Leuze

Original operating instructions

BPS 338i

Bar Code Positioning System

The Sensor People

We reserve the right to make technical changes
EN • 2020-11-26 • 50141265

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1 About this document

1.1 Used symbols and signal words

Tab. 1.1: Warning symbols and signal words

	Symbol indicating dangers to persons
	Symbol indicating dangers from harmful laser radiation
	Symbol indicating possible property damage
NOTE	Signal word for property damage Indicates dangers that may result in property damage if the measures for danger avoidance are not followed.
CAUTION	Signal word for minor injuries Indicates dangers that may result in minor injury if the measures for danger avoidance are not followed.
WARNING	Signal word for serious injury Indicates dangers that may result in severe or fatal injury if the measures for danger avoidance are not followed.

Tab. 1.2: Other symbols

	Symbol for tips Text passages with this symbol provide you with further information.
	Symbol for action steps Text passages with this symbol instruct you to perform actions.
	Symbol for action results Text passages with this symbol describe the result of the preceding action.

Tab. 1.3: Terms and abbreviations

ASCII	American Standard Code for Information Interchange
BCB	Bar code tape
BPS	Bar code Positioning System
CAT	Control Automation Technology
CFR	Code of Federal Regulations
CoE	CANopen over EtherCAT
DC	Distributed Clock
DCP	Discovery and Configuration Protocol
EMC	Electromagnetic compatibility
EN	European standard
ESI	EtherCAT Slave Information
EoE	Ethernet over EtherCAT
ETG	EtherCAT Technology Group
FE	Functional earth

GUI	Graphical User Interface
HEX	Hexadecimal
IO or I/O	Input/Output
I&M	Information & Maintenance
IP	Internet Protocol
LED	Light Emitting Diode
MAC	Media Access Control
MVS	Type of control bar code
MV0	Type of control bar code
NEC	National Electric Code
NTM	Network management
OSI	Open Systems Interconnection model
PC	Parameter Copy
PDO	Process Data Object
PELV	Protective Extra-Low Voltage
PR	Parameter Request
PS	Parameter Status
PT	Parameter Transfer
RAM	Random Access Memory
RT	Real Time
SDO	Service Data Object
PLC	Programmable Logic Control Programmable Logic Control
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
USB	Universal Serial Bus
UL	Underwriters Laboratories
UV	Ultraviolet
XML	Extensible Markup Language

2 Safety

This sensor was developed, manufactured and tested in line with the applicable safety standards. It corresponds to the state of the art.

2.1 Intended use

The device is an optical measuring system which uses visible red laser light of laser class 1 to determine its position relative to a permanently mounted bar code tape.

All accuracy details for the BPS 300 measurement system refer to the position relative to the permanently mounted bar code tape.

	CAUTION
	**Use only approved bar code tapes!** The bar code tapes approved by Leuze and listed on the Leuze website as accessories are an essential part of the measurement system. Bar code tapes not approved by Leuze are not allowed. The use of such bar code tapes is contrary to the intended use.

Areas of application

The BPS is designed for positioning in the following areas of application:

- Electrical monorail system
- Travel and lifting axes of high-bay storage devices
- Repositioning units
- Gantry crane bridges and their trolleys
- Elevators

	CAUTION
	**Observe intended use!** The protection of personnel and the device cannot be guaranteed if the device is operated in a manner not complying with its intended use. ↳ Only operate the device in accordance with its intended use. ↳ Leuze electronic GmbH + Co. KG is not liable for damages caused by improper use. ↳ Read these operating instructions before commissioning the device. Knowledge of the operating instructions is an element of proper use.

	NOTICE
	**Comply with conditions and regulations!** ↳ Observe the locally applicable legal regulations and the rules of the employer's liability insurance association.

2.2 Foreseeable misuse

Any use other than that defined under "Intended use" or which goes beyond that use is considered improper use.

In particular, use of the device is not permitted in the following cases:

- in rooms with explosive atmospheres
- for medical purposes
- as own safety component in accordance with the machinery directive

	NOTICE
	Use as safety-related component within the safety function is possible, if the component combination is designed correspondingly by the machine manufacturer.

NOTICE
Do not modify or otherwise interfere with the device! ↳ Do not carry out modifications or otherwise interfere with the device. The device must not be tampered with and must not be changed in any way. ↳ The use of a bar code tape not approved by Leuze is equivalent to an intervention in or change to the device/measurement system. ↳ The device must not be opened. There are no user-serviceable parts inside. ↳ Repairs must only be performed by Leuze electronic GmbH + Co. KG.

2.3 Competent persons

Connection, mounting, commissioning and adjustment of the device must only be carried out by competent persons.

Prerequisites for competent persons:

- They have a suitable technical education.
- They are familiar with the rules and regulations for occupational safety and safety at work.
- They are familiar with the operating instructions for the device.
- They have been instructed by the responsible person on the mounting and operation of the device.

Certified electricians

Electrical work must be carried out by a certified electrician.

Due to their technical training, knowledge and experience as well as their familiarity with relevant standards and regulations, certified electricians are able to perform work on electrical systems and independently detect possible dangers.

In Germany, certified electricians must fulfill the requirements of accident-prevention regulations DGUV (German Social Accident Insurance) provision 3 (e.g. electrician foreman). In other countries, there are respective regulations that must be observed.

2.4 Disclaimer

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- The device is not being used properly.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Changes (e.g., constructional) are made to the device.

2.5 Laser warning notices

⚠ ATTENTION
LASER RADIATION – CLASS 1 LASER PRODUCT The device satisfies the requirements of IEC/EN 60825-1:2014 safety regulations for a product of **laser class 1** and complies with 21 CFR 1040.10 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019. CAUTION: Opening the device can lead to dangerous exposure to radiation. ↳ Observe the applicable statutory and local laser protection regulations. ↳ The device must not be tampered with and must not be changed in any way. There are no user-serviceable parts inside the device. Repairs must only be performed by Leuze electronic GmbH + Co. KG.

3 Device description

3.1 Device overview

3.1.1 General information

The BPS bar code positioning system uses visible red laser light to determine its position and its speed value relative to a bar code tape that is affixed along the travel path. This takes place in the following steps:

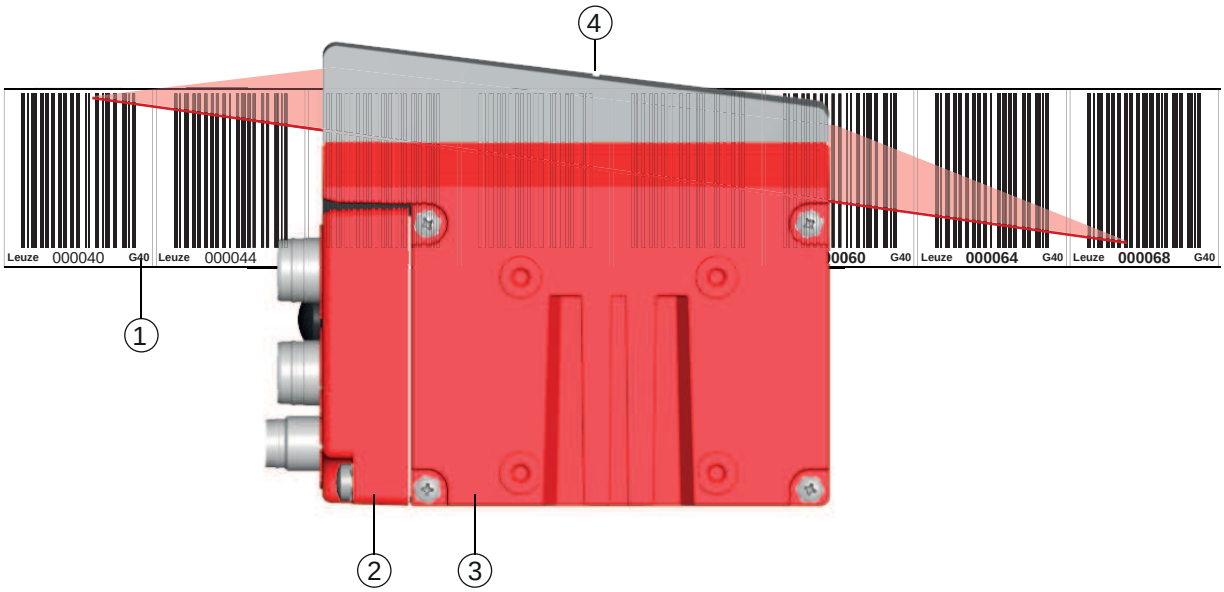
- Read a code on the bar code tape (see following figure)
- Determine the position of the read code in the scanning beam
- Calculate the position to within less than a millimeter using the code information and the code position relative to the device's center.

The position and speed values are then output to the controller via the host interface.

The BPS consists of device housing and interface connection hood for the connection to the control. The BPS can optionally be delivered with display and optics heating.

The following connection hoods are available for the connection of the EtherCAT interface:

- MS 338 connection hood with M12 connectors
- MK 338 connection hood with spring-cage terminals
- ME 338 103 connection hood with cables with M12 connector



1 Bar code tape
2 Connection hood
3 Device housing
4 Middle of the scanning beam (device middle, output position value)

Fig. 3.1: Device construction, device arrangement and beam exit

3.1.2 Performance characteristics

The most important performance characteristics of the bar code positioning system:

- Positioning with submillimeter accuracy from 0 to 10,000 m
- For the control at high traverse rates of up to 10 m/s
- Simultaneous position and speed measurement
- Working range: 50 to 170 mm; enables flexible mounting positions
- Interfaces: Ethernet
- Binary inputs and outputs for control and process monitoring
- Configuration via webConfig tool or EtherCAT service data objects (SDOs)
- Diagnosis via webConfig tool or optional display

- Optional model with display
- Optional model with heating for use to -35 °C

3.1.3 Accessories

Special accessories are available for the bar code positioning system. The accessories are optimally matched to the BPS:

- Highly flexible, scratch-, smudge- and UV-resistant bar code tape
- Mounting devices for precise mounting with one screw (easy-mount)
- Modular connection technology via connection hoods with M12 connectors, spring-cage terminals or with cables

3.1.4 Device model with heating

The bar code positioning system is optionally available as a model with integrated heating. In this case, heating is permanently installed ex works.

	NOTICE
	**No self-installation of the heating!** ↳ Self-installation of the heating on-site by the user is not possible.

The heating consists of two parts:

- Front cover heater
- Housing heater

Features of the integrated heating:

- Extends the application range of the BPS to -35 °C
- Supply voltage 18 … 30 V DC
- BPS release through an internal temperature switch (start-up delay of about 30 min for 24 V DC and minimum ambient temperature of -35 °C)
- Required conductor cross-section for the power supply: At least 0.75 mm^2

	NOTICE
	**Do not use ready-made cables!** ↳ It is not possible to use ready-made cables. The current consumption of the BPS is too high for the ready-made cables.

Function

When the supply voltage is applied to the BPS, a temperature switch initially only supplies the heating with current (front cover heater and housing heater). During the heating phase (around 30 min), when the inside temperature rises above 15 °C, the temperature switch connects the BPS to the supply voltage. This is followed by the self test and the changeover to read operation. The PWR LED lights up, showing overall readiness for operation.

When the inside temperature reaches approx. 18 °C, another temperature switch turns the housing heater off and, if necessary, back on again (if the inside temperature drops below 15 °C). This does not interrupt the read operation.

The front cover heater remains activated until an inside temperature of 25 °C is reached. At temperatures above this, the front cover heater switches off and, with a switching hysteresis of 3 °C, back on again at an inside temperature below 22 °C.

3.2 Connection technology

For the electrical connection of the BPS, the following connection variants are available:

- MS 338 connection hood with M12 connectors
- MK 338 connection hood with spring-cage terminals
- ME 338 103 connection hood with cables with M12 connector

The voltage supply (18 … 30 VDC) is connected acc. to the connection type selected.

