex}	Encoder config	4-177
5802_{hex}	Encoder status	4-180
5803_{hex}	Encoder flags	4-181
5804_{hex}	Encoder diag	4-183
5805_{hex}	SSI Native status	4-185
5806_{hex}	SSI Optional encoder status	4-189
5808_{hex}	Encoder control	4-190
5840_{hex}	SSI Diag mapping	4-191
6800_{hex}	Operating parameters	4-193
6810_{hex}	Preset values for multi-sensor devices	4-193
6820_{hex}	Position value	4-194
$6B00_{hex}$	CAN State register	4-195
$6B01_{hex}$	CAM Enable register	4-196
$6B02_{hex}$	CAM Polarity register	4-197
$6B10_{hex}$	CAM Low limit	4-198
$6B20_{hex}$	CAM High limit	4-198
$6B02_{hex}$	CAM Polarity register	4-197
$6B02_{hex}$	CAM Polarity register	4-197
$6B02_{hex}$	CAM Polarity register	4-197

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Object 5801$_{hex}$ – Encoder Config

The Encoder config object has an effect on parameter bytes 0 to 3 of the BL20-1SSI module and is used for setting the configuration. Write accesses initiate a parameter update on the BL20- module bus. The parameter is stored retentively in the gateway and is restored with every node reset.

Table 111: Objects 5801$_{hex}$

Feature	Description
Name	Encoder config
Object code	ARRAY
Data type	Unsigned32
Access	rw
Default value	No
PDO-mapping	No

Structure of the data bytes for the SSI-module:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	X	X	DIS_ERR _SSI	X	X	X	X	X
Byte 1	X	INVALID_BITS_MSB			INVALID_BITS_LSB			
Byte 2	X	X	X	X	SSI_BIT_RATE			
Byte 3	SSI_ CODE_ G/D	X	SSI_FRAME_LENGTH					

Table 112: Meaning of the data bits for SSI-modules

A *default setting*

Designation	Value	Description
DIS_ERR_SSI Encoder data cable test	0 **A**	Activate: ZERO test of data cable.
	1	Deactivate After the last valid bit, a ZERO test of the data cable is not carried out.
INVALID_BITS_ LSB Number of invalid bits (LSB)	0 to 15	Number of invalid bits on the LSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the LSB side are removed by shifting the position value to the right, starting with the LSB. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default 0 Bit = 0_{hex}
INVALID_BITS_ MSB Number of invalid bits (MSB)	0-7	Number of invalid bits on the MSB side of the position value supplied by the SSI encoder. The meaningful word width of the position value transferred to the module bus master is as follows: SSI_FRAME_LEN - INVALID_BITS_MSB - INVALID_BITS_LSB. The invalid bits on the MSB side are zeroed by masking the position value. INVALID_BITS_MSB + INVALID_BITS_LSB must always be less than SSI_FRAME_LEN. Default: 0 = 0_{hex}

Table 112: Meaning of the data bits for SSI-modules

Designation	Value	Description
SSI_BIT_RATE Bit transmission rate	0	1000000 bps
	1 **A**	500000 bps
	2	250000 bps
	3	125000 bps
	4	100000 bps
	5	83000 bps
	6	71000 bps
	7	62500 bps
	8 to 15	reserved
SSI_FRAME_LEN Number of data frame bits	1 to 32	Number of bits of the SSI data frame. SSI_FRAME_LEN must always be greater than INVALID_BITS. Default: 25 = 19_{hex}
SSI_CODE_G/D Data format	0 **A**	SSI encoder sends data in binary code
	1	SSI encoder sends data in Gray code

Object 5802$_{hex}$ – Encoder Status

On the BL20-1SSI module, bits 6 and 7 of the Encoder status object are emulated for the counter. The bits describe the up/down direction of the current values.

Table 113: Objects 5802$_{hex}$

Feature	Description
Name	Encoder status
Object code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO-mapping	Yes

Structure of **Byte 6** of the process input:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 6	STS_UP	STS_DN	0	0	0	0	0	0

Table 114: Meaning of the status data bits

Designation	Value	Description
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.

Object 5803_{hex} – Encoder Flags

On the BL20-1SSI module, bits 3 to 6 of the Encoder flags object are emulated as much as possible for the counter. The object comprises the bits FLAG_CMP1, FLAG_CMP2, STS_OFLW and STS_UFLW. Unlike the counter module, the bits STS_OFLW and STS_UFLW SSI module are non-retentive status bits. All other bits are 0.

Writing the object with any value will reset the markers FLAG_CMP1 and FLAG_CMP2. Exception: if the relevant condition for setting a marker is still fulfilled, this marker will continue to remain set.

Table 115: Objects 5803_{hex}

Feature	Description
Name	Encoder flags
Object code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO-mapping	Yes

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	STS_ UFLW	STS_ OFLW	FLAG_ CMP2	FLAG_ CMP1	0	0	0

Table 116: Meaning of the encoder flags

Designation	Value	Description
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.

Table 116: Meaning of the encoder flags

Designation	Value	Description
FLAG_CMP2	0	Default status, i.e. the register contents have not yet matched (REG_SSI_POS) = (REG_CMP2) since the last reset.
	1	The contents of the registers match: (REG_SSI_POS) = (REG_CMP2). This marker must be reset with CLR_CMP2 = 1 in the process output data.
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)

Object 5804_{hex} – Encoder Diag

The Encoder diag object reads the diagnostics byte of the BL20-1SSI module.

Table 117: Objects 5804_{hex}

Feature	Description
Name	Encoder diag
Object code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO-mapping	No

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	ERR_ PARA	STS_ UFLW	STS_ OFLW	ERR_ SSI	SSI_ DIAG

Table 118: Meaning of the data bits

Designation	Value	Description
SSI_DIAG	0	No enabled status signal active: SSI_STSx = 0 or no status messages of the SSI encoder present.
	1	At least one enabled status signal is active: SSI_STSx = 1.
ERR_SSI	0	SSI encoder signal present.
	1	SSI encoder signal faulty (e.g. due to a cable break).
STS_OFLW	0	SSI encoder value below / equal to upper limit.
	1	SSI encoder value above upper limit. Overflow occurred.

Table 118: Meaning of the data bits

Designation	Value	Description
STS_UFLW	0	SSI encoder value above / equal to lower limit.
	1	SSI encoder value below lower limit. Underflow occurred.
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.

Object 5805_{hex} – SSI Native Status

The SSI Native status object reads the bytes 0 to 1 of the process input of the BL20-1SSI module.

Writing the object with any value will reset the retentive markers FLAG_CMP1 and FLAG_CMP2. Exception: if the relevant condition for setting a marker is still fulfilled, this marker will continue to remain set.

Table 119: Objects 5805_{hex}

Feature	Description
Name	SSI Native status
Object code	ARRAY
Data type	Unsigned16
Access	rw
Default value	No
PDO-mapping	Yes

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	STS_STOP	X	X	ERR_PARA	STS_UFLW	STS_OFLW	ERR_SSI	SSI_DIAG
Byte 1	STS_UP	STS_DN	REL_CMP2	FLAG_CMP2	STS_CMP2	REL_CMP1	FLAG_CMP1	STS_CMP1

Table 120: Meaning of the data bits

Designation	Value	Description
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.
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).

Table 120: *Meaning of the data bits*

Designation	Value	Description
STS_UP (LED UP)	0	The SSI encoder values are decremented or the values are constant.
	1	The SSI encoder values are incremented.
STS_DN (LED DN)	0	The SSI encoder values are incremented or the values are constant.
	1	The SSI encoder values are decremented.
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)

Table 120: Meaning of the data bits

Designation	Value	Description
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)

Object 5806_{hex} – SSI Optional Encoder Status

The SSI Optional encoder status object reads byte 2 of the process input of the BL20-1SSI module. Bits 6 and 7 are masked out.

Table 121: Objects 5806_{hex}

Feature	Description
Name	SSI Optional encoder status
Object code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO-mapping	Yes

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 2	masked (0)	masked (0)	X	X	SSI_ STS3	SSI_ STS2	SSI_ STS1	SSI_ STS0

Table 122: Meaning of the data bits

Designation	Value	Description
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	

Object 5808_{hex} – Encoder Control

The object Encoder control writes and reads byte 0 of the control interface of the SSI module and serves for influencing the module during operation.

At the moment only bit 7 (STOP) is used.

Table 123: Objects 5808_{hex}

Feature	Description
Name	Encoder control
Object code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO-mapping	Yes

Object 5840$_{hex}$ – SSI Diag Mapping

The SSI Diag mapping object writes and reads register 51 (REG_SSI_MASK) of the BL20-1SSI module.

The REG_SSI_MASK contains the SSI encoder diagnostics transferred.

Some SSI encoders not only transfer the position value in the data frame that they transfer to the module but also supply additional status messages. It is advisable to include these status messages in the application in order to analyze the measured value.

Writing the REG_SSI_MASK register allows up to four individual bits to be taken from the SSI encoder data frame and transferred to the SSI_STSx bits of the process input data. It is also possible to output the "SSI encoder group diagnostics message" with an acyclic diagnostics operation when a status message is initiated.

Table 124: Objects 5840$_{hex}$

Feature	Description
Name	SSI Diag mapping
Object code	ARRAY
Data type	Unsigned32
Access	rw
Default value	No
PDO-mapping	No

Process input data		**REG_SSI_MASK**							
	Byte	Bit 7	Bit 6	B 5	B 4	B 3	B 2	B 1	B 0
SSI_STS0	0	EN_ D0_RMS0	EN_D0_DS	X	SSI_FRAME_BIT_SEL0				
SSI_STS1	1	EN_ D1_RMS1	EN_D1_DS	X	SSI_FRAME_BIT_SEL1				
SSI_STS2	2	EN_ D2_RMS2	EN_D2_DS	X	SSI_FRAME_BIT_SEL2				
SSI_STS3	3	EN_ D3_RMS3	EN_D3_DS	X	SSI_FRAME_BIT_SEL3				

Table 125: Meaning of the data bits

A *default setting*

Designation	**Value**	**Description**
EN_Dx_RMSx	0 **A**	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
EN_ Dx_DS	0 **A**	The evaluation of the SSI status messages for bit 0 of the diagnostics is not activated
	1	The evaluation of the SSI status messages for bit 0 of the diagnostics is activated.
SSI_FRAME_ BIT_SEL	0 **A** - 31	Definition of the selected bits in the frame of the SSI encoder to be evaluated or copied. Default: 0

The following applies to bit 0 (SSI group diagnostics) of the diagnostics interface and SSI_DIAG of the process input data:

(SSI_STS0 & EN_D0_DS) || (SSI_STS1 & EN_D1_DS) ||
(SSI_STS2 & EN_D2_DS) || (SSI_STS3 & EN_D3_DS)

Object 6800_{hex} – Operating Parameters

Note

Object 6800_{hex} (corresponds to object 6000_{hex} in accordance with CiA DS406) has no meaning with BL20-, and only exists because it is a "mandatory" object in accordance with DS406.

Table 126: Objects 6800_{hex}

Feature	Description
Name	Operating parameters
Object code	VAR
Data type	Unsigned16
Access	rw
Default value	00h
PDO-mapping	No

Object 6810_{hex} – Preset Values for Multi-Sensor Devices

Object 6810_{hex} (corresponds to object 6010_{hex} in accordance with CiA DS406) is used for zero point adaption. The content of this object is added to the value of the SSI encoder. The resulting value is stored in object 6820_{hex}.

Table 127: Objects 6810_{hex}

Feature	Description
Name	Position value for multi-sensor devices
Object code	ARRAY
Data type	Integer32
Access	rw
Default value	No
PDO-mapping	Yes

Object 6820_{hex} – Position Value

Position value for multi-sensor devices

Object 6820_{hex} (corresponds to object 6020_{hex} as per CiA DS406) contains the SSI encoder value of the BL20-1SSI module. The content of the object 6810_{hex} "Preset values for multi-sensor devices" contains a value that is added to correct the measured value for a zero point adjustment.

Table 128: Objects 6820_{hex}

Feature	Description
Name	Position value
Object code	ARRAY
Data type	Integer32
Access	ro
Default value	No
PDO-mapping	Yes

Object $6B00_{hex}$ – CAM State Register

The object CAM State register indicates in accordance with DS406 whether the actual counter status is within the range defined by CAM1 Low limit and CAM1 High limit (object $6B10_{hex}$ and $6B20_{hex}$).

Table 129: Objects $6B00_{hex}$

Feature	Description
Name	CAM State register
Object code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO-mapping	Yes

Table 130: Meaning of the data byte

Value	Meaning
00_{hex} (01_{hex}) **A**	The actual SSI encoder value is outside of the range defined by CAM1 Low limit and CAM1 High limit or the comparison function is not activated
01_{hex} (00_{hex}) **A**	The actual SSI encoder value is outside of the range defined by CAM1 Low limit and CAM1 High limit or the comparison function is not activated

A *If object CAM Polarity register ($6B02_{hex}$) = 01_{hex}, an inversion will be carried out*

Object $6B01_{hex}$ – CAM Enable Register

The object CAM Enable register defines if the SSI encoder value is to be compared with the values CAM1 Low limit and CAM1 High limit (object $6B10_{hex}$ and $6B20_{hex}$).

Table 131: Objects $6B01_{hex}$

Feature	Description
Name	CAM Enable register
Object code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO-mapping	No

Table 132: Meaning of the data byte

Value	Meaning
00_{hex}	The SSI encoder value is not compared with the values CAM1 Low limit and CAM1 High limit (object $6B10_{hex}$ and $6B20_{hex}$).
01_{hex}	The SSI encoder value is compared with the values CAM1 Low limit and CAM1 High limit (object $6B10_{hex}$ and $6B20_{hex}$).

Object 6B02$_{hex}$ – CAM Polarity Register

The object CAM Polarity register can cause an inversion of the values represented with object 6B00$_{hex}$.

Table 133: Objects 6B02$_{hex}$

Feature	Description
Name	CAM polarity register
Object code	ARRAY
Data type	Unsigned8
Access	rw
Default value	No
PDO-mapping	No

Table 134: Meaning of the data byte

Value	Meaning
00$_{hex}$	The value represented with object 6B00$_{hex}$ is not inverted.
01$_{hex}$	The value represented with object 6B00$_{hex}$ is inverted.

Object 6B10$_{hex}$ – CAM1 Low Limit

The object CAM1 Low limit defines in accordance with DS406 a lower limit of the counter range.

Object CAM1 Low limit matches the comparison value 2 of the BL20-1SSI module.

Table 135: Objects 6B10$_{hex}$

Feature	Description
Name	CAM1 Low limit
Object code	ARRAY
Data type	Integer32
Access	rw
Default value	No
PDO-mapping	No

Object 6B20$_{hex}$ – CAM1 High Limit

The object CAM1 High limit defines in accordance with DS406 an upper limit of the counter range.

Object CAM1 High limit matches the comparison value 1 of the BL20-1SSI module.

Table 136: Objects 6B20$_{hex}$

Feature	Description
Name	CAM1 High limit
Object code	ARRAY
Data type	Integer32
Access	rw
Default value	No
PDO-mapping	No

Objects for Counter-Modules

General Overview for Counter Objects

Table 137: General overview for counter objects

Object	Name	Page
5800_{hex}	Encoder Basic Mode	4-201
5801_{hex}	Encoder Config	4-205
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Objects to CiA DS-406		
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Table 138:

Object	Name	Page
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$6B10_{hex}$	Cam 1 Low Limit	4-237
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$6FFF_{hex}$	Device Type	4-245

Object 5800_{hex} – Encoder Basic

Object 5800_{hex} controls the operating mode parameters of the BL20 counter module. Its uses include the setting of count mode or measurement mode.

Write accesses initiate a parameter update via the internal BL20 module bus. The parameter is stored retentively in the BL20 gateway and is restored with every node reset.

Table 139: Object 5800_{hex}

Feature	Description
Name	Encoder Basic Mode
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data Type	Unsigned8
Access	ro
Default value, BL20	No
Sub-index	01_{hex} - 47_{hex}
Data Type	Unsigned32
Access	rw
Default value, BL20	No

Structure of data bits for count mode:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X		count mode					
Byte 1	X	main count direction		synchro-nization	function DI		digital input DI	gate function
Byte 2	X							
Byte 3	X							

X = reserved

Table 140: Meaning of the data bits (count mode)

A *default settings*

Designation	Value	Designation of the values/ Value range
count mode	000000 **A**	continuous count
	000001	single-action count
	000010	periodical count
main count direction	00 **A** 01 10	none up down
synchronization	0 **A** 1	single-action periodic
function DI	00 **A**	input
	01	HW gate
	10	latch retrigger when edge pos.
	11	synchronization when edge pos.
digital input DI	0 **A** 1	normal inverted

Table 140: Meaning of the data bits (count mode)

A *default settings*

Designation	Value	Designation of the values/ Value range
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, however, the counter continues on restart from the actual counter value.

Structure of data bits for measurement mode:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	X		measurement mode					
Byte 1	X				function DI		digital input DI	X
Byte 2	X							
Byte 3	X							

X = reserved

Table 141: Meaning of the data bits (measurement mode)

A *default settings*

Designation	Value	Designation of the values/ Value range
measurement mode	100000 **A**	frequency measurement
	100001	revolutions measurement
	100010	period duration measurement
	100011 To 111111	reserved
digital input DI	0 **A**	normal
	1	inverted
function DI	00 **A**	input
	01	HW gate
	10 to 11	reserved

Object 5801$_{hex}$ – Encoder Config

Object 5801$_{hex}$ controls the configuration parameters of the BL20 counter module:

- Output parameters
- Sensor and input filter
- Sensor parameters
- Behaviour on failure of the higher-level PLC

Write accesses initiate a parameter update via the internal BL20 module bus. The parameter is stored retentively in the BL20 gateway and is restored with every node reset.

Table 142: Objects 5801$_{hex}$

Feature	Description
Name	Encoder config
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned32
Access	rw
Default value	No

Structure of the data bytes for count mode:

<table>
<tr><th></th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Byte 0</td><td colspan="3">function DO2</td><td colspan="3">function DO1</td><td>diag- nostic DO1</td><td>substi- tute value DO1</td></tr>
<tr><td>Byte 1</td><td>direction input (B)</td><td colspan="2">sensor (A)</td><td>sensor/ input filter (DI)</td><td>sensor/ input filter (B)</td><td>sensor/ input filter (A)</td><td colspan="2">signal evaluation (A B)</td></tr>
<tr><td>Byte 2</td><td colspan="2">X</td><td colspan="2">behavior CPU/ master stop</td><td colspan="3">X</td><td>group diagnos- tics</td></tr>
<tr><td>Byte 3</td><td colspan="8">X</td></tr>
</table>

X = reserved

Structure of the data bytes for measurement mode:

<table>
<tr><th></th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Byte 0</td><td colspan="3">X</td><td colspan="3">function DO1</td><td>diag- nostic DO1</td><td>substitute value DO1</td></tr>
<tr><td>Byte 1</td><td>direction input (B)</td><td colspan="2">sensor (A)</td><td>sensor/ input filter (DI)</td><td>sensor/ input filter (B)</td><td>sensor/ input filter (A)</td><td colspan="2">signal evaluation A B)</td></tr>
<tr><td>Byte 2</td><td colspan="2">X</td><td colspan="2">behavior CPU/ master stop</td><td colspan="3">X</td><td>group diag- nostics</td></tr>
<tr><td>Byte 3</td><td colspan="8">X</td></tr>
</table>

X = reserved

Table 143: Meaning of the data bits

A *default settings*

Designation	Value	Designation of the values/ Value range
Output parameters (byte 0)		
substitute value DO1	0 **A** 1	This value determines the state of output DO1 in the event of a failure if: behaviour 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 (count mode)	000 **A**	output
	001	on when cnt. value ≧ ref. value
	010	on when cnt. value ≦ ref. value
	011	pulse when cnt. value = ref. value
function DO1 (measurement mode)	000 **A**	output
	001	measured value outside of the set limits
	010	below lower limit
	011	above upper limit

A *default settings*

Designation	Value	Designation of the values/ Value range
function DO2 (count mode)	000 **A**	output
	001	on when cnt. value ≧ ref. value
	010	on when cnt. value ≦ ref. value
	011	pulse when cnt. value = ref. value
Sensor parameters (byte 1)		
Signal evaluation (A B)	00 **A**	pulse and direction In this mode input B can control up and down counting in count mode. In measurement mode input B can receive a signal for the rotational direction.
	01	single-evaluation rotary sensor
Only Count mode:	10	double-evaluation rotary sensor
	11	fourfold-evaluation rotary sensor
Sensor and input filter 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.		
sensor/input filter (A)	0 **A** 1	2.5µs (200 kHz) 25µs (20 kHz)
sensor/input filter (B)	0 **A** 1	2.5µs (200 kHz) 25µs (20 kHz)
sensor/input filter (DI)	0 **A** 1	2.5µs (200 kHz) 25µs (20 kHz)
sensor (A)	00 **A** 01	normal inverted

A *default settings*

Designation	Value	Designation of the values/ Value range
direction input (B)	0 **A** 1	normal inverted
Release (byte 2)		
group diagnostics	0 **A** 1	release block
Behaviour on failure of the higher-level PLC		
behavior CPU/ master STOP	00 **A**	turn off DO1
	01	proceed with operating mode
	10	DO1 switch substitute value
	11	DO1 hold last value

Object 5802_{hex} – Encoder Status

Object 5802_{hex} supplies the following status messages:

- Direction forwards
- Direction backward
- Status DO2
- Status DO1
- Status DI
- Counting/measuring running

Table 144: Objects 5802_{hex}

Feature	Description
Name	Encoder status
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned8
Access	ro
Default value	No

Structure of the data bytes in count mode:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STS_ DN	STS_ UP	X	STS_ DO2	STS_ DO1	X	STS_ DI	STS_ GATE

X = reserved

Structure of the data bytes in measurement mode:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0 (Status)	STS_DN	STS_UP	X	X	STS_DO1	X	STS_DI	STS_GATE

X = reserved

Table 145: Meaning of the status data bits

Designation	Description
STS_DN	1: Status direction down.
STS_UP	1: Status direction up.
STS_DO2	Only count mode: 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/measuring operation running.

Object 5803_{hex} – Encoder Flags

Object 5803_{hex} supplies the following status messages in count mode:

- Status zero crossing
- Status lower count limit
- Status upper count limit
- Status comparator 1
- Status comparator 2
- Status synchronization

The following status messages are supplied in measurement mode:

- Value below lower measuring limit
- Value above upper measuring limit
- Measuring terminated

All status messages are reset by writing object 5803_{hex} with any value. If the condition for setting continues, the corresponding bit remains set.

Table 146: Objects 5803_{hex}

Feature	Description
Name	Encoder flags
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data type	Usigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Usigned8
Access	rw
Default value	No

Structure of the data bytes in count mode:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
STS_ ND	STS_ UFLW	STS_ OFLW	STS_ CMP2	STS_ CMP1	X		STS_ SYN

Table 147: Meaning of the encoder flags

Designation	Description
STS_ND	Status zero crossing Set on crossing zero in counter range when counting without main direction.
STS_UFLW	Status lower count limit Set if the count value goes below the lower count limit (→ "Object 6C01hex - Work Area Low Limit").
STS_OFLW	Status upper count limit Set if the counter goes above the upper count limit (→ "Object 6C02hex - Work Area High Limit").
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 via Function DO2: 001: On when cnt. value ≧ ref. value 010: On when cnt. value ≦ ref. value 011: Pulse if cnt. value = ref. value A comparison is executed. 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.

Table 147:
Meaning of the encoder flags

Designation	Description
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 via Function DO1: 001: On when cnt. value ≧ ref. value 010: On when cnt. value ≦ ref. value 011: Pulse if cnt. value = ref. value A comparison is executed. Otherwise STS_CMP1 simply indicates that the output is or was set. STS_CMP1 is also set if DO1 SET_DO1 = 1 when the output is not released.
STS_SYN	Status synchronization After synchronization is successfully completed the STS_SYN status bit is set.

Structure of the data bytes in measurement mode:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	STS_ UFLW	STS_ OFLW	X	STS_ CMP1	X	X	X

Table 148:
Meaning of the encoder flags

Designation	Description
STS_UFLW	1: The lower measuring limit was undershot.
STS_OFLW	1: The upper measuring limit was exceeded.
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.

Object 5804_{hex} – Encoder Diag

Object 5804_{hex} reads the diagnostics byte of the BL20 counter module. A short/open circuit and error are indicated when configured.

Table 149: Objects 5804_{hex}

Feature	Description
Name	Encoder diag
Object code	ARRAY
Data type	Unsigned8
Access	ro
Default value	No
PDO-mapping	No

Meaning of the data bits in count mode:

Tabelle 6: Meaning of the data bits in count mode

Bit	Diagnostics message	Meaning
0	Short-/open circuit	Short-/open circuit
1	short-/open circuit ERR_DO	Short-circuit sensor supply
2	Bit 2: Parameter error	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 Wert range for this SINT Wert is: 0...2147483645; 2147483646; 2147483647
3	Bit 3: Parameter error	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 Wert range for this SINT Wert is: -2147483648...-2,-1.0

Tabelle 6: Meaning of the data bits in count mode

Bit	Diagnostics message	Meaning
4	Bit 4: Parameter error	Inverting the digital input signal with the Latch Retrigger function is not permissible.
5	Bit 5: Parameter error	The Wert (11) for selecting the main count direction is incorrect. Permissible values: 00 = None 01 = Up 10 = Down
6	operating mode wrong	The Wert (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
7	Measurement mode	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.