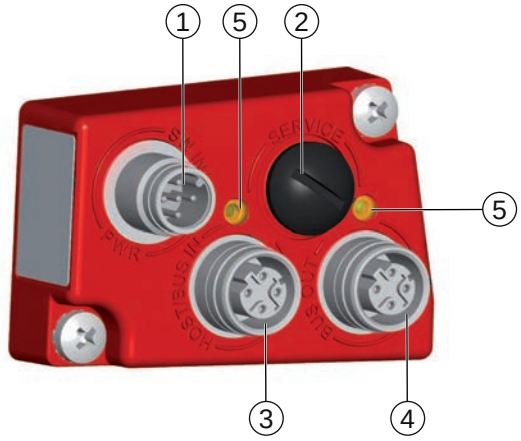
Two freely programmable switching inputs/switching outputs for individual adaptation to the respective application are also available here.

3.2.1 MS 338 connection hood with M12 connectors

The MS 338 connection hood features three M12 connector plugs and a Mini-B type USB socket as a service interface for configuration and diagnosis of the BPS.

NOTICE
The integrated parameter memory for the simple replacement of the BPS is located in the connection hood. In the integrated parameter memory, the settings of the BPS and the network address are stored temporarily. Upon device exchange, they are automatically transmitted to the new device.

NOTICE
Network interruption with EtherCAT in a linear topology! ↳ In the event of a device exchange, the EtherCAT network is interrupted at this location. ↳ The EtherCAT network is interrupted if the BPS is unplugged from the connection hood. ↳ If there is no voltage supply for the BPS, the EtherCAT network is interrupted.



1 PWR / SW IN/OUT: M12 plug (A-coded)
2 SERVICE: Mini-B USB socket (behind protective cap)
3 HOST / BUS IN: M12 socket (D-coded), EtherCAT IN
4 BUS OUT: M12 socket (D-coded), EtherCAT OUT
5 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 3.2: MS 338 connection hood, connections

NOTICE
Shielding connection ↳ The shielding connection is done via the M12 connector housing.

3.2.2 MK 338 connection hood with spring-cage terminals

The MK 338 connection hood makes it possible to connect the BPS directly and without additional connectors.

- The MK 338 features three cable bushings in which the shielding connection for the interface cable is also located.
- A Mini-B type USB socket is used for service purposes and for configuration and diagnostic of the BPS.

NOTICE

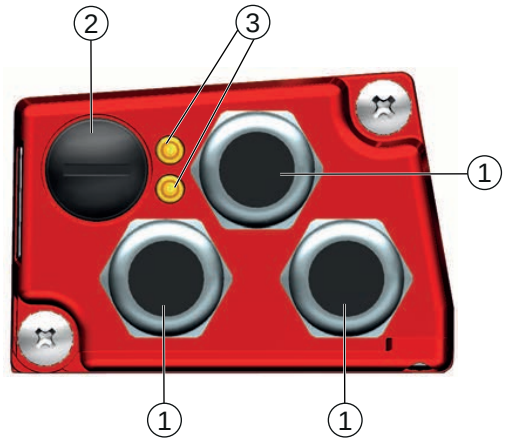
The integrated parameter memory for the simple replacement of the BPS is located in the connection hood.

In the integrated parameter memory, the settings of the BPS and the network address are stored temporarily. Upon device exchange, they are automatically transmitted to the new device.

NOTICE

Network interruption with EtherCAT in a linear topology!

- In the event of a device exchange, the EtherCAT network is interrupted at this location.
- The EtherCAT network is interrupted if the BPS is unplugged from the connection hood.
- If there is no voltage supply for the BPS, the EtherCAT network is interrupted.



1 3x cable bushing, M16 x 1.5
- PWR / SW IN/OUT
- HOST / BUS IN: EtherCAT IN
- BUS OUT: EtherCAT OUT

2 SERVICE: Mini-B USB socket (behind protective cap)

3 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 3.3: Connection hood MK 338, connections

Cable fabrication and shielding connection

- Remove approx. 78 mm of the connection cable sheathing. 15 mm of sheath of the shielded line must be freely accessible.
- Lead the individual wires into the terminals according to the diagram.

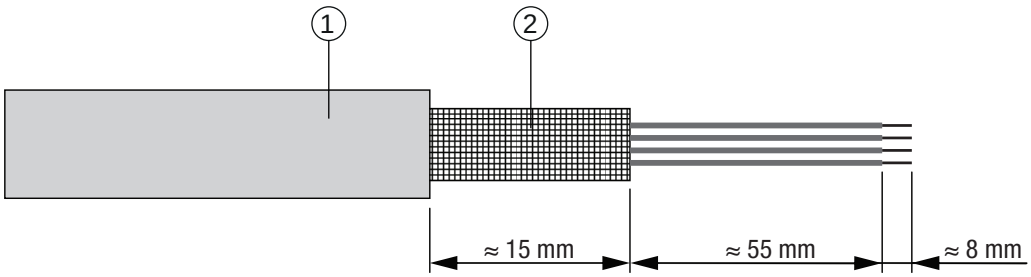
NOTICE

Do not use wire-end sleeves!

- When fabricating cables, we recommend against using wire-end sleeves.

NOTICE

The shield is automatically contacted when the cable is lead into the metal screw fitting and fastened when the cord grip is closed.



1 Diameter of contact area, cable: 6 … 9.5 mm
2 Diameter of contact area, shield: 5 … 9.5 mm

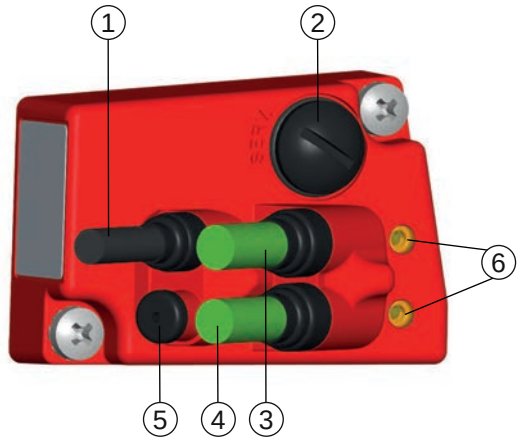
Fig. 3.4: Cable fabrication for connection hoods with spring-cage terminals

3.2.3 ME 338 103 connection hood with cables with M12 connector

The ME 338 103 connection hood features three connection cables with M12 connector plugs and a Mini-B type USB socket as a service interface for configuration and diagnostics of the BPS.

	NOTICE
	The integrated parameter memory for the simple replacement of the BPS is located in the connection hood. In the integrated parameter memory, the settings of the BPS and the network address are stored temporarily. Upon device exchange, they are automatically transmitted to the new device.

	NOTICE
	Network interruption with EtherCAT in a linear topology! ↳ In the event of a device exchange, the EtherCAT network is interrupted at this location. ↳ The EtherCAT network is interrupted if the BPS is unplugged from the connection hood. ↳ If there is no voltage supply for the BPS, the EtherCAT network is interrupted.



1 PWR / SW IN/OUT: Connection cable with M12 plug (A-coded)
2 SERVICE: Mini-B USB socket (behind protective cap)
3 BUS OUT: Connection cable with M12 socket (D-coded), EtherCAT OUT
4 HOST / BUS IN: Connection cable with M12 socket (D-coded), EtherCAT IN
5 Protection cap (no connection)
6 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 3.5: ME 338 103 connection hood, connections

3.3 Display elements

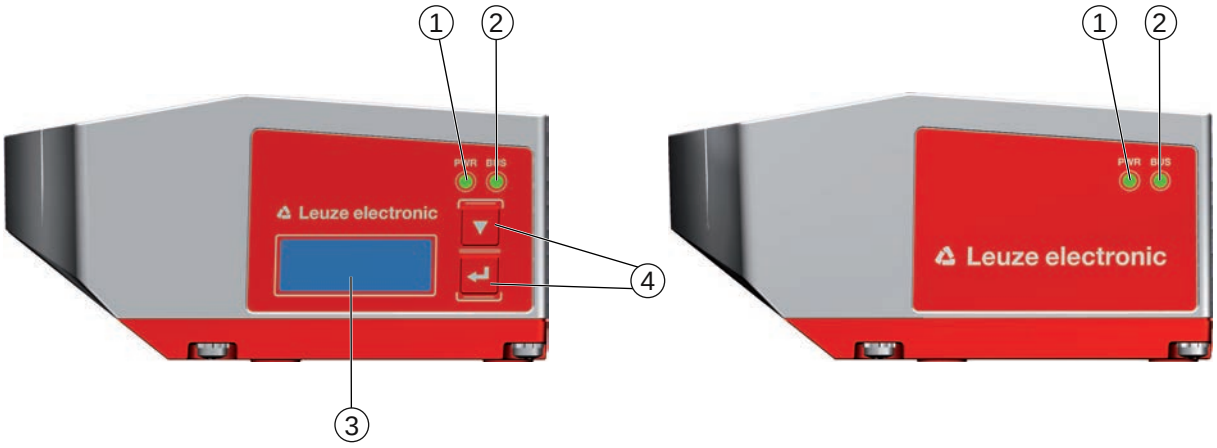
The BPS is available optionally with display, two control buttons and LEDs or with only two LEDs as indicators on the device housing.

Located in the connection hood (MS 338, MK 338 or ME 338 103) are two, split, two-colored LEDs as status display for EtherCAT connections EtherCAT IN (HOST / BUS IN) and EtherCAT OUT (BUS OUT).

3.3.1 LED indicators

The device housing features the following multicolor LED indicators as primary display element:

- PWR
- BUS



1 PWR LED
2 BUS LED
3 Display
4 Control buttons

Fig. 3.6: Indicators on the device housing

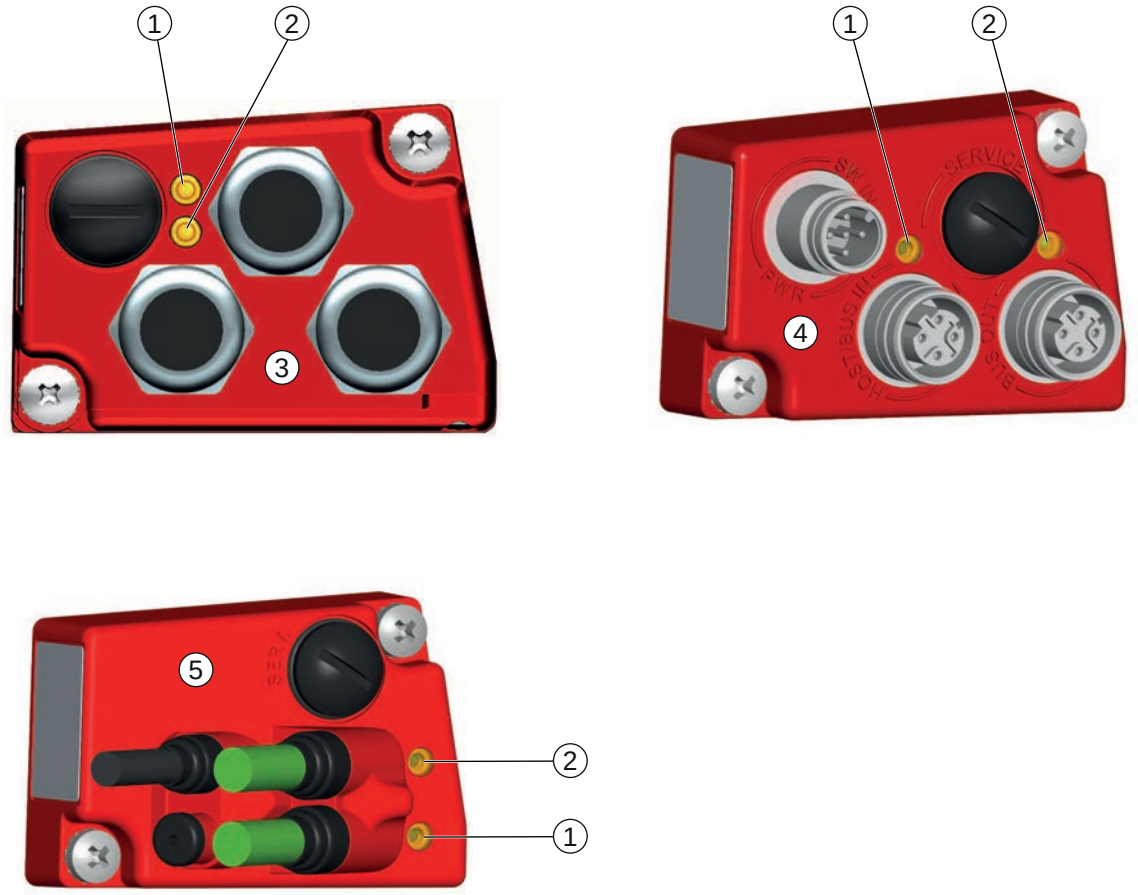
Tab. 3.1: Meaning of the LED indicators on the device housing