Meaning of the data bits in measurement mode:

Table 150: Meaning of the data bits in measurement mode

Bit	Diagnostics message	Meaning
0	Short-/open circuit	Short-/open circuit
1	short-/open circuit ERR_DO	Short-circuit sensor supply
2	Bit 2: Parameter error	This error signal refers to the parameter value Sensor pulses per revolution. The latest configuration tools prevent an incorrect value from being entered.
3	Bit 3: Parameter error	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.
4	Bit 4: Parameter error	The value for the upper limit is incorrect. Permissible value range: 1 to 16777215
5	Bit 5: Parameter error	The value for the lower limit is incorrect. Permissible value range: 0 to 16777214

Table 150: Meaning of the data bits in measurement mode

Bit	Diagnostics message	Meaning
6	operating mode wrong	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
7	Measurement mode	This message is always shown in conjunction with other diagnostics messages and indicates that messages refer to an active measurement mode.

Object 5808_{hex} – Encoder Control

The object 5808_{hex} has the following control functions:

- Release/set the digital outputs
- Start/stop counting/measuring
- Release synchronization

Table 151: Object 5808_{hex}

Feature	Description
Name	Encoder control
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned8
Access	rw
Default value	No

Structure of the data bytes in count mode:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	CTRL_ DO2	SET_ DO2	CTRL_ DO1	SET_ DO1	X	CTRL_ SYN	SW_ GATE

X = reserved

Structure of the data bytes in measurement mode:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	CTRL_ DO1	SET_ DO1	X		SW_ GATE

X = reserved

Table 152: Meaning of the data bits

A *Unlike the physical digital output DO1, output DO2 is only a data value that is indicated with the data bit STS_DO2.*

Designation	Description
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. The parameter definition of DO2 for this function can be carried out via object 5801_{hex}. 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. The parameter definition of DO2 for this function can be carried out via object 5801_{hex}. The default setting for DO1 is to display the value of SET_DO1.
CTRL_SYN	Release synchronization 1: 0 $\rightarrow$ 1 (rising edge) at the physical DI input enables the counter value to be set (synchro-nized) once/periodically to the load value. Single-action/periodical is selected in object 5800_{hex}.

Table 152: Meaning of the data bits

Designation	Description
SW_GATE	0 → 1: Counting/measuring is started (release). 1 → 0: Counting/measuring is stopped. The starting and stopping of the counting/measuring operation with a data bit is called the "SW gate". The HW gate is also provided in addition for stopping and starting the counting/measuring operation via the DI hardware input. If this option is set (function DI in "Object 5800hex – Encoder Basic"), a positive signal must be present at DI in order to activate the SW gate (logical AND operation).

4

Object 5810$_{hex}$ - Encoder Load Prepare Value

Object 5810$_{hex}$ contains the load value for Load in preparation in count mode, i.e. the event-driven setting of the counter value is set to this value:

This load value is accepted as the new counter value in response to any of the following events:

- Lower or upper count limit is reached when no main count direction has been configured.
- Reaching the upper count limit with the main count direction set to up counting.
- Reaching the lower count limit with the main count direction set to down counting.

Main count direction: see "Object 5800hex – Encoder Basic"

The required handshake with the counter module is carried out by the BL20 gateway.

The parameter can be stored retentively in the gateway and is restored with every node reset.

Note

The object 5810$_{hex}$ is only valid if the counter module is operating in count mode.

Table 153: Object 5810$_{hex}$

Feature	Description
Name	Encoder Load Prepare Value
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No

Table 153: Object 5810_{hex}

Feature	Description
Sub-index	01_{hex} - 47_{hex}
Data type	Integer32
Access	rw
Default value	No

Object 5811_{hex} - Encoder Pulse Width

Object 5811_{hex} is used to set the pulse duration for digital outputs DO1 and DO2.

A pulse is generated at outputs DO1 and DO2 in count mode if:

Function DO1/Function DO2:
Pulse on count value = Comp. value is set (see "Object 5801hex – Encoder Config") and the values are equal.

Write accesses initiate a parameter update on the BL20 internal module bus.

The parameter is stored retentively in the gateway and is restored with every node reset.

In object 5811_{hex} the time is entered in milliseconds. The value range can be set in 2 ms increments between 0 ms to 510 ms.

Note

The object 5811_{hex} is only valid if the counter module is operating in count mode.

Table 154: Object 5811_{hex}

Feature	Description
Name	Encoder Pulse Width
Object code	ARRAY
PDO-mapping	No

Table 154: Object 5811_{hex}

Feature	Description
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned16
Access	rw
Default value	No

Object 5820_{hex} - Measuring Integration Time

Object 5820_{hex} is used to set the Integration time for measurement mode. Permissible values are: 1 to 1000.

In **Frequency measurement** mode the module counts the pulses that are received in the defined integration time and calculates an average frequency from this. The value range for the integration time can be set in 10 ms increments between 10 ms to 10000 ms.

In **revolutions measurement mode** the counter module counts the pulses received from a rotary sensor within a predefined integration time. The number of “sensor pulses per revolution” must be defined beforehand by parameters in the system. The number of “sensor pulses per revolution” and the pulses counted determines the speed of the connected motor. The value range for the integration time can be set in 10 ms increments between 10 ms to 10000 ms.

In **period duration measurement mode**, the counter module measures the time between two rising edges of the counter signal in ms by counting the pulses of an exact internal quartz crystal reference frequency (1 MHz). An averaging operation can be carried out over 1 to 1 000 periods. The number of periods is defined by the Integration time parameter.

Write accesses initiate a parameter update on the BL20 internal module bus.

The parameter is stored retentively in the gateway and is restored with every node reset.

Note

The object 5820_{hex} is only valid if the counter module is operating in measurement mode.

Table 155: Object 5820_{hex}

Feature	Description
Name	Measuring Integration Time
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned32
Access	rw
Default value	No

Object 5821_{hex} - Measuring Low Limit

Object 5821_{hex} is used to set the lower measuring limit for the counter module.

Permissible value range: 0 to 16777214

Write accesses initiate a parameter update on the BL20 internal module bus.

The parameter is stored retentively in the gateway and is restored with every node reset.

Note

The object 5821_{hex} is only valid if the counter module is operating in measurement mode.

Table 156: Object 5821_{hex}

Feature	Description
Name	Measuring Low Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned32
Access	rw
Default value	No

Object 5822_{hex} - Measuring High Limit

Object 5822_{hex} is used to set the upper measuring limit for the BL20 counter module.

Permissible value range: 1 to 16777215

Write accesses initiate a parameter update on the BL20 internal module bus.

The parameter is stored retentively in the gateway and is restored with every node reset.

Note

The object 5822_{hex} is only valid if the counter module is operating in measurement mode.

Table 157: Object 5822_{hex}

Feature	Description
Name	Measuring High Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned32
Access	rw
Default value	No

Object 5823_{hex} - Measuring Units Per Revolution

Object 5823_{hex} is used to set the sensor pulses per revolution for the BL20 counter module.

Write accesses initiate a parameter update on the BL20 internal module bus.

The parameter is stored retentively in the gateway and is restored with every node reset.

Permissible value range: 1 to 65535

Note

The object 5823_{hex} is only valid if the counter module is operating in measurement mode.

Table 158: Object 5823_{hex}

Feature	Description
Name	Measuring Units Per Revolution
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned16
Access	rw
Default value	No

Object 6800_{hex} – Operating Parameters

Note

Object 6800_{hex} (corresponds to object 6000_{hex} in accordance with CiA DS406) has no meaning with BL20, and only exists because it is a "mandatory" object in accordance with DS406.

Object 6810_{hex} – Load Value For Multi-Sensor Devices

Object 6810_{hex} (corresponds to object 6010_{hex} in accordance with CiA DS-406) writes the direct load value for the counter module.

The output values in the subindices of object 6820_{hex} are set to the values of the corresponding subindices of object 6810_{hex}.

Note

The object 6810_{hex} is only valid if the counter module is operating in count mode.

Table 159: Object 6810_{hex}

Feature	Description
Name	Preset value for multi-sensor devices
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Integer32
Access	rw
Default value	No

Object 6820$_{hex}$ – Position value for multi-sensor devices

Object 6820$_{hex}$ (corresponds to object 6020$_{hex}$ as per CiA DS406) contains the count value or measured value of the counter module.

Table 160: Object 6820$_{hex}$

Feature	Description
Name	Position value for multi-sensor devices
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Integer32
Access	ro
Default value	No

Object $6B00_{hex}$ – CAM State Register

Object $6B00_{hex}$ (corresponds to object 6300_{hex} in accordance with CiA DS-406) indicates whether the current counter status is within a specified range. This range is limited by CAM1 Low Limit (object $6B10_{hex}$) and CAM1 High Limit (object $6B20_{hex}$).

On the BL20 counter module the behaviour is only defined in accordance with CiA DS-406 by means of the appropriate configuration and operating mode selection:

- Operating mode is set to Counting
- The operating mode for DO1 is set to Switch on when counter status ≤ reference value1.
- The operating mode for DO2 is set to Switch on when counter status ≥ reference value2.
- The release bits for DO1 and DO2 are set.

The following should be observed:

- The object $6B10_{hex}$ "CAM1 Low Limit" corresponds to reference value2 of the BL20 counter module.
- The object $6B20_{hex}$ "CAM1 High Limit" corresponds to reference value1 of the BL20 counter module.
- These two reference values 1 and 2 are assigned to outputs DO1 and DO2.
- The object $6B00_{hex}$ "CAM 1 State Register" supplies the result of the AND operation of the two outputs DO1 and DO2.

Note

The object $6B00_{hex}$ is only valid if the counter module is operating in count mode.

Table 161: Objects 6B00$_{hex}$

Feature	Description
Name	CAM State register
Object code	ARRAY
PDO-mapping	Yes
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned8
Access	ro
Default value	No

Structure of the data byte:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	STAT_ CAM1

X = reserved

Table 162: Meaning of the data bits

A *The values can be inverted using object* $6B02_{hex}$

Designation	Description
STAT_CAM1	0 **A** : The counter status is in the following range: Reference value2 ≤ counter status ≥ reference value1 or the conditions for activating this status message have not been fulfilled.
	1 **A**: The counter status is outside the following range: Reference value2 ≤ counter status ≥ reference value1

Object 6B01$_{hex}$ – CAM 1 Enable Register

The object CAM Enable register releases or blocks the status message for the comparison result (object 6B00$_{hex}$):

Reference value2 ≤ counter status ≥ reference value1

Other configuration settings are required in order to activate the status message for the comparison result.

Table 163: Object 6B01$_{hex}$

Feature	Description
Name	CAM 1 Enable Register
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned8
Access	rw
Default value	No

Structure of the data byte:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	EN_ CAM1

X = reserved

Table 164: Meaning of the data bits

Designation	Description
EN_CAM1	0: The object 6B00$_{hex}$ is blocked.
	1: The object 6B00$_{hex}$ is released.

Object 6B02$_{hex}$ – CAM Polarity Register

The object CAM Polarity register can invert the status message for the comparison result with object 6B00$_{hex}$.

Table 165: Object 6B02$_{hex}$

Feature	Description
Name	CAM Polarity Register
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned8
Access	rw
Default value	0$_{hex}$

Structure of the data byte:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	X	X	POL_CAM1

X = reserved

Table 166: Meaning of the data bits

Designation	Description
POL_CAM1	0: The status message of the object $6B00_{hex}$ is not inverted.
	1: The status message of the object $6B00_{hex}$ is inverted.

Object $6B10_{hex}$ – CAM1 Low Limit

The object $6B10_{hex}$ corresponds to reference value2 of the BL20 counter module. The following comparisons can be configured (5801_{hex}):

- Count value ≥ reference value2
- Count value ≤ reference value2
- Count value = reference value2

The object is the same as object 6310_{hex} in accordance with CiA DS-406 which defines a lower switch limit for the count range. The reference value2 must be a lower limit if evaluation is to be carried out using object $6B00_{hex}$.

Object $6B10_{hex}$ is assigned to output DO2.

Note

The object $6B10_{hex}$ is only valid if the counter module is operating in count mode.

Table 167: Object $6B10_{hex}$

Feature	Description
Name	CAM1 Low Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned32
Access	rw
Default value	No

Object $6B20_{hex}$ – CAM1 High Limit

The object $6B20_{hex}$ corresponds to reference value1 of the BL20 counter module. The following comparisons can be configured (5801_{hex}):

- Count value ≥ reference value1
- Count value ≤ reference value1
- Count value = reference value1

The object is the same as object 6320_{hex} in accordance with CiA DS-406 which defines an upper switch limit for the count range. The reference value1 must be an upper limit if evaluation is to be carried out using object $6B00_{hex}$.

Object $6B20_{hex}$ is assigned to output DO1.

Note

The object $6B20_{hex}$ is only valid if the counter module is operating in count mode.

Table 168: Object 6B20$_{hex}$

Feature	Description
Name	CAM1 High Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Integer32
Access	rw
Default value	0000$_{hex}$

Object 6B30$_{hex}$ - CAM1 Hysteresis

The object 6B30$_{hex}$ (corresponds to object 6330$_{hex}$ in accordance with CiA DS-406) defines a hysteresis value for reference value2 (CAM1 Low Limit - Object 6B10$_{hex}$) and reference value1 (CAM1 High Limit Object 6B20$_{hex}$).

Note

The object 6B30$_{hex}$ is only valid if the counter module is operating in count mode.

Table 169: Object 6B30$_{hex}$

Feature	Description
Name	CAM1 Hysteresis
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned16
Access	rw
Default value	No

Object 6C00$_{hex}$ - Area State Register

The object 6C00$_{hex}$ (corresponds to object 6400$_{hex}$ in accordance with CiA DS-406) contains two status bits that indicate the count value going below the lower count limit (object 6C01$_{hex}$ Work Area Low Limit) and above the upper count limit (object 6C02$_{hex}$ Work Area High Limit). The status bit are stored in a non-volatile memory. All status messages are reset by writing object 5803$_{hex}$ with any value. Object 5803$_{hex}$ contains the two redundant status bits (STS_OFLOW, STS_UFLOW).

Note

The object 6C00$_{hex}$ is only valid if the counter module is operating in count mode.

Table 170: Object 6C00$_{hex}$

Feature	Description
Name	Area State Register
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No

Structure of the data byte:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
X	X	X	X	X	STS_ UFLW	STS_ OFLW	X

X = reserved

Table 171: Meaning of the data bits

Designation	Description
STS_UFLW	Status lower count limit Set if the count value goes below the lower count limit. This bit must be reset by writing object 5803_{hex} with any value.
STS_OFLW	Status upper count limit Set if the counter goes above the upper count limit. This bit must be reset by writing object 5803_{hex} with any value.

Object $6C01_{hex}$ - Work Area Low Limit

Object $6C01_{hex}$ (corresponds to object 6401_{hex} in accordance with CiA DS-406) defines the value for the lower count limit. In the event of an underflow, bit 2 in object $6C00_{hex}$ and bit 6 in object 5803_{hex} are set.

The permissible range for the lower count limit is therefore:

-2147483648 to 0 ($_{hex}$adecimal: 8000 0000_{hex} to 0_{hex})

Note

The object $6C01_{hex}$ is only valid if the counter module is operating in count mode.

Table 172: Object $6C01_{hex}$

Feature	Description
Name	Work Area Low Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00_{hex}
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01_{hex} - 47_{hex}
Data type	Unsigned32
Access	rw
Default value	No

Object 6C02$_{hex}$ - Work Area High Limit

Object 6C02$_{hex}$ (corresponds to object 6402$_{hex}$ in accordance with CiA DS-406) defines the value for the upper count limit. In the event of an underflow, bit 1 in object 6C00$_{hex}$ and bit 5 in object 5803$_{hex}$ are set.

The permissible range for the upper count limit is therefore:
0 to 2147483647 ($_{hex}$adecimal:0$_{hex}$ to 7FFF FFFF$_{hex}$)

Note

The object 6C02$_{hex}$ is only valid if the counter module is operating in count mode.

Table 173: Object 6C02$_{hex}$

Feature	Description
Name	Work Area High Limit
Object code	ARRAY
PDO-mapping	No
Sub-index	00$_{hex}$
Data type	Unsigned8
Access	ro
Default value	No
Sub-index	01$_{hex}$ - 47$_{hex}$
Data type	Unsigned32
Access	rw
Default value	No

Object 6D00$_{hex}$ - Operating Status

Object 6D01$_{hex}$ - SingleTurn resolution (rotary), Measuring step (linear)

Object 6D02$_{hex}$ - Number of distinguishable revolutions

Note

The objects 6D00$_{hex}$ to 6D02$_{hex}$ (correspond to the objects 6500$_{hex}$ to 6502$_{hex}$ in accordance with CiA DS-406) have no meaning for BL20 and only exist because they are mandatory objects in accordance with DS-406. With BL20 the objects are always set to 0.

Object 6FFF$_{hex}$ - Device Type

Object 6FFF$_{hex}$ (corresponds to object 67FF$_{hex}$ in accordance with CiA DS-406) specifies the type of the second device profile supported. The object is assigned the value 000A 0196$_{hex}$. The Low word (0196$_{hex}$ = 406$_{dec}$) specifies the device profile. The High Word (000A$_{hex}$) describes the encoder type to CiA DS-406 (10$_{dec}$ = Multi Sensor Encoder Interface).

Table 174: Object 6FFF$_{hex}$

Feature	Description
Name	Device Type
Object Code	VAR
PDO Mapping	No
Data type	Unsigned32
Access	ro

Parameters of BL20-1CNT

Table 175: Parameters of the BL20-1CNT

Module/Parameter	Object	Sub-Index	Byte	Bit
Count mode				
– Operating mode				
Operating mode	5800_{hex}	0xh	0	5 to 0
Release function			1	0
Digital input DI				1
Function DI				3 to 2
Synchronization				4
Main count direction				6 to 5
– Count limits				
Lower count limit	$6C01_{hex}$	0xh	0 to 3	
Upper count limit	$6C02_{hex}$	0xh	0 to 3	
Hysteresis	$6B30_{hex}$	0xh	0 to 1	
Pulse duration DO1/ DO2	5811_{hex}	0xh	0 to 1	

Table 175: Parameters of the BL20-1CNT

Module/Parameter	Object	Sub-Index	Byte	Bit
– Configuration				
Substitute value DO1	5801_{hex}	0xh	0	0
Diagnostics DO1				1
Function DO1				4 to 2
Function DO2				7 to 5
Signal evaluation (A,B)			1	1 to 0
Sensor/Input filter (A)				2
Sensor/Input filter (B)				3
Sensor/Input filter (DI)				4
Sensor (A)				6 to 5
Direction input (B)				7
Group diagnostics			2	0
Behaviour CPU/Master STOP				5 to 4

Table 175: Parameters of the BL20-1CNT

Module/Parameter	Object	Sub-Index	Byte	Bit
Measurement mode				
– Operating mode				
Operating mode	5800_{hex}	0xh	0	5 to 0
Digital input DI			1	1
Function DI				3 to 2
Measuring range limits				
Lower limit	5821_{hex}	0xh	0 to 3	
Upper limit	5822_{hex}	0xh	0 to 3	
Integration time	5820_{hex}	0xh	0 to 3	
Sensor pulses per revolution	5823_{hex}	0xh	0 to 1	
– Configuration				
Substitute value DO1	5801_{hex}	0xh	0	0
Diagnostics DO1				1
Function DO1				4 to 2
Signal evaluation (A,B)			1	1 to 0
Sensor/Input filter (A)				2
Sensor/Input filter (B)				3
Sensor/Input filter (DI)				4
Sensor (A)				6 to 5
Direction input (B)				7
Group diagnostics			2	0
Behaviour CPU/Master STOP				5 to 4

Parameter list for the counter module

Module/Parameter	Object	Value	Meaning
Count mode			
– Operating mode			
Operating mode	5800_{hex}	000000	Continuous count **A**
		000001	Single-action count
		000010	Periodical count
Release function		0	Abort count operation **A**
		1	Interrupt count operation
Digital input DI		0	Normal **A**
		1	Inverted
Function DI		00	Input **A**
		01	Hardware release (HW gate)
		10	Latch retrigger function when edge positive
		11	Synchronization when edge positive
Synchronization		0	Single-action **A**
		1	Periodical
Main count direction		00	None **A**
		01	Up counting
		10	Down counting

A default settings

Module/Parameter	Object	Value	Meaning
– Count limits			
Lower count limit	$6C01_{hex}$	0 to -2147483648[1)]	Lower counter limit for channel x
Upper count limit	$6C02_{hex}$	0 to 2147483647[1)]	Upper counter limit for channel x
Hysteresis	$6B30_{hex}$	01[1)] to 255	Hysteresis for channel x
Pulse duration DO1/ DO2	5811_{hex}	0 to 255/1[1)]	Pulse duration for DO1 and DO2 for channel x (n*2 ms)
– Configuration			
Substitute value DO1	5801_{hex}	0	1 **A**
		1	1
Diagnostics DO1		0	On **A**
		1	Off
Function DO1		000	Output **A**
		001	On when cnt. value ≧ ref. value
		010	On when cnt. value ≦ ref. value
		011	Pulse if cnt. value = ref. value
Function DO2		000	Output **A**
		001	On when cnt. value ≧ ref. value
		010	On when cnt. value ≦ ref. value
		011	Pulse if cnt. value = ref. value

A default settings

Module/Parameter	Object	Value	Meaning
Signal evaluation (A,B)	5801_{hex}	00	Pulse and direction **A**
		01	Single-evaluation rotary sensor
		10	Double-evaluation rotary sensor
		11	Fourfold-evaluation rotary sensor
Sensor/Input filter (A)		0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor/Input filter (B)	5801_{hex}	0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor/Input filter (DI)		0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor (A)		00	Normal **A**
		01	Inverted
Direction input (B)		0	Normal **A**
		1	Inverted
Group diagnostics		0	Release **A**
		1	Block
Behaviour CPU/Master STOP		00	turn off DO1 **A**
		01	Proceed with operating mode
		10	Switch substitute value DO1
		11	DO1 hold last value

A default settings

Module/Parameter	Object	Value	Meaning
Measurement mode			
– Operating mode			
Operating mode	5800_{hex}	10000	frequency measurement **A**
		10001	revolutions measurement
		10010	period duration measurement
Digital input DI		0	Normal **A**
		1	Inverted
Function DI	5800_{hex}	00	Input **A**
		01	Hardware release (HW gate)
– Measuring range limits			
Lower limit	5821_{hex}	0 **A** to $16777214*10^{-3}$	Lower measuring limit for channel x
Upper limit	5822_{hex}	0 to $16777215*10^{-3}$ **A**	Upper measuring limit for channel x
Integration time	5820_{hex}	1 to 1000/10 **A**	Integration time (n*10 ms) frequency measurement
		1 to 1000/10 **A**	Integration time (n*10 ms) frequency measurement
		1 to 1000/10 **A**	Number of periods for periods duration measurement
Sensor pulses per revolution	5823_{hex}	1 **A** to 65535	Sensor pulses for channel x

Module/Parameter	Object	Value	Meaning
– Configuration			
Substitute value DO1	5801hex	0	0 **A**
		1	1
Diagnostics DO1		0	On **A**
		1	Off
Function DO1		000	Output **A**
		001	Outside of the set limits
		010	Below the lower limit
		011	Above the upper limit
Signal evaluation (A,B)		00	Pulse and direction **A**
		01	Single-evaluation rotary sensor
Sensor/Input filter (A)		0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor/Input filter (B)		0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor/Input filter (DI)		0	2.5 µs (200 kHz) **A**
		1	25 µs (20 kHz)
Sensor (A)		00	Normal **A**
		01	Inverted
Direction input (B)		0	Normal **A**
		1	Inverted
Group diagnostics		0	Release **A**
		1	Block

Module/Parameter	Object	Value	Meaning
Behaviour CPU/Master STOP	5801_{hex}	00	turn off DO1 **A**
		01	Proceed with operating mode
		10	Switch substitute value DO1
		11	DO1 hold last value

A default settings

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Objects for SWIRE modules

General Overview for SWIRE Objects

Table 176: General overview for SWIRE objects

Object	Name	Page
Inputdata		
6000_{hex}	Read input 8 bit	4-117
...		
6120_{hex}	Read input 32 bit	4-120
Outputdata		
6200_{hex}	Write output 8 bit	4-123
...		
6320_{hex}	Write output 32 bit	4-126
Diagnostic data		
3040_{hex}	XBI Diag Byte	4-264ff.
3042_{hex}	XBI Diag Word	
3044_{hex}	XBI Diag Dword	
3045_{hex}	XBI Diag Dword2	
3046_{hex}	XBI Diag Dword3	
3047_{hex}	XBI Diag Dword4	

Parameter data		
3060_{hex}	XBI Param Byte	4-273ff.
3062_{hex}	XBI Param Word	
3064_{hex}	XBI Param DWord	
3065_{hex}	XBI Param DWord2	
3066_{hex}	XBI Param DWord3	
3067_{hex}	XBI Param DWord4	
3068_{hex}	XBI Param DWord5	
$3069h_{hex}$	XBI Param DWord6	
$306A_{hex}$	XBI Param DWord7	
$306B_{hex}$	XBI Param Dword8	

Representation of process input data

The process input data of the BL20-E-1SWIRE modules is represented by objects 6000_{hex}, 6020_{hex}, 6021_{hex}, and 6022_{hex}, 6100_{hex} or 6120_{hex} for digital input channels of a BL20 station.