LED	Color, state	Description
PWR LED	Off	Device is switched off • No supply voltage
	Green, flashing	Device is being initialized • Supply voltage connected • Initialization running • No measurement value output
	Green, continuous light	Device in operation • Initialization finished • Measurement value output
	Red, flashing	Warning set • No measurement (e.g. no bar code tape)
	Red, continuous light	Device error • Device function is limited • Details via event log (see chapter 10.1.1 "Diagnosis with webConfig tool")
	Orange, continuous light	Service active • No data on the host interface • Configuration via USB service interface

LED	Color, state	Description
BUS LED	Off	No supply voltage EtherCAT communication not initialized or inactive
	Green, steady flashing	Device status: PRE-OPERATIONAL
	Green, flashing (once)	Device status: SAFE-OPERATIONAL
	Green, continuous light	Device status: OPERATIONAL
	Red, steady flashing	Faulty configuration Device status: PRE-OPERATIONAL
	Red, flashing (once)	Local error, e.g., synchronization error
	Red, flashing (twice)	Timeout • Process Data Watchdog Timeout • EtherCAT Watchdog Timeout • Sync Manager Watchdog Timeout
	Red, continuous light	Bus error, no communication established to master

LED indicators on the connection hood

Located in the connection hood are two split, two-colored LEDs as status display for the EtherCAT connections.



1 ACT0/LINK0: EtherCAT IN
2 ACT1/LINK1: EtherCAT OUT
3 MK 338 connection hood
4 MS 338 connection hood
5 ME 338 connection hood

Fig. 3.7: LED indicators on the connection hoods

Tab. 3.2: Meaning of the LED indicators on the connection hood

LED	Color, state	Description
ACT0/LINK0	Green, continuous light	Ethernet connected (LINK)
	Yellow, flickering light	Data communication (ACT)
ACT1/LINK1	Green, continuous light	Ethernet connected (LINK)
	Yellow, flickering light	Data communication (ACT)

3.3.2 Display indicators

The optional display of the BPS is only used as a display element. The display has the following features:

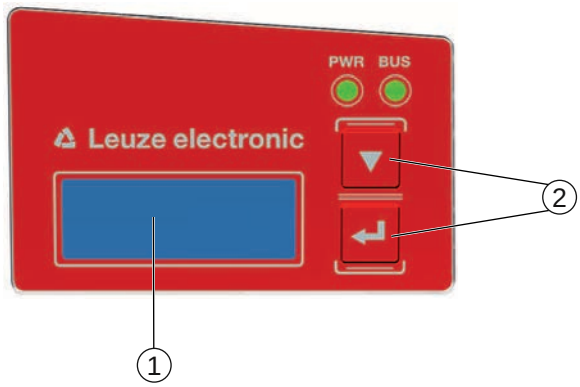
- Monochromatic with white background lighting
- Double line, 128 x 32 pixels
- Display language: English

Two control buttons can be used to control which values appear in the display.

The background lighting is activated by pressing any control button and is automatically deactivated after ten minutes have passed.

The display shows the content on two lines:

- The upper display line shows the selected function as an English term.
- The lower display line shows the data of the selected function.



1 Display
2 Control buttons

Fig. 3.8: Display on the device housing

Display functions

Display	Display function
`Position Value` `+34598.7 mm`	1st line: *position value* display function 2nd line: position value in mm (decimal delimiter ".")
`Quality` `84 %`	1st line: *reading quality* display function 2nd line: reading quality in percent (e.g. 0 … 100%)
`BPS Info` `System OK`	1st line: *device status* display function 2nd line: device status – System OK / Warning / Error
`I/O status` `IO1 IN:0 / IO2 OUT:0`	1st line: *I/O status* display function (status of the inputs/outputs) 2nd line: In/Out depending on configuration, 0/1 for state of the input/output
`BPS Address` `0`	1st line: BPS network address 2nd line: second station address
`Version` `SW: V1.7.0 HW:1`	1st line: *version information* display function 2nd line: software and hardware version of the device

NOTICE

Laser activation by selecting *Quality*!

↳ If the position measurement has stopped and the laser thereby switched, the laser is switched on and the position measurement started by activating *Quality*.

The display is controlled via the control buttons:

- ↵ – **Enter**: activate or deactivate the display shift function
- ▼ – **Down**: scroll through functions (downwards)

Example: Representation of the I/O status on the display

1. Press button ↵ : Display flashes
2. Press button ▼ : Display changes from position value (*Position Value*) to reading quality (*Quality*)
3. Press button ▼ : Display changes from reading quality (*Quality*) to device status (*BPS Info*)
4. Press button ▼ : Display changes from device status (*BPS Info*) to *I/O Status*
5. Press button ↵ : *I/O Status* displayed, display stops flashing

Display during device start-up

During device start-up, a start-up display first appears which is briefly followed by the display with the version information.

The standard display after starting up the BPS is *Position Value*.

3.4 Bar code tape

3.4.1 General information

The bar code tape is available in different variants:

- BCB G40 … bar code tape with 40 mm grid
  Code128 with character set C, increasing in increments of 4 (e.g., 000004, 000008, …)
- BCB G30 … bar code tape with 30 mm grid
  Code128 with character set C, increasing in increments of 3 (e.g. 000003, 000006, …)

A bar code tape consists of a sequence of individual position labels in one of the two grids. Defined cut marks are provided for cutting the BCB.

The BCB is delivered on a roll. A roll contains up to 300 m of BCB, with the wrapping direction from the outside to the inside (smallest number on the outside). If more than 300 m of BCB is ordered, the total length is divided into rolls of max. 300 m.

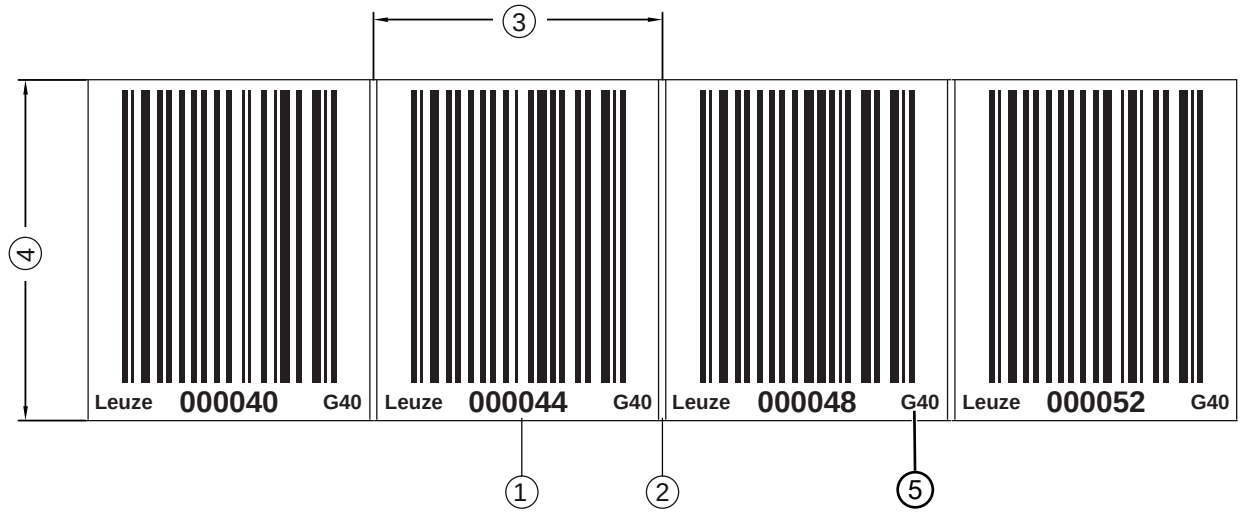
Standard bar code tapes in fixed length increments as well as special bar code tapes with custom tape start value, tape end value, custom length and height can be found on the Leuze website in the accessories for the BPS 300 devices.

An entry wizard is available for special bar code tapes on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

	NOTICE
	**Only one BCB type per system!** ↳ In a given system, use either only BCB G30 … with 30 mm grid or only BCB G40 … with 40 mm grid. If different BCB G30 … or BCB G40 … models are used in one system, the BPS cannot ensure an exact position determination.

	NOTICE
	**Configure the BPS for the used BCB type!** ↳ The used BCB type must be set in the webConfig tool with the *Tape selection* parameter; see chapter 9.3.4 "CONFIGURATION function". ↳ On delivery, the BPS is set for BCB G40 … with a 40 mm grid. If the BCB G30 … with a 30 mm grid is used, the *Tape selection* must be adjusted in the BPS configuration. ↳ If the used BCB type does not correspond to the *Tape selection* configured in the BPS, exact position determination cannot be performed by the BPS.

BCB G40 … bar code tape with 40 mm grid



1 Position label with position value
2 Cut mark
3 Grid dimension = 40 mm
4 Height
Standard heights: 47 mm and 25 mm
5 G40 = designation in plain-text for 40 mm grid

Fig. 3.9: BCB G40 … bar code tape with 40 mm grid

NOTICE

Standard BCB G40 … bar code tapes are available in various length increments in the following heights:

- 47 mm
- 25 mm

Special BCB G40 … bar code tapes are available in mm height increments between 20 and 140 mm.

An entry wizard is available for special bar code tapes on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

BCB G30 … bar code tape with 30 mm grid

1 Position label with position value
2 Cut mark
3 G30 = designation in plain-text for 30 mm grid

Fig. 3.10: BCB G30 … bar code tape with 30 mm grid

NOTICE

Standard BCB G30 … bar code tapes are available in various length increments in the following heights:

- 47 mm
- 25 mm

Special BCB G30 … bar code tapes are available in mm height increments between 20 and 140 mm.

An entry wizard is available for special bar code tapes on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

3.4.2 Control bar codes

With the help of control bar codes that are affixed on top of the bar code tape at appropriate positions, functions in the BPS can be activated or deactivated, e.g., for changing various position values at switches.