The user can choose between 4 different formats for representing the values:

- Only one bit represented by each SUB-index (objects 6020_{hex}, 6021_{hex} and 6022_{hex}), see page 4-118.
- 8 bits represented by each SUB-index (object 6000_{hex}), see page 4-117.
- 16 bits represented by each SUB-index (object 6100_{hex}), see page 4-119.
- 32 bits represented by each SUB-index (object 6120_{hex}), see page 4-120.

PDO mapping of object 6000_{hex} is always executed by default and automatically for the first 8 sub-indexes.

This corresponds to the 64 bits of the SWIRE feedback interface. If more than 64 process input data items are present, the PDO mapping must be carried out by the user. A total of 36 groups of 8 bits each can be displayed (288 bits).

If the representation of the data bits is **not** required with the object 6000_{hex} or if another arrangement of the mapped objects is required, PDO mapping must be carried out by the user.

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 input data

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

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

The following table shows the meaning of the data bits:

Table 177: Meaning of the data bits

Designa-tion	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	Contactor coil is switched off
	1	ON	Contactor coil is switched on
PKZSTx	**Switch status, PKZ x**		
	0	OFF	The motor-protective circuitbreaker is off or has tripped
	1	ON	The motor-protective circuitbreaker is switched on

Designa-tion	Status		Comment
SDx	**Communication error, slave x**		
	Setting the NDDIAG parameter copies the slave diagnostics message (input byte 1/bit 3) to the feed-back interface. The information is provided as status information in the PLC for the user.		
	0	ON LINE	Status of slave x: Everything o.k.
	1	OFF LINE	Status of slave x: Slave diagnostics message present

Representation of process output data

The process output data of the BL20-E-1SWIRE modules is represented by objects 6200hex, 6220hex, 6221hex, and 6222hex, 6300hex or 6320hex for digital output channels of a BL20 station. The user can choose between 4 different formats for representing the values:

- Only one bit represented by each SUB-index (objects 6220hex, 6221hex and 6222hex), page 4-124
- 8 bits represented by each SUB-index (object 6200hex), page 4-123.
- 16 bits represented by each SUB-index (object 6300hex), page 4-125.
- 32 bits represented by each SUB-index (object 6320hex), page 4-126.

PDO mapping of object 6200hex is always executed by default and automatically for the first 8 subindexes.

This corresponds to the 64 bits of the SWIRE command interface. If more than 64 process output data items are present, the PDO mapping must be carried out by the user. A total of 36 groups of 8 bits each can be displayed (288 bits).

If the representation of the data bits is **not** required with the object 6200hex or if a different arrangement of the mapped objects is required, PDO mapping must be carried out by the user.

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

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

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

The following table shows the meaning of the data bits:

Table 178: Meaning of the data bits

Designa-tion	Status			Comment
SOx	Relay x relay x			
		SOx is transferred as the switch status of the contactor coil from the SWIRE bus master to the appropriate SWIRE bus slave.		
	0	OFF	OFF	Contactor not switched on
	1	ON	ON	Contactor is switched on

Representation of diagnostics data

The 8 bytes of diagnostics data for the BL20-E-1SWIRE module are represented by the manufacturer specific objects of the CANopen gateway.

The following manufacturer specific objects for representing the diagnostics data are used:

- 3040hex, “XBI Diag Byte”, ARRAY, Unsigned8
- 3042hex, “XBI Diag Word”, ARRAY, Unsigned16
- 3044hex, “XBI Diag Dword”, ARRAY, Unsigned32
- 3045hex, “XBI Diag Dword2”, ARRAY, Unsigned32
- 3046hex, “XBI Diag Dword3”, ARRAY, Unsigned32
- 3047hex, “XBI Diag Dword4”, ARRAY, Unsigned32

The objects have the following structure:

- The objects have a maximum of 74 sub-indexes. This number corresponds to the number of modules that are present on a BL20 station. The sub-index corresponds to the module number of the BL20 module.
- A sub-index can represent a maximum of 4 bytes. Larger diagnostics data volumes are distributed on the following objects. The sub-index also belongs to the module number.

The following table shows the assignment of the diagnostics data bytes of the BL20-E-1SWIRE module to the manufacturer specific objects:

<table>
<tr><th>Byte no.</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td></td><td colspan="8">8 diagnostic bytes of BL20-E-1SWIRE</td><td colspan="8">free</td></tr>
<tr><td rowspan="3">Object no. in (hex)</td><td colspan="4">3044
(see page 4-271)</td><td colspan="4">3045
(see page 4-272)</td><td colspan="4">3046</td><td colspan="4">3047</td></tr>
<tr><td colspan="2">3042</td><td colspan="14">(only the first 2 bytes are shown)</td></tr>
<tr><td>3040</td><td colspan="15">(only the first byte is shown</td></tr>
</table>

Note

Use the objects 3044_{hex} and 3045_{hex} to access all the diagnostics data!

The diagnostics bytes of the BL20-E-1SWIRE module are represented completely with the objects 3044_{hex} and 3045_{hex}.

The **sub-index** of the objects must correspond to the slot of the module in the BL20 slave.

The structure of the diagnostics data of the BL20-1SWIRE module is described in the following:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	GENE-RAL_{ERR}	U_{SWERR}	frei	COM_{ERR}	frei	RDY_{ERR}	frei	SW_{ERR}
Byte 2	frei	U_{AUXERR}	TYP_{ERR}	frei	PKZ_{ERR}	frei	SD_{ERR}	frei
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 meanign of the diagnostic bits:

Byte	Design.	Status		Comment
Byte 1	SW_{ERR}	**SWIRE MASTER**		
		The configuration was accepted according to the parameter setting and the SWIRE bus is in data exchange mode.		
		0	Data exchange	The bus is in data exchange mode
		1	Offline	The configuration was not accepted, the bus does not switch to data exchange mode. (SW LED flashing)
	RDY_{ERR}	**SPS SLAVE**		
		Parameter setting is faulty. The ACTUAL configuration was accepted according to the SET configuration and the data exchange with the higher-level is o.k.		
		0	Data exchange	The bus is in data exchange mode
		1	Offline	The configuration was not accepted, the bus does not switch to data exchange mode. (Rdy LED flashing)
	COM_{ERR}	**Communication SWIRE**		
		A communication error is present, such as a slave is no longer reached, its internal timeout has elapsed or communication is faulty. The master cannot carry out data exchange with at least one slave.		
		0	OK	No error present.
		1	faulty	An error is present

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Byte	Design.	Status		Comment
Byte 1	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	under-voltage	An error is present.
	GENE-RAL_{ERR}	**Error message**		
		The creation of a function block shows that systems/function blocks for the general checking of a slave for any diagnostics messages present only check the first byte.		
		0	none	No diagnostics message present
		1	present	One/several diagnostics messages present
Byte 2	SD_{ERR}	**Communication SWIRE slave**		
		If the parameter SD_{ERR}A is set for group diagnostics, this bit indi-cates an error as soon as only one slave on the bus sets its SD error bit.		
		0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
		1	faulty	An error is present.
	PKZ_{ERR}	**Overcurrent protective circuit-breaker**		
		If the parameter PKZ_{ERR}A is set for group diagnostics, this bit indi-cates an error as soon as only one PKZ of a slave has tripped.		
		0	OK	No PKZ has tripped or diagnostics function has been deactivated via the parameter setting.
		1	tripping	At least one PKZ has tripped.

Byte	Design.	Status		Comment
Byte 2	TYP_{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	under-voltage	Contactor supply voltage is not o.k. (< 18 VDC).

Byte	Design.	Status	Comment
Byte 3,4	TYP_{ERR} Sx	**Device configuration, slave x**	
		Info field for the individual indication of a configuration error as error message. If the $TYPE_{INFO}$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 diag-nostics, this bit field indicates the error as soon as the slave diag-nostic message of the slave Sx is triggered.	
		0 OK	No error is present or diagnostics function has been deactivated via the parameter setting.
		1 Offline	A diagnostics message is present.

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

Object 3044hex - XBI Diag Dword

The object XBI Diag Dword reads the first Diag-Dword (Bytes 0...3) of a module on the BL20 module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 179: Object 3044_{hex}

Feature	Description
Name	XBI Diag Dword
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	ro
Default value	No

Object 3045hex - XBI Diag Dword2

The object XBI Diag Dword2 reads the second Diag-Dword (Bytes 4...7) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 180: Object 3045_{hex}

Feature	Description
Name	XBI Diag Dword2
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	ro
Default value	No

Representation of parameter data

The 24 bytes of parameter data for the BL20-E-1SWIRE module are represented by the manufacturerspecific objects of the CANopen gateway.The following manufacturer specific objects for representing the parameter data are used:

- 3060hex, “XBI Param Byte”, ARRAY, Unsigned8
- 3062hex, “XBI Param Word”, ARRAY, Unsigned16
- 3064hex, “XBI Param Dword”, ARRAY, Unsigned32
- 3065hex, “XBI Param Dword2”, ARRAY, Unsigned32
- 3066hex, “XBI Param Dword3”, ARRAY, Unsigned32
- 3067hex, “XBI Param Dword4”, ARRAY, Unsigned32
- 3068hex, “XBI Param Dword5”, ARRAY, Unsigned32
- 3069hex, “XBI Param Dword6”, ARRAY, Unsigned32
- 306Ahex, “XBI Param Dword7”, ARRAY, Unsigned32
- 306Bhex, “XBI Param Dword8”, ARRAY, Unsigned32

The objects have the following structure:

- The objects have a maximum of 74 sub-indexes. This number corresponds to the number ofmodules that are present on a BL20 station. The sub-index corresponds to the module numberof the BL20 module.
- A sub-index can represent a maximum of 4 bytes. Larger parameter data volumes are distributedon the following objects. The sub-index also belongs to the module number.

The following table shows the assignment of the parameter data bytes of the BL20-E-1SWIRE module to the manufacturer specific objects:

Byte no.	1	2	3	4	5	6	7	8
	Parameter bytes 1 to 8 of BL20-E-SWIRE							
Object no. in (hex)	3064 (see page 4-281)				3065 (see page 4-282)			
	3062		(only the first two bytes are shown)					
	3060	(only the first byte is shown)						
Byte no.	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
	Parameter bytes 9 to 16 of BL20-E-SWIRE							
Object no. in (hex)	3066 (see page 4-282)				3067 (see page 4-283)			
	17	**18**	**19**	**20**	**21**	**22**	**23**	**24**
	Parameter bytes17 to 24 of BL20-E-SWIRE							
Object no. in (hex)	3068 (see page 4-282)				3069 (see page 4-282)			

Note

Use the objects 3064_{hex} to 3069_{hex} to access all the parameter data!

The parameter bytes of the BL20-1SWIRE module are represented completely with the objects 3064_{hex} and 3069_{hex}.

The sub-index of the objects must correspond to the slot of the module in the BL20 station.

The structure of the parameter data of the BL20-1SWIRE module is described in the following:

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

The following table shows the meaning of the parameter bits:

Byte	Design.	Status		Comment
Byte 1	Disable Cfg	**Automatic SWIRE configuration**		
		Disabling of the acceptance of the physically present configuration as ACTUAL configuration on manual pushbutton actuation.		
		0 **A**	Inactive	The physically present configuration of the SWIRE bus is only accepted as the ACTUAL configuration by pressing the CFG button. The comparison with the SET configuration is then carried out
		1	Active	The physically present configuration is automatically accepted as the ACTUAL configuration and then compared with the SET configuration.
	Configuration	**PLC configuration check**		
		The configuration check parameter enables a comparison of the set and actual configuration based on the device ID.		
		0 **A**	Inactive	Configuration check based on device ID. Only SWIRE slaves with a device ID completely matching the set configuration are accepted on the bus
		1	Active	All slaves are mapped in 4Bit INPUT/ 4Bit OUTPUT without checking the device ID.

Byte	Design.	Status		Comment
Byte 1	MNA	**Configuration check (active/passive)**		
		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 **A**	Bus based	No data exchange with a slave with an incomplete / incorrect configuration.
		1	Slave based	The bus also goes into operation with the correctly configured slaves even if the configuration is incomplete. This means in position oriented addressing: All slaves detected by the daisy chain configuration with a position that matches the set configuration are started up. Slaves that do not match the set configuration are inactive.
Byte 2	SD_{INFO}	**Slave error field**		
		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 **A**	Inactive	Single diagnostics is activated
		1	Active	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 **A**	Inactive	Group diagnostics is activated
		1	Active	Group diagnostics is not activated

Byte	Design.	Status		Comment
Byte 2	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 **A**	Inactive	Single diagnostics is activated
		1	Active	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 **A**	Inactive	Group diagnostics is activated
		1	Active	Group diagnostics is not activated
	TYP_{INFO}	**Configuration error field**		
		As soon as a slave on the bus does not match the set configuration and therefore cannot be started, this is indicated as an individual error depending on the parameter set.		
		0 **A**	Inactive	Single diagnostics is activated
		1	Active	Single diagnostics is not activated

Byte	Design.	Status		Comment
Byte 2	TYP_{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.		
		0 **A**	Inactive	Group diagnostics is activated
		1	Active	Group diagnostics is not activated
	U_{AUXERR}	**Error message -U_{AUX}**		
		Activate system diagnostics $UAUX_{ERR}$. $UAUX_{ERR}$ will generate an error message as soon as the power supply goes below a level at which the function of the relays is not guaranteed.		
		0 **A**	Inactive	Error message $UAUX_{ERR}$ activated
		1	Active	Error message $UAUX_{ERR}$ not activated
Byte 3	reserved			
Byte 4	Life-guarding	**Lifeguarding time of the SWIRE slaves**		
		0x02-0xFF 0x64 **A**	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		
		0 **A**	Inactive	SD_{DIAG}Sx is accepted
		1	Active	SD_{DIAG}Sx is not accepted

Byte	Design.	Status		Comment
Byte 9-24	Device ID, slave x	TYPE setting for the LIN slave at position x on the SWIRE bus		
		0x20		SWIRE-DIL-MTB (: 0xFF)
		0xFF		Basic setting (no slave)
Byte 3,4	TYP_{ERR} Sx	**Device configuration, slave x**		
		Info field for the individual indication of a configuration error as error message. If the $TYPE_{INFO}$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 diag-nostics, this bit field indicates the error as soon as the slave diag-nostic message of the slave Sx is triggered.		
		0	OK	No error is present or diagnostics function has been deactivated via the parameter setting.
		1	Offline	A diagnostics message is present.

Byte	Design.	Status		Comment
Byte 7,8	PKZ_{ERR} Sx		Overcurrent protective circuit-breaker, slave x	
			Info field for the individual indication of the tripping a motor-protective circuit-breaker (PKZ) as error message. If the PKZ_{INFO}A is set for single diagnos-tics, 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 diag-nostics function has been deactivated via the parameter setting.
		1	tripped	The PKZ of the slave has tripped.

Object 3064hex - XBI Param Dword

The object XBI Param Dword reads the first Param-Dword (Byte 0...3) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 181: Object 3064_{hex}

Feature	Description
Name	XBI Param Dword
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

Object 3065hex - XBI Param Dword2

The object XBI Param Dword2 reads the second Param-Dword (Byte 4...7) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 182: Object 3065$_{hex}$

Feature	Description
Name	XBI Param Dword2
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

Object 3066hex - XBI Param Dword3

The object XBI Param Dword3 reads the third Param-Dword (Byte 8...11) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 183: Object 3066$_{hex}$

Feature	Description
Name	XBI Param Dword3
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

Object 3067hex - XBI Param Dword4

The object XBI Param Dword4 reads the fourth Param-Dword (Byte 12...15) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 184: Object 3067$_{hex}$

Feature	Description
Name	XBI Param Dword4
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

Object 3068hex - XBI Param Dword5

The object XBI Param Dword5 reads the fifth Param-Dword (Byte 16...19) of a module on the BL20module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 185: Object 3068$_{hex}$

Feature	Description
Name	XBI Param Dword5
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

Object 3069hex - XBI Param Dword6

The object XBI Param Dword reads the sixth Param-Dword (Byte 20…...24) of a module on theBL20 module bus. The sub-index 1 to 74 corresponds to the module number of the BL20 module.

Table 186: Object 3069$_{hex}$

Feature	Description
Name	XBI Param Dword6
Object code	ARRAY
PDO-mapping	No
Data type	Unsigned32
Access	rw
Default value	No

5 Diagnostics - Emergency Frames

General

The gateway sends out the following diagnostic information: the state of the BL20 station, the communication through the internal modules bus, the communication with CANopen, the state of the gateway itself.

Diagnostics messages are indicated in two different ways:

- through the individual LEDs, see page 3-27 ff.
- through Emergency Frames in a CANopen configuration tool (software)

Structure of the Emergency Frames

BL20 CANopen supports Emergency Frames (EMCY) as standardized in CiA DS-301.

The COB-IDs for the EMCY telegrams are defined by the Predefined Master-Slave Connection Set:

COB-ID = 129 - 1 + Node-ID

In the event of a communication error, not only the Emergency Error Code but also the Error register (see "Object 1001_{hex}") and additional information will be transmitted, so that the error can be more precisely identified. Only a portion of the 5 bytes is used for the additional information. The remaining bytes are then 0.

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Data contents	Emergency Error Code (Table 188:)		Error register (Table 186:)	Additional information - only valid for Error Code 8100h- (Table 187:)				

Error Register

Table 186: Bit assignments for the error register

A *M = mandatory*
B *O = optional*

Error register	M/O	Meaning
Bit 0	M **A**	Generate the error message
Bit 1	O **B**	Current error
Bit 2	O	Voltage error
Bit 3	O	Temperature error
Bit 4	O	Communication error (overrun, error state)
Bit 5	O	Device-profile-specific error
Bit 6	O	reserved
Bit 7	O	Manufacturer-specific error

Additional information

Table 187: Content of Byte 3 to 7 of Emergency Frame

Content	Meaning
01_{hex}	Guard Fail
02_{hex}	Warning Level Reached
03_{hex}	Transmit-Time-Out
04_{hex}	Bus-off

Gateway-Diagnostics

Table 188: Diagnostics for the BL20-CANopen gateway

Diagnostics	Error Code	Designation as per CiA DS-301/DS-401	Meaning
Error Reset/ No Error	0000_{hex}	-	Error Reset
Mains voltage too high	3110_{hex}		System voltage too high
Mains voltage too low	3120_{hex}	Mains voltage too low	System voltage too low
Field voltage too low	3320_{hex}	Output voltage too low	Field voltage too low
Deviating I/O-configuration	$707A_{hex}$	Additional modules	I/O module list, adaptable change, e.g. module removed
I/O-configuration error	$707D_{hex}$	Additional modules	I/O module list, incompatible change
Deviating I/O-configuration – module expansion	$707E_{hex}$	Additional modules	I/O module list extended
Deviating I/O-configuration – module removed	$707F_{hex}$	Additional modules	1 module removed from I/O module list
CAN-Warning-Level reached	8100_{hex}	Communication	CAN communication faulty (at least one of the error counters for the CAN controller of the BL20-CANopen gateway has reached the value 96)

Table 188: Diagnostics for the BL20-CANopen gateway

Diagnostics	Error Code	Designation as per CiA DS-301/DS-401	Meaning
CAN Transmit Timeout	8100_{hex}	Communication	The BL20-CANopen gateway was not able to transmit a frame within the specified time.
Life-Guard Error or Heartbeat Error	8130_{hex}	Life-Guard error or Heartbeat error	The BL20-CANopen gateway has detected an error in the CANopen Guarding or Heartbeat Protocol, e.g. a time-out.
Left CAN-BusOff	8140_{hex}	Recovered from Bus-Off	The system has left the CAN-Bus Off state, i.e. the CAN controller for the BL20-CANopen gateway has moved out of this serious fault condition.
I/O-Assistant Force Mode active	9009_{hex}	External Error	Force Mode is active, i.e. the outputs of the BL20 station are not under the control of CANopen at the moment.

I/O-Module Diagnostics

Digital Input Modules

The digital input modules BL20-4DI-NAMUR with diagnosis function have supplementary diagnostics which can not be sent via detailed error codes.

In case of an error occurring at one of these modules, the gateway sends an error frame specifying the module- and channel-number of the respective module as well as a common error classification.

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

If necessary, detailed information about the diagnostic message, can be read from a manufacturer specific object, the "object 3042_{hex} XBI Diag Word" (see next page).

Note

Objects 3000_{hex} to 3097_{hex} enable direct access to the internal module bus of the BL20 station.

Object 3042_{hex} - XBI Diag Word

This object reads the first diagnosis word (byte 0 and byte 1) of a BL20 module within the station.

Attention

The sub-index corresponds to the slot number of the respective module in a station.

Table 189: Object 3042_{hex}

Feature	Description/ Value
Name	XBI Diag Word
Object code	ARRAY
Data Type	Unsigned16
Access	ro
Default value	No
PDO-mapping	No

The structure of the 2 bytes of diagnostic data depends on the module concerned.

BL20-4DI-NAMUR

Table 190: Diagnostic Bytes for BL20-4DI-NAMUR

Diagnosis byte	Bit	Diagnosis
0	0	short circuit sensor 1
	1	open circuit sensor 1
	2	short circuit sensor 2
	3	open circuit sensor 2
	4	short circuit sensor 3
	5	open circuit sensor 3
	6	short circuit sensor 4
	7	open circuit sensor 4

Digital Output Modules

Designation/ Meaning	**Byte 0/1 Error code**	**Byte 2 Error register**	**Byte 3 Extra info**	**Byte 4 Extra info**
Load dumps at outputs: Open circuit or current too low (threshold: positive converter limit value)	2310_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
Output current out of range: The current is outside of the permissible range **A**	2330_{hex}	Bit 1 = 1 (current error)	Module number	Channel number

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

Analog Input Modules

- **BL20-xAI-I(0/4...20MA)**

Designation/ Meaning	Byte 0/1 Error code	Byte 2 Error register	Byte 3 Extra info	Byte 4 Extra info
Input current too high: The input current is outside of the permissible range. **A**	2110_{hex}	Bit 1 = 1 (current error)	Module number	Channel number (for multi-channel modules)
Input current too low: Open circuit or input current (for the measuring range 4 to 20 mA) too low. The threshold is 3 mA.	2130_{hex}	Bit 1 = 1 (current error)	Module number	Channel number

A *The threshold for this error message is 1% over the upper measuring range value or 1 % below the lower measuring range value.*

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

- **BL20-xAI-U(-10/0...+10VDC)**

Designation/ Meaning	Byte 0/1 Error code	Byte 2 Error register	Byte 3 Extra info	Byte 4 Extra info
AI U voltage out of range: The input voltage is outside of the permissible range.	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

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

Designation/ Meaning	Byte 0/1 Error code	Byte 2 Error register	Byte 3 Extra info	Byte 4 Extra info
Load dumps at outputs: Open circuit or current too low (threshold: positive converter limit value)	2310_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
Output current too high: Current too high (threshold: approx. 5 O; only with temperature measuring ranges)	2323_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
Output current out of range: The current is outside of the permissible range **A**	2330_{hex}	Bit 1 = 1 (current error)	Module number	Channel number

Note
For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

- **BL20-2AI-THERMO-PI**

Designation/ Meaning	Byte 0/1 Error code	Byte 2 Error register	Byte 3 Extra info	Byte 4 Extra info
AI U voltage out of range: Open circuit or input voltage is outside of the permissible range.	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

- **BL20-4AI-U/I**

Designation/ Meaning	**Byte 0/1 Error code**	**Byte 2 Error register**	**Byte 3 Extra info**	**Byte 4 Extra info**
Input current too high: The input current is outside of the permissible range. **A**	2110_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
Input current too low: Open circuit or input current (for the measuring range 4 to 20 mA) too low. The threshold is 3 mA.	2130_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
AI U voltage out of range: Open circuit or input voltage is outside of the permissible range.	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number

A*The threshold for this error message is 1% over the upper measuring range value or 1 % below the lower measuring range value.*

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

Technology Modules

- **BL20-1RS232/ BL20-1RS4xx**

Byte 0 + Byte 1: Error Code	Byte 3	Byte 4	Byte 5	Meaning
7000_{hex}	Module number	Channel number (always = 1)	08_{hex}	Parameter error
			10_{hex}	Hardware failure
			20_{hex}	Handshake error
			30_{hex}	Frame error
			40_{hex}	RX buffer overflow

Note

For the exact byte assignment of the Emergency frame, please see "Structure of the Emergency Frames", page 5-3.

Note

For the process data image and the diagnostic data of the modules please refer to page 4-163ff.

- **BL20-1SSI**

Byte 0 + Byte 1: Error Code	Byte 3	Byte 4	Byte 5	Meaning
7000_{hex}	Module number	Channel number (always = 1)	01_{hex}	SSI diag
			02_{hex}	SSI error
			04_{hex}	Overflow error
			08_{hex}	Underflow error
			10_{hex}	Parameter error

Note

For the process data image and the diagnostic data of the modules please refer to page 4-176ff.