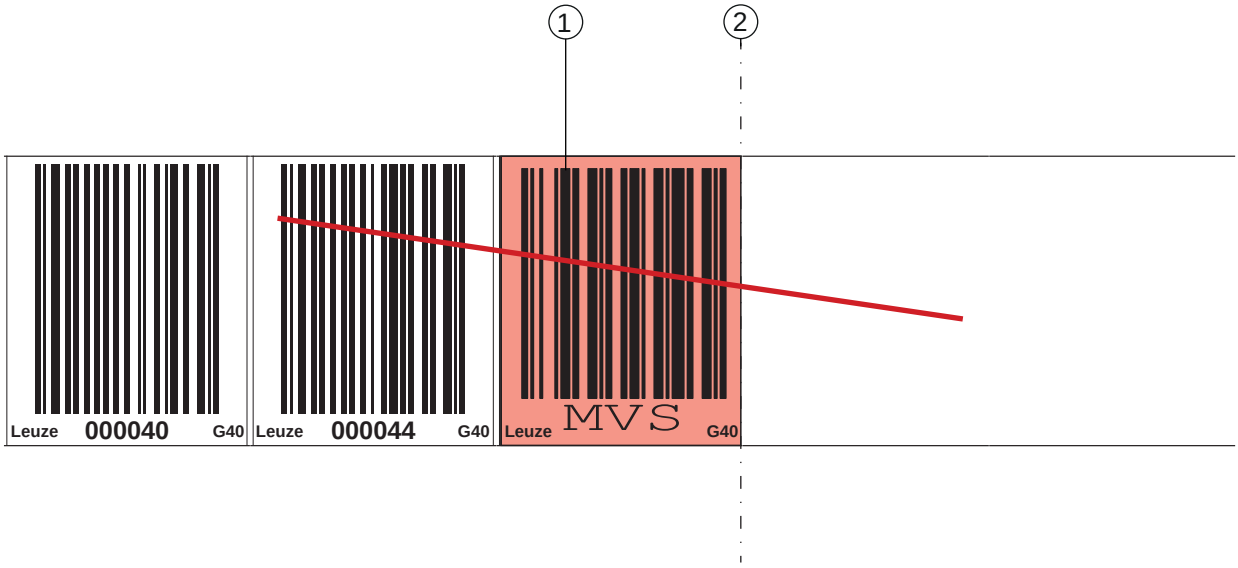
Code type Code128 with character set B is used for the control bar code.

MVS label

Designation: BCB G40 … MVS or BCB G30 … MVS

The *MVS* label is a control bar code for the direction-independent switching of the position values from one bar code tape to another in the middle of the control bar code label.

If, upon reaching the changeover position in the middle of the *MVS* label, the BPS does not detect the new BCB section in the scanning beam, the position value of the first BCB section is still output after the middle of the *MVS* label for half of the label width.



1 Control bar code
2 Deactivation of the position determination at the end of the MVS label

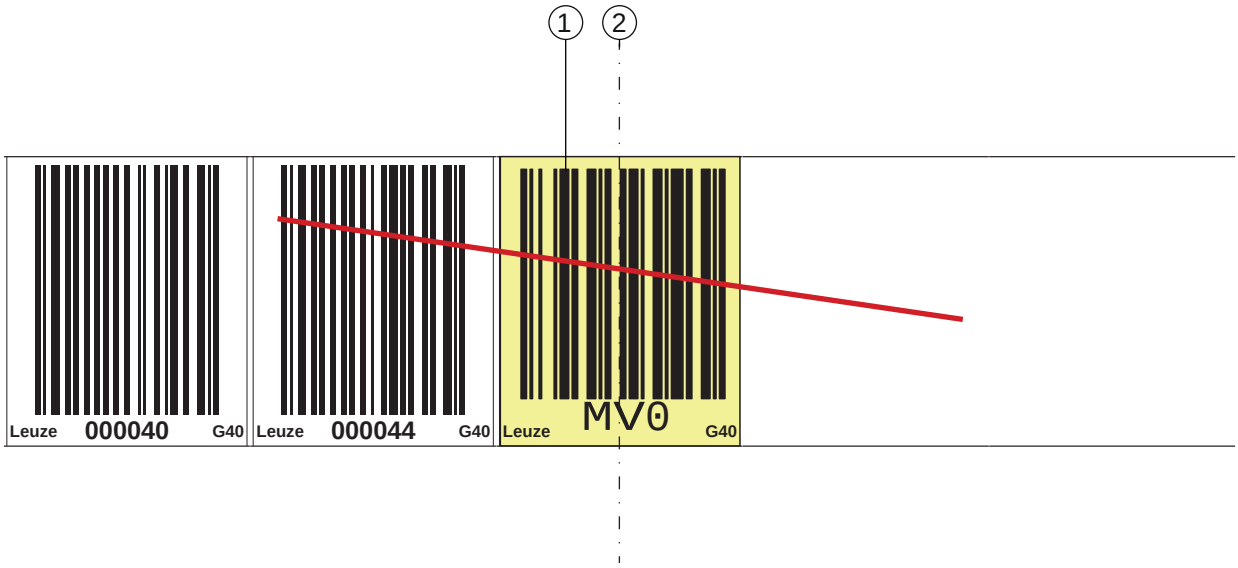
Fig. 3.11: Arrangement of the MVS control bar code

MV0 label

Designation: BCB G40 … MV0 or BCB G30 … MV0

The *MV0* label is a control bar code for the direction-independent switching of the position values from one bar code tape to another in the middle of the control bar code label.

If, upon reaching the changeover position in the middle of the *MV0* label, the BPS does not detect the new BCB section in the scanning beam, no position is output after the middle of the *MV0* label for.



1 Control bar code
2 Deactivation of position determination from the middle of the control bar code

Fig. 3.12: Arrangement of the MV0 control bar code

Arrangement of the control bar codes

The control bar code is attached in such a way that it replaces one position bar code or seamlessly connects two bar code tapes with different value ranges to one another.

A position label does not need to follow immediately after the MVS or MV0 control bar code. For an uninterrupted measurement value determination, a gap less than or equal to one label width (40 mm) may be present between the control bar code and the subsequent position label.

NOTICE

Distance between two control bar codes!

↳ Make certain that there is only one control bar code (or marker label) in the scanning beam at a time.
The minimum distance between two control bar codes is determined by the distance between the BPS and bar code tape and the resulting length of the scanning beam.

The control bar codes are simply affixed over the existing bar code tape.

A control bar code should cover an entire position bar code and must have the correct grid dimension:

- 30 mm with BCB G30 … bar code tapes
- 40 mm with BCB G40 … bar code tapes

NOTICE

↳ Keep the gap between the BCBs that are switched between as small as possible.

1 Control bar code perfectly affixed on the bar code tape
2 Control bar code at small gap between two bar code tapes

Fig. 3.13: Correct positioning of the control bar code

NOTICE

Gaps in bar code tape!

- Avoid polished and high-gloss surfaces.
- Keep the gaps between the two bar code tapes and the control bar code as small as possible.

Measurement value switching between two bar code tapes with different value ranges

The *MVS* or *MV0* control bar code is used to switch between two bar code tapes.

NOTICE

1 m difference in the bar code position values for correct measurement value switching!

- For different BCB value ranges, make certain that the position value has a value distance of minimum 1 m between the preceding position bar code (before the control bar code) and the subsequent position bar code (after the control bar code).
  If the minimum distance between the bar code values is not maintained, position determination may be faulty.
- ⇨ Example (BCB with 40 mm grid): If the last position bar code on the BCB before the control bar code is *75120*, the following position bar code on the BCB after the control bar code must be at least *75220*.

- The end of the preceding bar code tape and the start of the subsequent bar code tape can end and begin, respectively, with completely different position bar codes.
- Position value changeover by means of a control bar code always occurs at the same position, i.e., it serves to change from the preceding tape to the subsequent tape and vice versa.
- If the center of the BPS reaches the transition point of the control bar code, the device switches to the second BCB, provided the next position label is in the BPS's scanning beam.

  The output position value is thereby always uniquely assigned to one BCB.

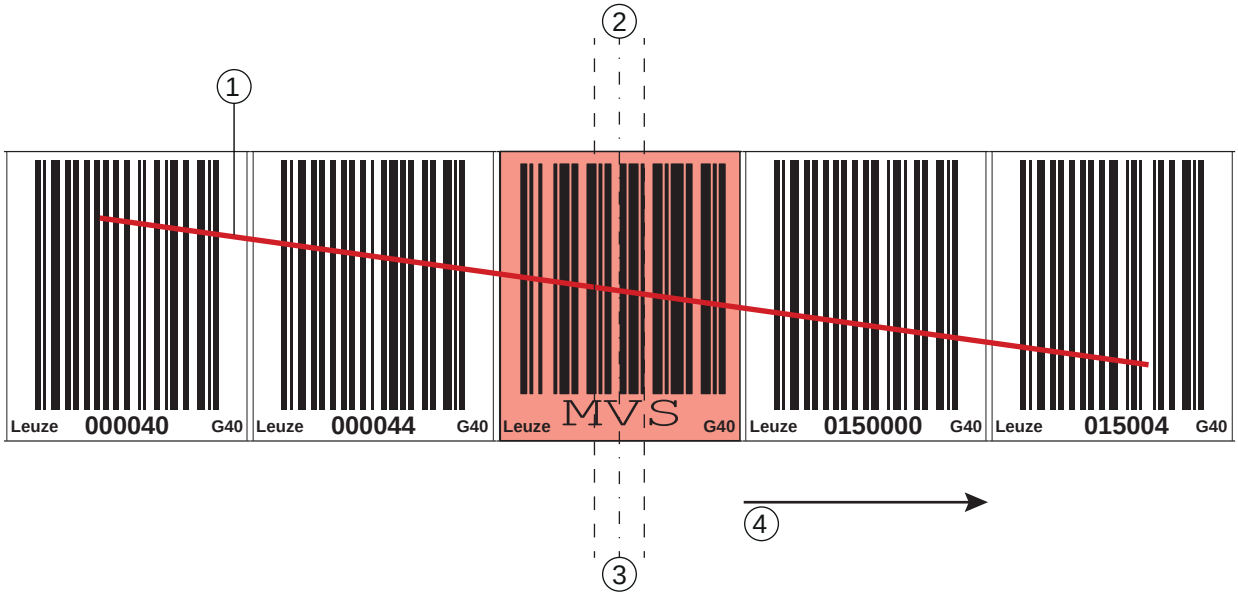
NOTICE

If the BPS does not detect the new BCB section upon reaching the changeover position, the position-value output is dependent on the used control bar code.

MVS control bar code: The position value of the first BCB is output beyond the middle of the *MVS* label for half of the label width.

MV0 control bar code: No position values are output after the middle of the *MV0* label.

- When the control label is passed, the new BCB value is output relative to the middle of the device or label.



1 Scanning beam
2 Control bar code center
3 Middle of the BPS
4 Direction of movement

Fig. 3.14: Changeover position with *MVS* control bar code for BCB changeover

3.4.3 Marker labels

Designation: BCB G30 … ML … or BCB G40 … ML …

Marker labels, which are affixed at the appropriate locations on top of the bar code tape, can be used to trigger various functions in the superior control. The BPS detects the defined marker labels in the scanning beam, decodes them, and makes them available to the control.

NOTICE	
	Distance between two marker labels! ↳ Make certain that there is only one marker label (or control bar code) in the scanning beam at a time. The minimum distance between two marker labels is determined by the distance between the BPS and bar code tape and the resulting length of the scanning beam.

Definition of the marker label

The following combinations of letters and numbers may be used as marker labels:

- AA1
- BB1
- CC1
- DD1
- EE1
- FF1
- GG1

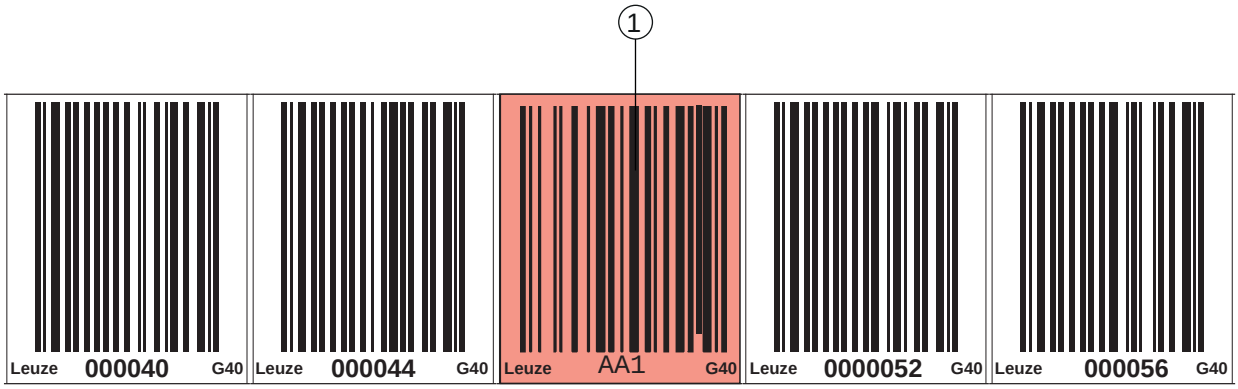
Marker labels are implemented as follows:

- Color red
- Height 47 mm
- in grid dimension 40 mm (BCB G40 … ML)
- in grid dimension 30 mm (BCB G30 … ML)
- Code 128 B

Marker labels are individual labels and are supplied in a packaging unit containing 10 pieces.