- **BL20-1CNT**

Designation/ Meaning	**Byte 0/1 Error code**	**Byte 2 Error register**	**Byte 3 Extra info**	**Byte 4 Extra info**
Load dumps at outputs: Open circuit or current too low (threshold: positive converter limit value)	2310_{hex}	Bit 1 = 1 (current error)	Module number	Channel number
Output current out of range: The current is outside of the permissible range **A**	2330_{hex}	Bit 1 = 1 (current error)	Module number	Channel number

Note

For the process data image of the modules please refer to page 4-199ff.

- **BL20-E-SWIRE**

Byte 0 + Byte 1: Error Code	**Byte 3**	**Byte 4**	**Byte5**	**Byte6**	**Byte7**
7000_{hex}	Module number	Diagbyte 0	Diagbyte 1	Diagbyte 2 | 4 | 6	Diagbyte 3 | 5 | 7

Bytes 6 and 7 of the Emergency frame contain a bit for each connected SWIRE module, which is the result of the bit OR-operation of the module diagnositc bytes (see page 4-264ff).

Note

For the process data image and the diagnostic data of the modules please refer to page 4-255ff.

6 Guidelines for Station Planning

Random Module Arrangement

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

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

Note

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

Complete Planning

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

Attention

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

Maximum System Extension

A BL20 station can consist of a gateway and a maximum of 74 modules in slice design (equivalent to 1 m in length of mounting rail including the end bracket and end plate). The maximum number of modules is less when using block modules (1 block module is equivalent to 8 modules in slice design).

The following overview shows the maximum number of channels possible, on condition that the entire station is made up of that respective type of channel only:

Table 197: Maximum system extension

Channels		Modules	
Type	Max. no.	Type	Max. no.
Digital inputs	288	BL20-4DI-24VDC-P	72 **B**
Digital outputs	288	BL20-4DO-24VDC-0.5A-P	72 **B**
Analog inputs, current	126	BL20-2AI-I(0/4...20MA)	63 **C**
Analog inputs, voltage	126	BL20-2AI-U(-10/0...+10VDC)	63 **C**
Analog inputs, voltage/current	112	BL20-4AI-U/I	28 **A**
Analog inputs, PT /Ni	126	BL20-2AI-PT/NI-2/3	63 **C**
Analog inputs, Thermocouple	126	BL20-2AI-THERMO-PI	63 **C**
Analog outputs, current	126	BL20-2AO-I(0/4...20MA)	63 **C**
Analog inputs, voltage	126	BL20-2AO-U(-10/0...+10VDC)	63 **C**
Counter	31	BL20-1CNT-24VDC	31 **A**
RS232	31	BL20-1RS232	31 **A**
RS485/422	31	BL20-1RS232	31 **A**
SSI	31	BL20-1SSI	31 **A**
SWIRE	16	BL20-E-1SWIRE	16 **A**

A *plus 1 Bus Refreshing module*
B *plus 2 Bus Refreshing modules*
C *plus 3 Bus Refreshing modules*

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

Attention

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

Note

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

Power Supply

Gateway Supply

Note

On a BL20 station including a gateway without integrated power supply unit, the first module to be mounted after the gateway is a Bus Refreshing module with either a BL20-P3x-SBB or a BL20-P4x-SBBC base module with tension clamp or screw connection.

Module Bus Refreshing

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

Attention

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

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

Example 1:

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

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

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

Example 2:

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

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

The calculation shows that an additional/further Bus Refreshing module is required at the latest following the last BL20-2AO module. This Bus Refreshing module is sufficient to supply the remaining modules.

Note

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

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

Table 198: Nominal current consumption of the BL20 modules on the module bus

Module	Supply	Nominal current consumption
Gateway	1 500 mA	≤ 430 mA
BL20-PF-24VDC-D		≤ 28 mA
BL20-PF-120/230VAC-D		≤ 25 mA
BL20-2DI-24VDC-P		≤ 28 mA
BL20-2DI-24VDC-N		≤ 28 mA
BL20-2DI-120/230VAC		≤ 28 mA
BL20-4DI-24VDC-P		≤ 29 mA
BL20-4DI-24VDC-N		≤ 28 mA
BL20-16DI-24VDC-P		≤ 45 mA
BL20-32DI-24VDC-P		≤ 30 mA
BL20-1AI-I(0/4...20MA)		≤ 41 mA
BL20-2AI-I(0/4...20MA)		≤ 35 mA
BL20-1AI-U(-10/0...+10VDC)		≤ 41 mA
BL20-2AI-U(-10/0...+10VDC)		≤ 35 mA
BL20-2AI-PT/NI-2/3		≤ 45 mA
BL20-2AI-THERMO-PI		≤ 45 mA
BL20-4AI-U/I		≤ 50 mA
BL20-2DO-24VDC-0.5A-P		≤ 32 mA
BL20-2DO-24VDC-0.5A-N		≤ 32 mA

Module	Supply	Nominal current consumption
BL20-2DO-24VDC-2A-P		≤ 33 mA
BL20-4DO-24VDC-0.5A-P		≤ 30 mA
BL20-16DO-24VDC-0.5A-P		≤ 45 mA
BL20-1AO-I(0/4...20MA)		≤ 39 mA
BL20-2AO-I(0/4...20MA)		≤ 40 mA
BL20-2AO-U(-10/0...+10VDC)		≤ 43 mA
BL20-2DO-R-NC		≤ 28 mA
BL20-2DO-R-NO		≤ 28 mA
BL20-2DO-R-CO		≤ 28 mA
BL20-1CNT-24VDC		≤ 40 mA
BL20-1RS232		≤ 140 mA
BL20-1RS485/422		≤ 60 mA
BL20-1SSI		≤ 50 mA
BL20-2RFID		≤ 30 mA
BL20-E-1SWIRE		≤ 60 mA

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

Note

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

Figure 6: Power supply at BL20-GWBR-CANOPEN

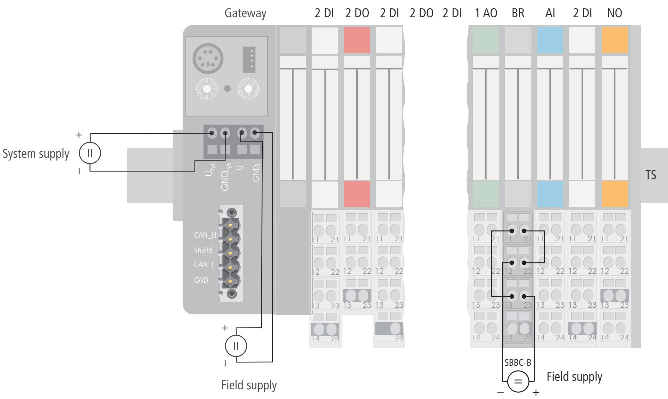
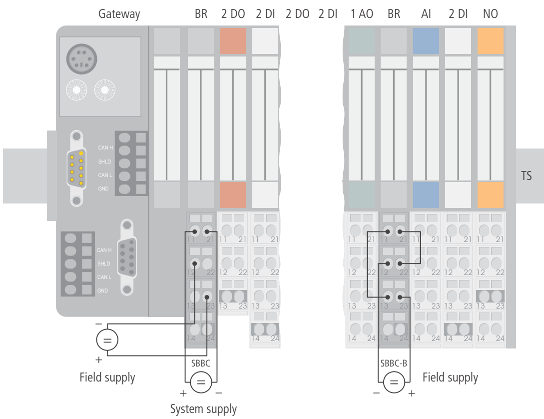


Figure 7: Power supply at BL20-GW-CANOPEN



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

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

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

Creating Potential Groups

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

Attention

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

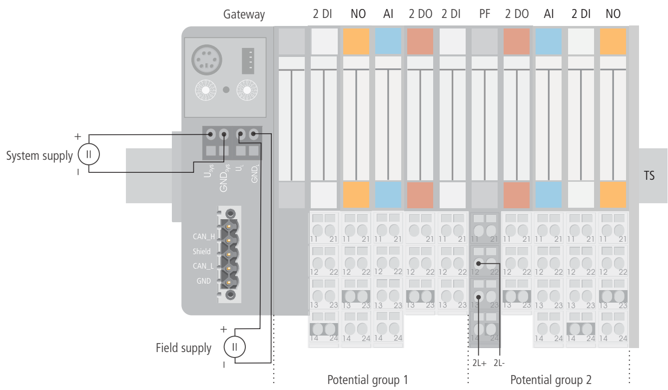


Figure 8: Example for creating potential groups with BL20-GWBR-CANOPEN

Note

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

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

Attention

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

Protecting the Service Interface on the Gateway

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

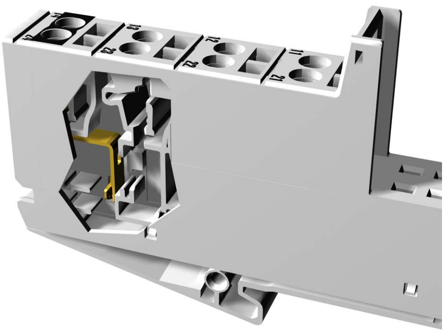
C-Rail (Cross Connection)

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 9: C-rail front view

Figure 10: C-rail side view



Warning

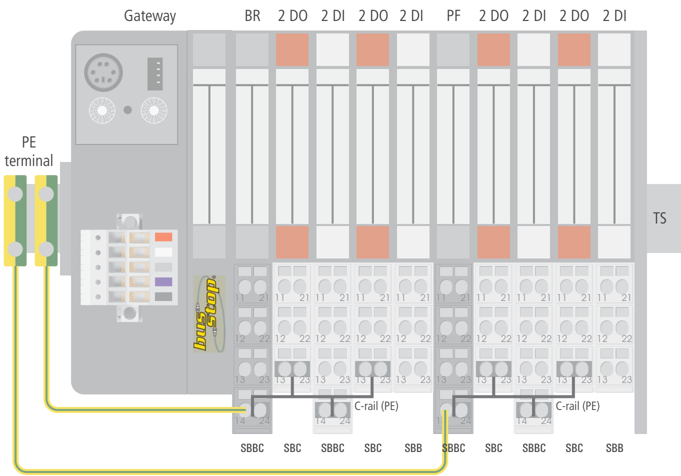
It is permitted to load the C-rail with a maximum of 24 V. Not 230 V!

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 7.

Figure 11: Using the C-rail as a protective earth

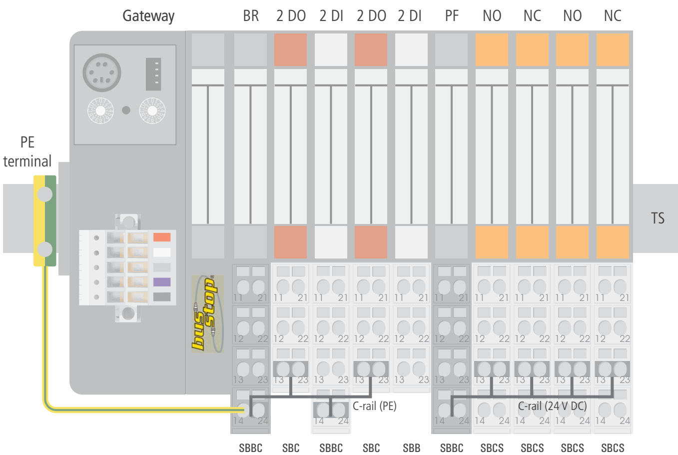


C-rails can be used for a common voltage supply when relay modules are planned. To accomplish this, the load voltage is connected to a Power Feeding module with the BL20-P4x-SBBC base module with tension clamp or screw connection. All the following relay modules are then supplied with power via the C-rail.

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 12: 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 in chapter 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.

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.

Extending an Existing Station

Attention

Please note that extensions to the station (mounting further modules) should be carried out only when the station is off-circuit.

Once alterations have been made to the order of the modules on the BL20 station, the new configuration must be saved to the ”actual configuration memory” of the BL20 gateway. This is done by either pressing the SET button between the two decimal rotary coding switches (see chapter 2) or by making the appropriate settings in the configuration software (see chapter 3).

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

General Notes

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.).

Cable Routing

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

Cable Routing Inside and Outside of Cabinets:

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

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

Group 1:

- shielded bus and data cables
- shielded analog cables
- unshielded cables for DC voltage $\leq$ 60 V
- unshielded cables for AC voltage $\leq$ 25 V

Group 2:

- unshielded cables for DC voltage > 60 V and $\leq$ 400 V
- unshielded cables for AC voltage > 25 V and $\leq$ 400 V

Group 3:

- unshielded cables for DC and AC voltages > 400 V

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

Group 1/Group 2

The group combinations:

Group 1/Group 3 and Group 2/Group 3

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

Cable Routing Outside Buildings

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

Warning

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

Lightning Protection

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

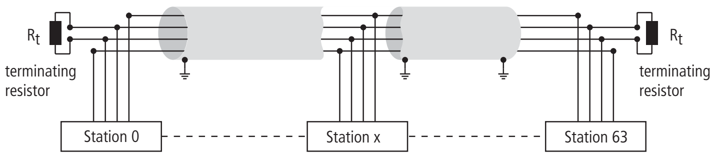
Signal cables must be protected against overvoltage by varistors or inert-gas filled overvoltage arrestors. Varistors and overvoltage arrestors must be installed at the point where the cables enter the building.