Arrangement when using the marker label with positioning

The marker label must be attached to the bar code tape aligned with the grid of the actual coding. A position code should be visible before and after the marker label.



1 Marker labels

Fig. 3.15: System arrangement of marker labels

Arrangement when using the marker label without positioning

The marker label must be positioned within the BPS's detection range.

3.4.4 Twin tapes

Designation: BCB G40 … TWIN … or BCB G30 … TWIN …

Twin tapes are jointly manufactured bar code tapes with the same value range.

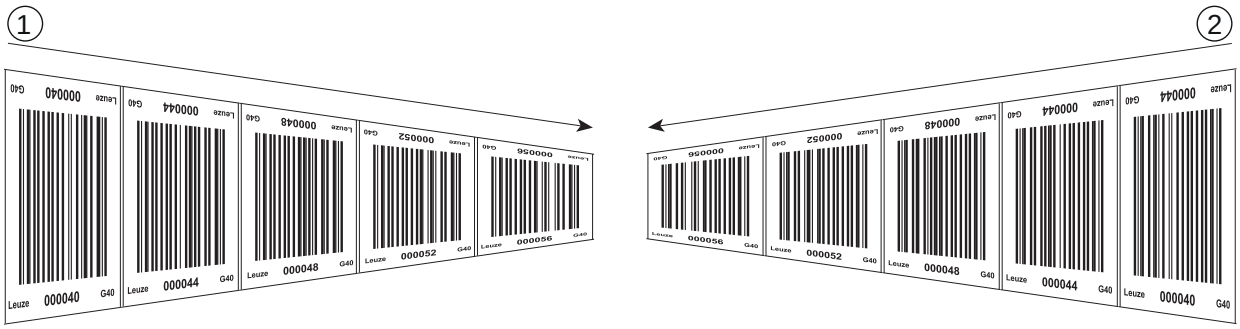
NOTICE

A twin tape always consists of two bar code tapes!

↳ When ordering a twin tape, two bar code tapes are always included with an order.

Twin tapes are used if positioning with two bar code tapes is necessary, e.g., with crane systems or elevators.

Because they are manufactured jointly, both tapes have the same length tolerance. As a result, differences in length and code position are minimal. By having the same code position on both tapes, improved synchronization can be achieved during positioning compared to bar code tapes that are manufactured separately.



1 Twin bar code tape 1
2 Twin bar code tape 2

Fig. 3.16: Twin bar code tape with double numbering

NOTICE

Twin tapes are always delivered in pairs on two rolls.
If twin tapes are replaced, both tapes are to be replaced.
An entry wizard for twin tapes with custom tape start value, tape end value, custom length and height is available on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

4 Functions

This chapter describes the functions of the BPS and the parameters for adaptation to the respective application conditions and requirements.

The parameters are set via the webConfig tool (see chapter 9 "Starting up the device – webConfig tool") or via the Service Data Objects (SDOs) (see chapter 8.6 "Object index").

Main functions:

- Position measurement
- Speed measurement

The following parameters are relevant for the time behavior of the position and speed measurement:

- Measurement value preparation

  Configurable response time
- Measurement error tolerance

  Configurable time-based error suppression

4.1 Position measurement

The output value of the position measurement is calculated from the measurement and the settings for resolution, preset, offset, etc.

The most important individual parameters for the position measurement are:

Parameter	Description	Range/Values
Position resolution	The parameter specifies the resolution of the position value. It acts only on the host interface. The resolution has no effect on the set parameter values such as offset or preset.	0.01 mm 0.1 mm 1 mm 10 mm or Free resolution
Unit	The parameter specifies the measurement unit of the measured position and speed. The selection of the measurement unit affects all parameters with measurement units.	Metric (mm) or Inch (1/100 in)
Offset	The offset is used to correct the position value by a fixed amount. If the offset is activated, the offset is added to the position value. This yields a new output value: Output value = position value + offset	1 mm or inch/100
Preset	Like the offset, the preset is used to correct the position value. With preset, a preset value is specified. The value is accepted during a corresponding event (switching input or fieldbus). If the preset is activated, this has priority over the offset.	1 mm or inch/100

4.2 Speed measurement

The current speed is ascertained and output on the basis of the respective position values.

The most important individual parameters for the speed measurement are:

Parameter	Description	Range/Values
Speed resolution	The parameter defines the resolution of the speed value. It affects only the fieldbus output.	1 mm/s 10 mm/s 100 mm/s or Free resolution
Averaging	The parameter specifies the averaging time of the calculated speed values in steps.	Steps: 1 to 32 ms

4.3 Time behavior

The BPS of the 300i series operate with a scanning rate of 1000 scans per second. A measurement value is ascertained every 1 ms.

The following parameters are relevant for the time behavior of the position and speed measurement:

Parameter	Description	Range/Values
Integration depth	The integration depth affects the measurement of position and speed. The *integration depth* parameter specifies the number of sequential measurements that the BPS uses for position determination. The integration results in smoothing of the output measurement value. With the BPS 300i, an *integration depth* of 8 yields a response time of 8 ms.	Factory setting: 8
Error delay time	Errors that occur are suppressed for the configured time. If no valid position or speed value can be ascertained in the configured *error delay time*, the last valid value is always output. If the error persists after the *error delay time* elapses, the value of the *Position/Speed value in case of error* parameter is then output (standard).	Factory setting: 50 ms

4.4 WebConfig tool

The webConfig configuration tool offers a graphical user interface for the display of process data, configuration and diagnosis of the BPS via a PC; see chapter 9 "Starting up the device – webConfig tool".

4.5 Evaluation of the reading quality

NOTICE
Output of the reading quality The bar code positioning system can diagnose the reading quality from the arrangement of the BPS relative to the bar code tape. ↳ The reading quality is displayed in % values. ↳ In spite of optimum operating conditions, the reading quality may be slightly below 100%. This does not indicate a defect of the BPS or of the bar code tape.

NOTICE
The warning threshold preset ex works for a reading quality < 60% as well as a switch-off threshold for a reading quality < 30% corresponds to Leuze's experience in a typical application. For applications that involve an intentional interruption of the bar code tape (switches, expansion gaps, vertical slopes/descents), the preset limit values can be adapted to the respective application.

The reading quality is dependent on several factors:

- Operation of the BPS in the specified depth of field
- Number of bar codes in the transmitted beam
- Number of bar codes in the reading field
- Soiling of the bar code
- Traverse rate of the BPS (number of bar code symbols within the time window)
- Ambient light incident on the bar code and on the optics (glass exit window) of the BPS

The reading quality is affected, in particular, in the following cases:

- Switches, expansion gaps and other transition points at which the bar code tape is not affixed interruption-free.
- Vertical travel if at least three bar code symbols are not completely in the reading field of the sensor at any given point in time.
- Vertical curve in which the bar code tape was separated at the marked cut marks for adapting to the curve.

NOTICE
If the reading quality is influenced by the factors listed above, the reading quality can be reduced to as low as 0%. ↳ This does not mean that the BPS is defective, but rather that the reading quality characteristics are reduced to as low as 0% in the given arrangement. ↳ If, at a reading quality of 0%, a position value is output, it is correct and valid.

NOTICE
The values of the reading quality are displayed via the optional display (*Quality*), the serial communication protocol and via the webConfig tool (see chapter 9.3.3 "ALIGNMENT function").

The evaluation of the reading quality provides the following information, e.g.:

- The reading quality is constantly bad: Soiling of the BPS optics
- The reading quality is always bad at certain position values: Soiling of the BCB

5 Applications

Wherever systems are moved automatically, it is necessary to uniquely determine their respective positions. In addition to mechanical measuring sensors, optical methods are particularly well suited for position determination as they can be used to determine position without mechanical wear and slippage.

Compared to common optical measurement techniques, the Leuze Bar code Positioning System (BPS) is able to measure a position with absolute sub-millimeter accuracy, i.e. independent of reference points. As a result, it is able to provide a unique position value at any time. With the highly flexible and hard-wearing Bar Code Tape (BCB), the system can even be used without problem in systems with curves or guide tolerances. And this at lengths of up to 10,000 meters.

The product family of Leuze bar code positioning systems convinces with a variety of advantages:

- The laser simultaneously scans three bar codes and, as a result, is able to determine the position with sub-millimeter accuracy. The wide reading field makes accurate position determination possible even in the event of minor damage to the tape.
- With the systems' flexible depth of field, it is also possible to bridge over mechanical deviations.
- Due to the large reading distance combined with the great depth of field, a large opening angle and a very compact construction, the device is ideally suited for the conveyor and storage technology market.
- The BPS devices are capable of simultaneously measuring position and speed and are thus also suitable for control tasks in your automation applications.
- Using a mounting device, the BPS can be mounted with millimeter accuracy with just one screw. If mounted using a mounting device, a new device is automatically aligned correctly should it be necessary to exchange a device (easy-mount).
- The unique encoding of the position value on the bar code tape allows the system to be put back into operation without problem even after a brief voltage drop without, e.g., needing to utilize a reference point.
- The Leuze bar code tape is very robust, highly flexible and, thanks to the self-adhesive back, can be easily integrated into your overall mechanical system. It can be fit optimally to both vertical as well as horizontal curved paths and thereby reliably facilitates trouble-free and reproducible measurement at any point in your system with sub-millimeter accuracy.