Transmission Cables

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

The bus cables must be terminated at the beginning and end with a bus terminating resistor. This can be connected via the number 4 DIP switch on the gateway.

Figure 13: Representation of a bus cable



Cable Types

TURCK offers a variety of premoulded bus cables - please refer to the BL20-catalog (TURCK documentation number: D300418).

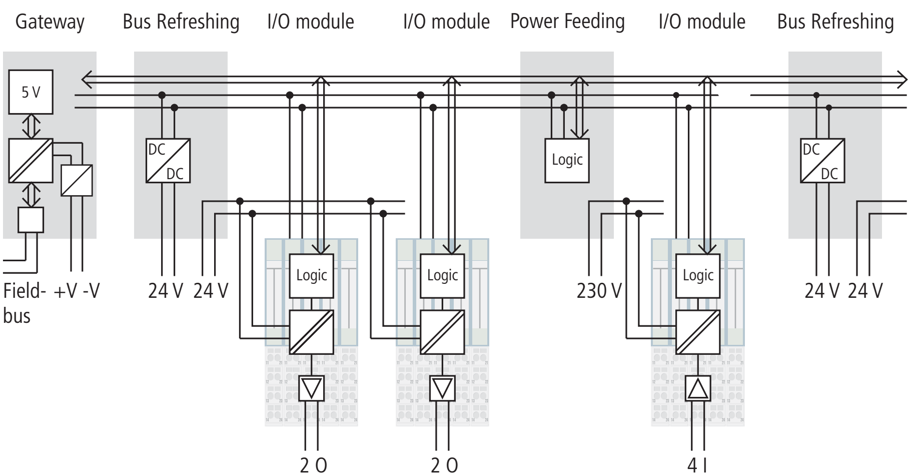
Potential Relationships

General

The potential relationship of a CANopen 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 distributed via a Bus Refreshing module.
- All BL20 modules (gateway, Bus Refreshing, 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 station.



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.

Non-isolated Installation

In a non-isolated installation, the reference potentials of the control and load circuitry are galvanically connected.

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.

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.

Grounding of Inactive Metal Components

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

- In the areas of screw connections, the painted, anodized or isolated metal components must be freed of the isolating layer. Protect the points of contact against rust.
- Connect all free moving groundable components (cabinet doors, separate mounting plates, etc.) by using short bonding straps to large surface areas.

- Avoid the use of aluminum components, as its quick oxidizing properties make it unsuitable for grounding.

Warning

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.

PE Connection

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

Earth-Free Operation

Observe all relevant safety regulations when operating an earthfree system.

Protect against high frequency interference signals

Attention

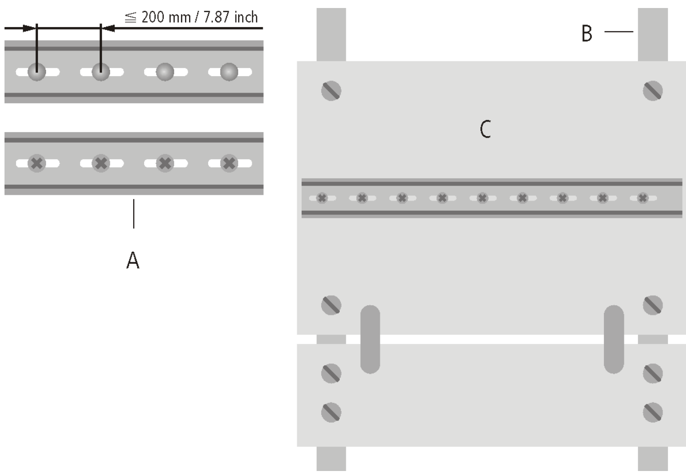
In order to comply with radiation limit values in accordance with EN 55 011/2 000, the supply lines of the power distribution module BL20-BR-24VDC-D for supplying the gateway with power are to be fed through a ferrite ring (BL20PS416-ZBX-405). This is to be placed immediately next to the connection terminals. From there on, it is not permitted to make connections to further devices.

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 14: Mounting options

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

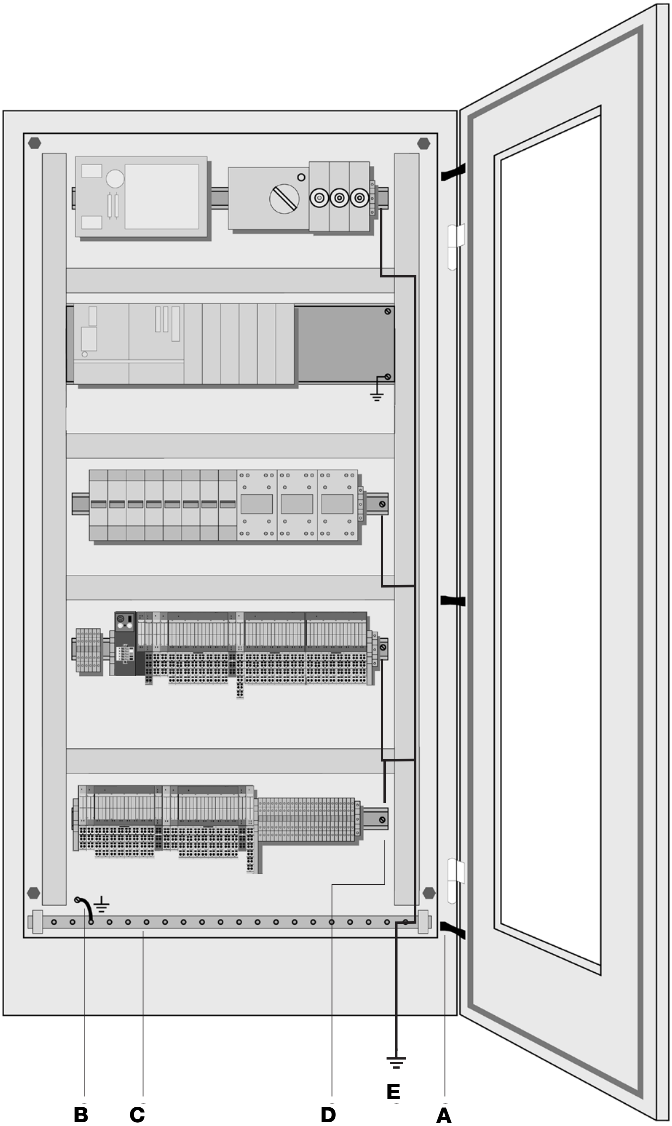


Mount the mounting rails over a large surface area and with a low impedance to the support system using screws or rivets.

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

EMC Compliant Cabinet Installation

Figure 15: EMC compliant cabinet installation



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.

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.

Potential Compensation

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

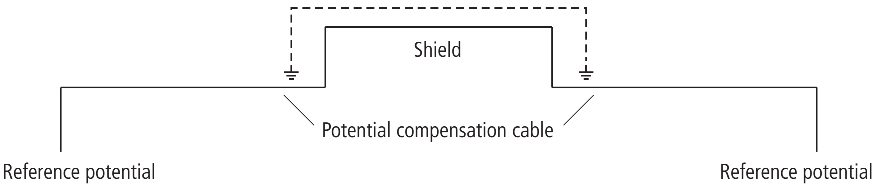
- are fed by different supplies,
- have double-sided conductor shields which are grounded on different installation components.

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

Warning

Never use the shield as a potential compensation.

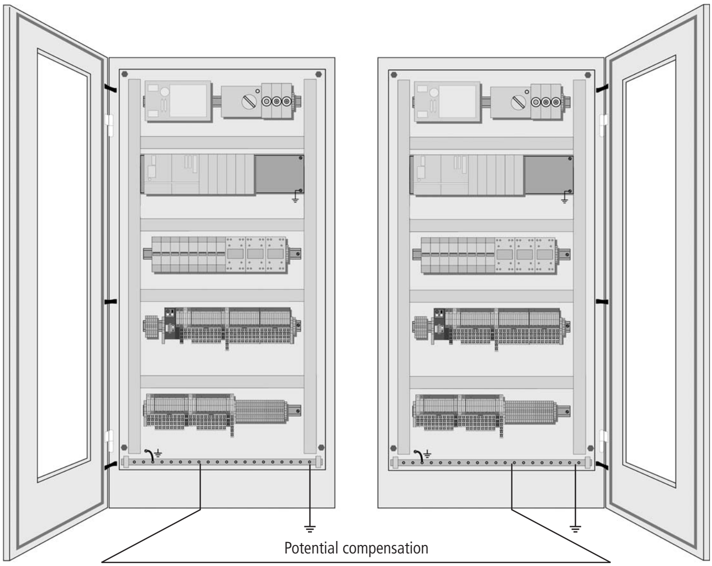
Connection 1				Connection 2
CAN_H	0	---------	0	CAN_H
CAN_L	0	---------	0	CAN_L
GND	0	---------	0	GND



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 16: Potential compensation between switchgear cabinets



Switching Inductive Loads

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

Protection against Electrostatic Discharge (ESD)

Attention

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

Bus Connection

An Open Style Connector (5-pole) is available for connecting the BL20-GWBR-CANOPEN to the CANopen fieldbus.

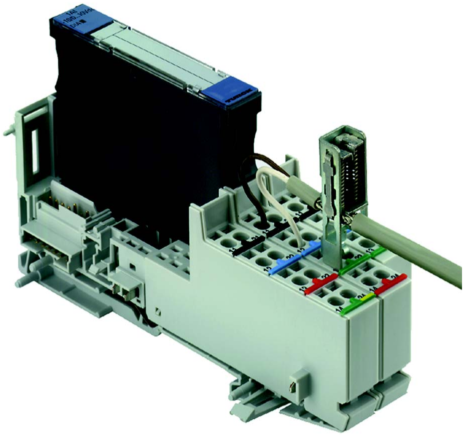
The shield connection is made via the shielding braid of the cable.

For detailed information about the bus connection of the gateway please refer to Chapter 3, Section „Connections of the data cables to BL20-GWBR-CANopen".

Two-Pole Shield Connection

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 17: Two-pole shield connection for analog modules



The following cable diameters are permissible for the shield connection:

Diameter of the shielding braid:	max. 4.9 mm / 0.19 inch
Outer diameter of the cable:	max. 6.5 mm / 0.26 inch

8 Glossary

A

Acknowledge

Acknowledgment of a signal received.

Active metal component

Conductor or conducting component that is electrically live during operation.

Address

Identifier 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.

Attribute

Attributes represent the data that a device makes available via the DeviceNet fieldbus (e. g. status of an object, serial number of the device, process data).

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 data transmission speeds in Bit/s.

Bidirectional

Working in both directions.

Bit Strobe

A Bit Strobe I/O connection is a connection between a DeviceNet client and an undetermined number of servers, these being queried by commands sent by the client.

Bonding strap

Flexible conductor, normally braided, that joins inactive components, e. g. the door of a switchgear cabinet to the cabinet main body.

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, e. g. parallel-routed signal cables, contactors and electrostatic discharges.

Class

A group of Objects that all describe the same system components. All Objects of a Class are identical in form and behavior, they can though contain different attributes.

COB

Communication Object, which is made of one or more CAN frames. Any information transmitted via CANopen has to be mapped into COBs (Source: CiA DS 401 V2.1).

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COB-ID

COB-Identifier. Identifies a COB uniquely in a CAN network. The identifier determines the priority of that COB in the data link layer, too (Source: CiA DS 401 V2.1).

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.

Cyclic

Messages are triggered time-controlled in Cyclic I/O connections by means of a time generator.

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

EDS

Electronic Device Data Sheet which contains standardized DeviceNet station descriptions. They simplify the planning of the DeviceNet nodes.

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.

Force Mode

Software mode which enables the user to set his plant to a required state by forcing certain variables on the input and output modules.

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.

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.

Instance

An Instance is defined as being an Object that is actually set up in a device.

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.

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

M

NMT

see Chapter 2 "Short description of CANopen", Page 2-3.

O

Overhead

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

P

PDO

see Chapter 2 "Short description of CANopen", Page 2-4.

PLC

Programmable Logic Controller.

Polling

Establish a Polled I/O Connection, i. e. a conventional Master/Slave relationship between a controller and a DeviceNet device.

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.

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 e. g. 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.

S

SDO

see Chapter 2 "Short description of CANopen", Page 2-4.

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