Typical applications for the BPS include:

- High-bay storage device (see chapter 5.1 "High-bay storage device")
- Electrical monorail system (see chapter 5.2 "Electrical monorail system")
- Gantry cranes (see chapter 5.3 "Gantry cranes")

5.1 High-bay storage device

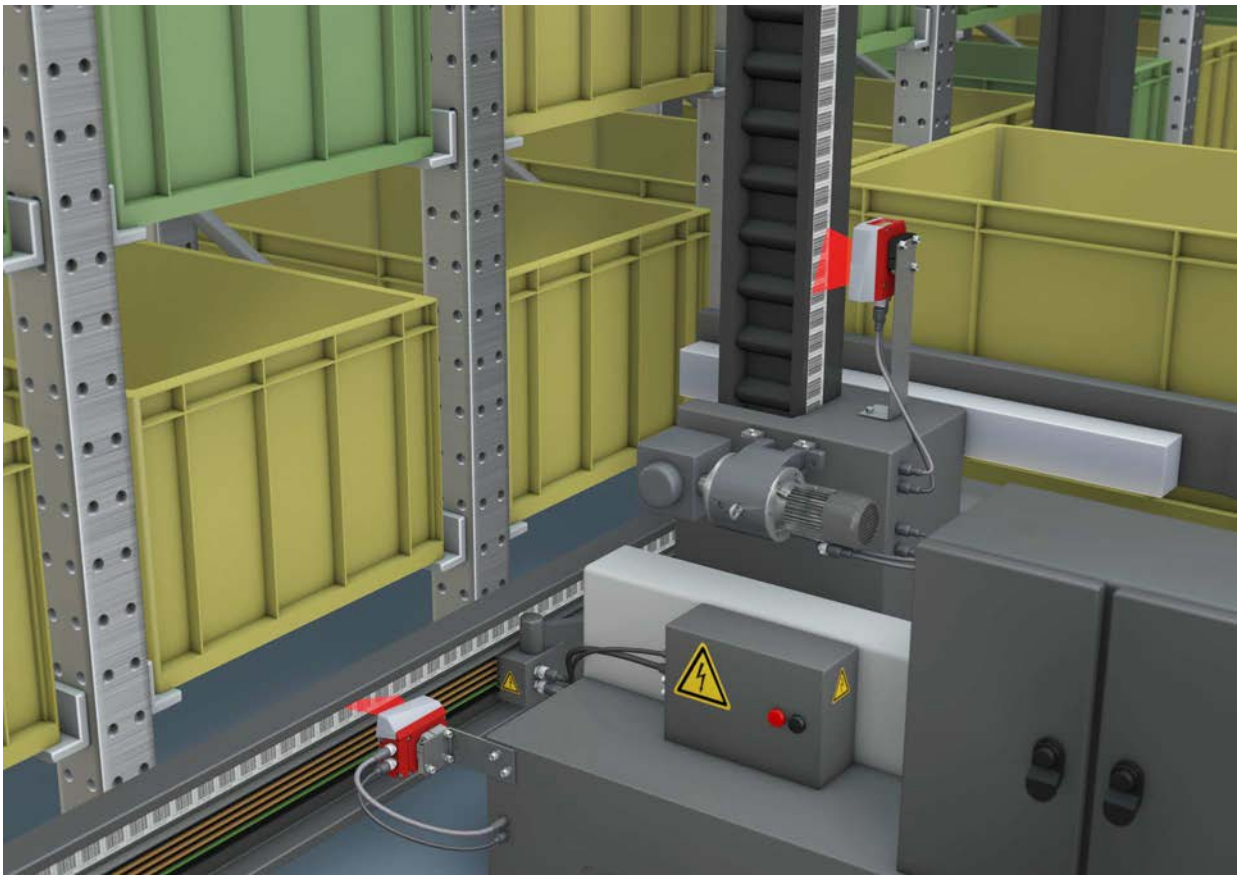


Fig. 5.1: High-bay storage device

- Simultaneous position and speed measurement for regulation tasks
- Precise positioning with a reproducibility of ± 0.15 mm
- Control at high traverse rates of up to 10 m/s

5.2 Electrical monorail system

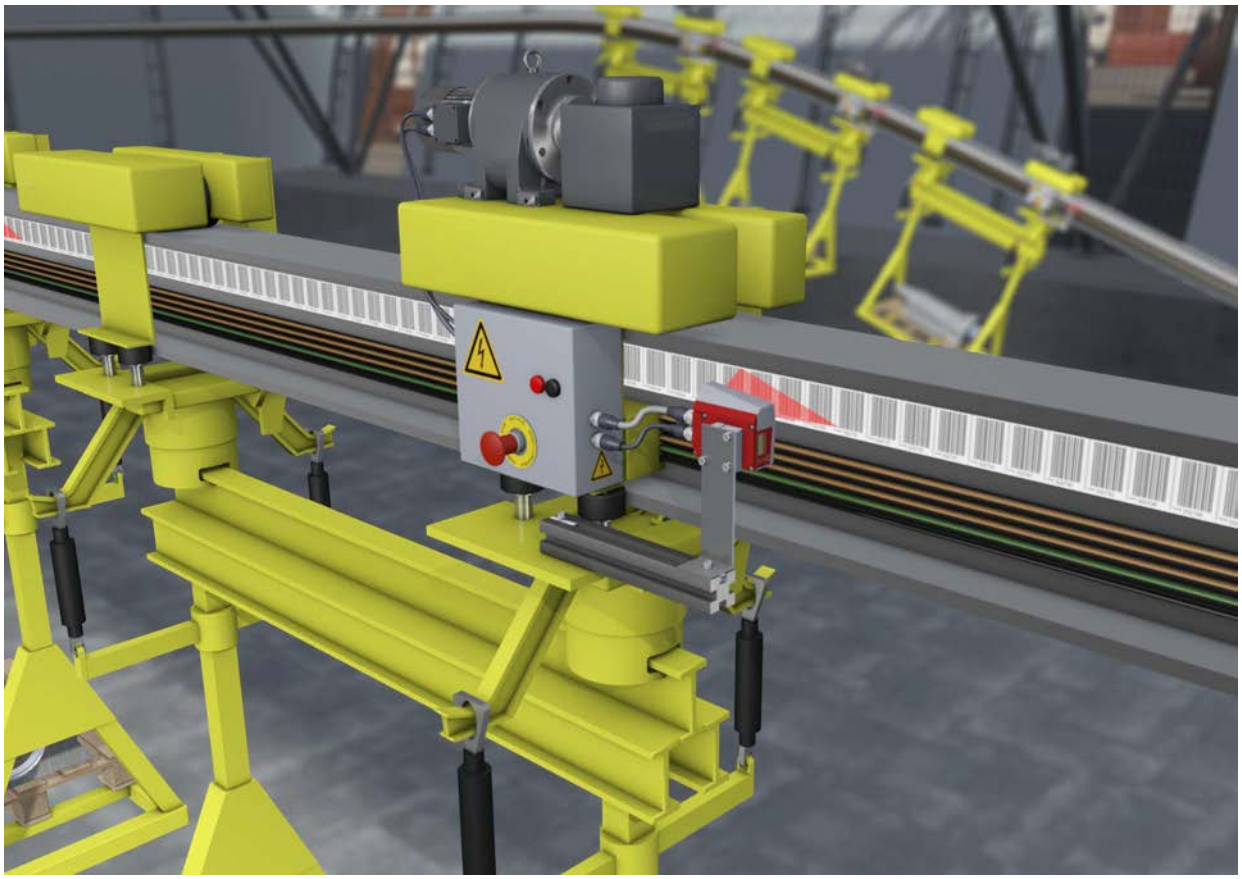


Fig. 5.2: Electrical monorail system

- Positioning from 0 to 10,000 meters
- The working range from 50 - 170 mm allows for mounting positions and reliable position detection at varying distances
- Control codes for changing to different position values at switches

5.3 Gantry cranes

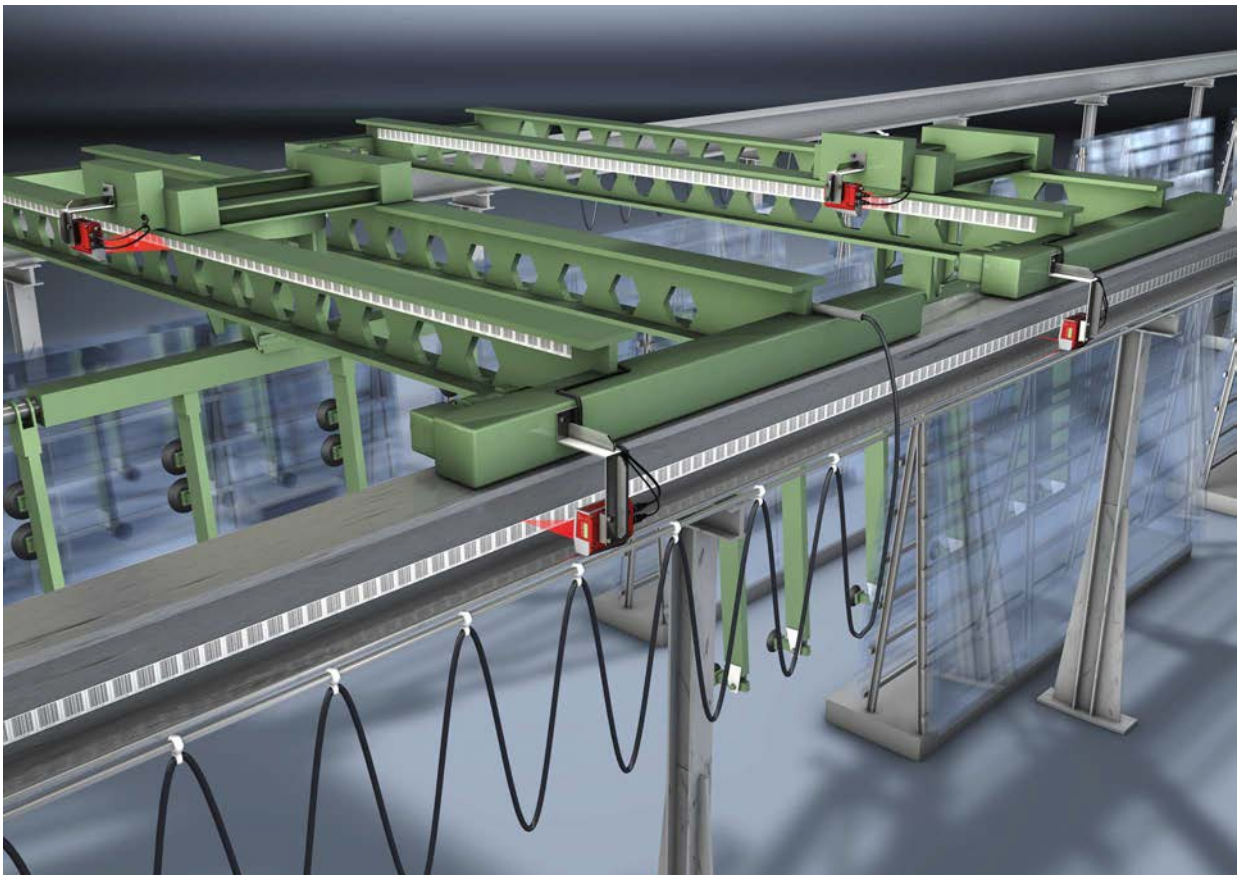


Fig. 5.3: Gantry cranes

- Scratch- and smudge-proof, UV-resistant bar code tapes
- Synchronous positioning with twin tapes on both rails
- Mounting device for fast, precise mounting with one screw

6 Mounting

6.1 Mounting bar code tape

6.1.1 Installation and application remarks

NOTICE

BCB mounting

- When processing BCBs, observe the specified processing temperatures.
  When processing BCBs in cold storage facilities, the BCB must be affixed before cooling the storage facility.
  However, if it should be necessary to affix the BCB at temperatures outside of the specified processing temperature, assure that the bonding surface as well as the BCB are at the processing temperature.
- Avoid dirt deposits on the BCB.
  If possible, affix the BCB vertically.
  If possible, affix the BCB below an overhead covering.
  The BCB must never be continuously cleaned by on-board cleaning devices such as brushes or sponges. Permanent on-board cleaning devices polish the BCB and give it a glossy finish. The reading quality deteriorates as a result.
- After affixing the BCBs, make certain that there are no polished, high-gloss surfaces in the scanning beam (e.g., glossy metal at gaps between the individual BCBs), as the measurement quality of the BPS may be impaired.
  Affix the BCBs to a diffusely reflective support, e.g., a painted surface.
- Avoid sources of extraneous light and reflections on the BCB.
  Ensure that neither strong sources of extraneous light nor reflections of the support on which the BCB is affixed occur in the vicinity of the BPS scanning beam.
- Affix the BCB over expansion joints up to a width of several millimeters.
  The BCB must not be interrupted at this location.
- Cover protruding screw heads with the BCB.
- Ensure that the BCB is affixed without tension.
  The BCB is a plastic tape that can be stretched by strong mechanical tension. Excessive mechanical stretching results in lengthening of the tape and distortion of the position values.

NOTICE

BCB application

- Make certain that the BCB is located in the scanning beam of the BPS over the entire traversing path. The BPS can determine the position on BCBs with arbitrary orientation.
- Bar code tapes with different value ranges may not directly follow one another.
  In the case of different value ranges, a gap of at least 1 m must be maintained between the position value of the last position bar code of the preceding BCB and the first position value of the first position bar code of the subsequent BCB (see chapter 3.4.2 "Control bar codes").
- For *MVS*/*MV0* control bar codes (see chapter 3.4.2 "Control bar codes"), the minimum distance of 1 m between the last position bar code before the control bar code and the first position bar code after the control bar code must be maintained.
- For bar code tapes with different value ranges, both BCBs must correspond to the BCB type configured in the BPS (see chapter 3.4.1 "General information").
- Avoid position bar code labels with the value *00000*.
  Measurements to the left of the center of a *00000* label produce negative position values that may not be displayed correctly.

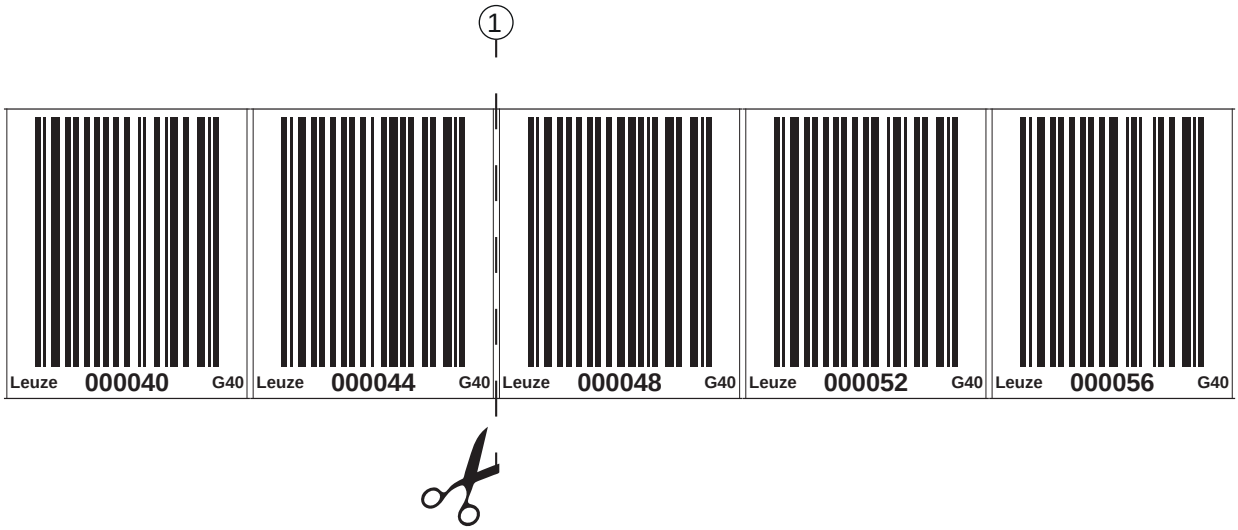
6.1.2 Cutting bar code tapes

NOTICE

Avoid cutting BCB!

- If possible, avoid cutting bar code tapes.
  Optimum position value determination by the BPS is achieved with continuously affixed BCB.
- If there are mechanical gaps, first affix the BCB continuously. Then cut the BCB.

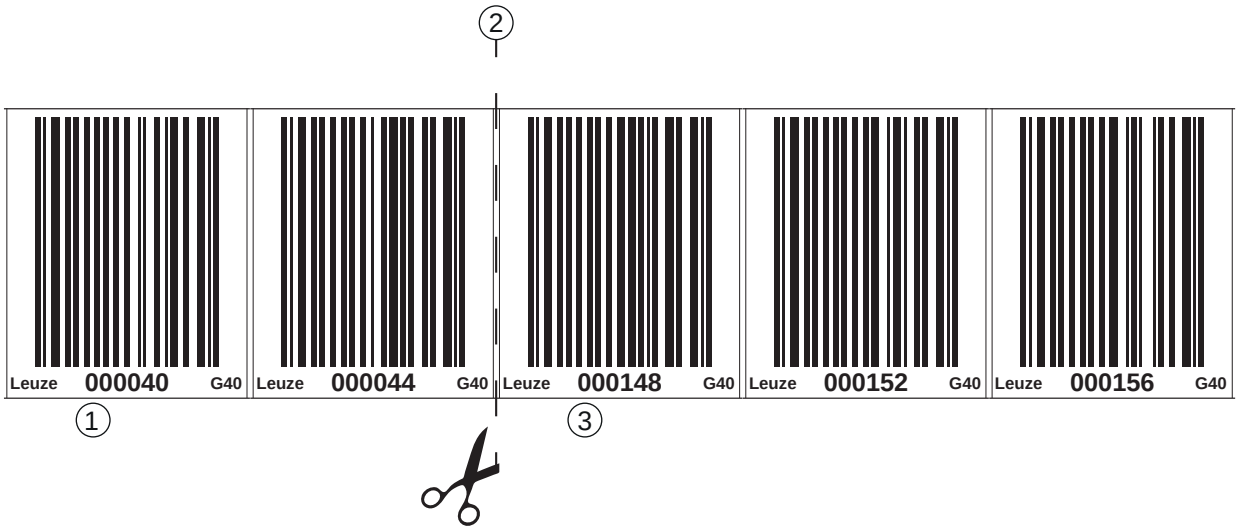
The BCB is cut at the indicated cut marks:



1 Cut mark

Fig. 6.1: Cut mark on the bar code tape

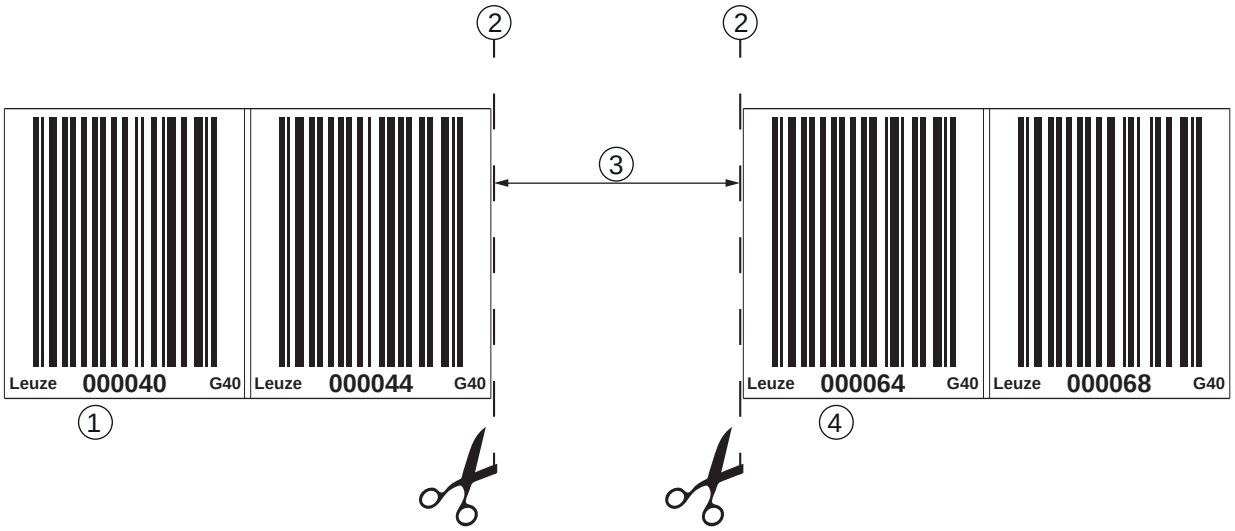
If another BCB is to be affixed directly after the preceding BCB, the subsequent bar code value must differ from the preceding BCB by at least 1 m:



1 Preceding bar code tape
2 Cut mark
3 Subsequent bar code tape, value range + 1 m

Fig. 6.2: Cut bar code tape

If there is a gap without tape after the preceding BCB, it must be at least 300 mm wide before the subsequent BCB is affixed. The first bar code value of the subsequent BCB must differ by at least 20 (200 mm) from the last bar code value of the preceding BCB.



1 Preceding bar code tape
2 Cut mark
3 Gap, at least 300 mm
4 Subsequent bar code tape

Fig. 6.3: Gap in cut bar code tape to avoid double positions

NOTICE

No glossy gaps in the cut bar code tape!

- Ensure that there are matt, bright surfaces behind the gaps in the BCB.
  Polished, reflective, and high-gloss surfaces in the scanning beam may impair the measurement quality of the BPS.

6.1.3 Mounting the BCB

Mount the BCB as follows:

- Check the surface.
  It must be flat, free of grease and dust, and be dry.
- Define a reference edge (e.g., metal edge of the busbar).
- Remove the backing and affix the BCB along the reference edge tension free.
- Secure the bar code tape to the mounting surface by pressing down with the palm of your hand. When affixing, make certain that the BCB is free of folds and creases and that no air pockets form.

NOTICE

When mounting, do not pull on the BCB!

The BCB is a plastic tape that can be stretched by strong mechanical tension.

The stretching results in lengthening of the tape and distortion of the position values on the BCB.

While the BPS can still perform the position calculation in the event of distortions, the absolute measurement accuracy is no longer ensured in this case. If the values are taught using a teach-in process, stretching of the BCB is irrelevant.

NOTICE

If a bar code tape was damaged, e.g., by falling parts, you can download a repair kit for the BCB from the Internet (see chapter 11.2.2 "BCB repair with repair kit").

- Use the bar code tape created with the repair kit only temporarily as an emergency solution.

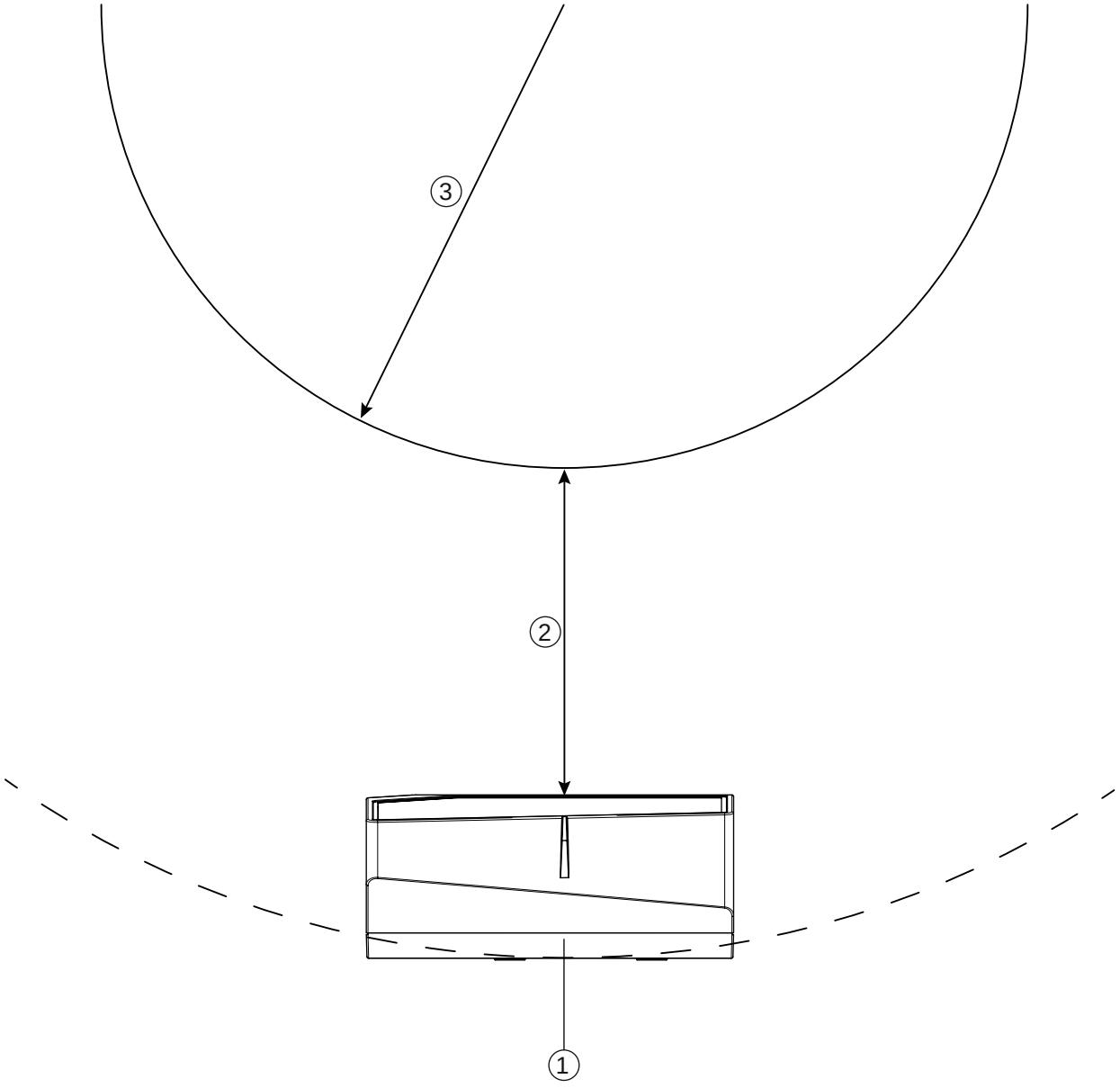
BCB mounting in horizontal curves

NOTICE

Limited absolute measurement accuracy and reproducibility!

BCB mounting in curves reduces the absolute accuracy of the BPS, since the distance between two bar codes is no longer exactly 40 mm or 30 mm due to optical distortions.

- For horizontal curves, maintain a minimum bending radius of 300 mm.



1 BPS
2 Reading distance
3 Radius of the bar code tape, R_{min} = 300 mm

Fig. 6.4: Mounting the bar code tape for use in horizontal curves

BCB mounting in vertical curves

NOTICE

Limited absolute measurement accuracy and reproducibility!

- BCB mounting in curves decreases the absolute measurement accuracy of the BPS, since the distance between two bar codes is no longer exactly 40 mm or 30 mm.
- In areas where the BCB is fanned out around curves, limitations of the reproducibility must be expected.

- Only partially cut the BCB at the cut mark.
- Affix the BCB along the curve like a fan.
- Ensure that the BCB is affixed without mechanical tension.

NOTICE

No glossy gaps in the bar code tape!

- Ensure that there are matt, bright surfaces behind the fanning in the BCB curves. Polished, reflective, and high-gloss surfaces in the scanning beam may impair the measurement quality of the BPS.

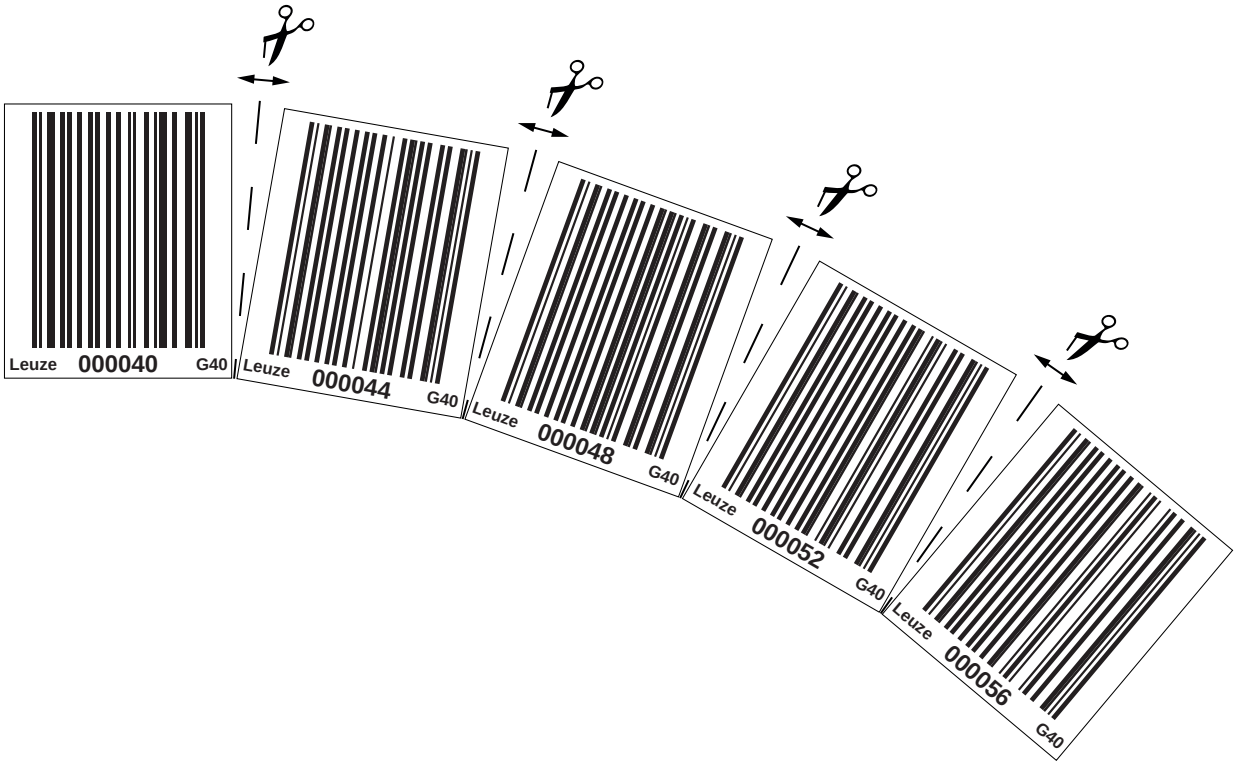
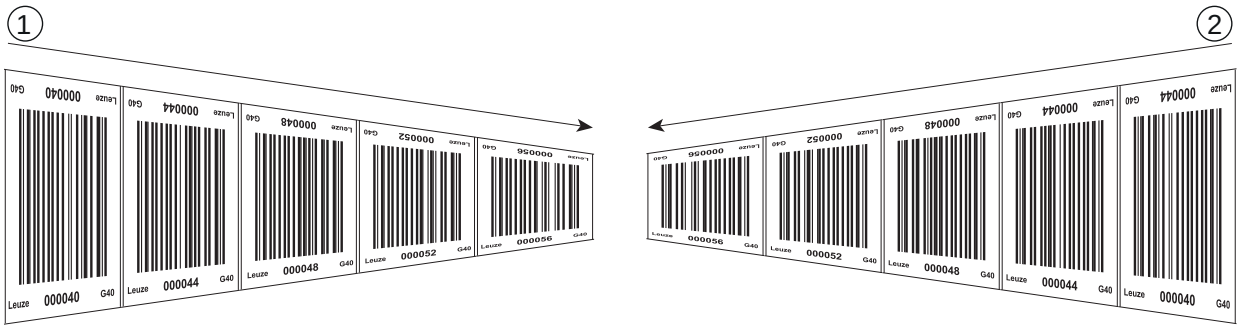


Fig. 6.5: Preparing the bar code tape for use in vertical curves

Mounting twin tapes

If two bar code tapes with the same value range are used for positioning, e.g., for crane systems or elevators, the use of twin tapes is recommended (see chapter 3.4.4 "Twin tapes").

Twin tapes are provided with duplicate numbering. As a result, it is not necessary to affix the BCBs upside down in order to have the same values at the same position.



1 Twin bar code tape 1
2 Twin bar code tape 2

Fig. 6.6: Mounting twin bar code tapes

NOTICE

A twin tape always consists of two bar code tapes.

- When ordering twin tapes, two bar code tapes are always included with an order.
- The two twin bar code tapes have the exact same length tolerances relative to each other.
- Ensure that the BCB is affixed without tension.
  The BCB is a plastic tape that can be stretched by strong mechanical tension. Excessive mechanical stretching results in lengthening of the tape and distortion of the position values.

Mounting two bar code tapes with the same value range

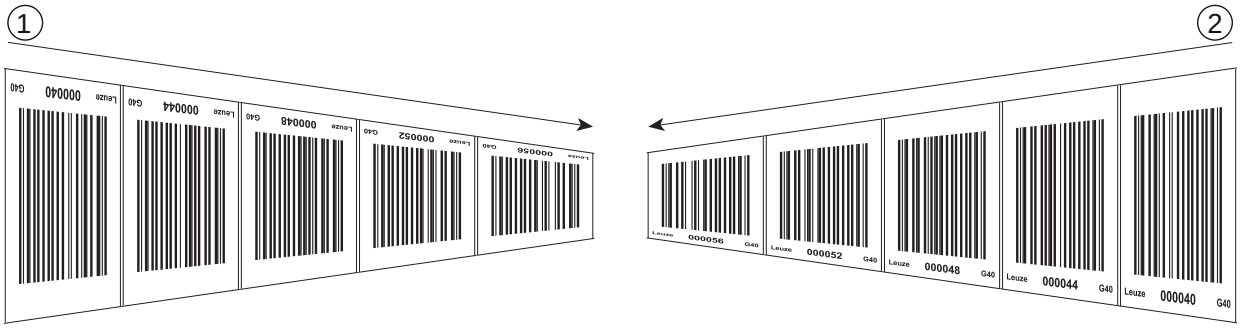
For crane systems or elevators, two bar code tapes with the same value range are used for positioning.

NOTICE

If two bar code tapes with the same value range and the same length tolerances are needed, the use of twin tapes is recommended (see chapter 3.4.4 "Twin tapes").

If a twin tape is not used: To have the same values at the same position, one bar code tape must be affixed with numbers upside down while the other is affixed normally.

If twin bar code tapes are not used, the two bar code tapes may deviate +/- 1 mm per meter relative to one another.



1 BCB affixed upside down
2 BCB affixed normally

Fig. 6.7: Affixing two bar code tapes with the same value range

6.2 Mounting the bar code positioning system

The BPS can be mounted in the following ways:

- Mounting using a mounting device on the fastening grooves
  - BTU 0300M-W: Wall mounting
  - BT 56: Mounting on a rod
- Mounting using a mounting device on the M4 mounting threads on the rear of the device
  - BT 300 W: Mounting on a mounting bracket
  - BT 300-1: Mounting on a rod
- Mounting using four M4 mounting threads on the rear of the device

NOTICE

If the BTU 0300M-W mounting device is used to mount the device, the new device is automatically aligned correctly should it be necessary to exchange a device.

6.2.1 Mounting instructions

NOTICE

Select the mounting location.

- Make certain that the required environmental conditions (humidity, temperature) are maintained.
- Make certain that the distance between BPS and bar code tape is sufficiently large.
  The scanning beam of the BPS should cover three or more bar codes.
  The distance between BPS and bar code tape must be in the working range of the reading field curve.
- Make certain that the exit window does not become soiled, e.g., by leaking liquids, abrasion from cardboard packaging or residues from packaging material.
- Mounting the BPS outdoors or with BPS with integrated heating:
  Mount the BPS in a way which provides maximum thermal isolation, e.g., using rubber-bonded metal.
  Mount the BPS so that it is protected from airflow, e.g., in a protective housing.
- Mounting the BPS in a protective housing:
  When installing the BPS in a protective housing, ensure that the scanning beam can exit the protective housing without obstruction.
- Make certain that the working range determined from the scanning curve is adhered to at all locations where a position determination is to be made.
- Ensure that the scanning beam is always incident on the BCB when the system is moving.
  For the position calculation, the scanning beam of the BPS must be incident on the BCB without interruption.
  For the best functionality, the BPS must be guided parallel to the BCB. It is not permitted to move outside of the approved working range of the BPS (50 … 170 mm) while the system is in motion.
- Make certain that there is only one control bar code (or marker label) in the scanning beam at a time.
  The minimum distance between two control bar codes is determined by the distance between the BPS and bar code tape and the resulting length of the scanning beam.

NOTICE

For parallel mounting, maintain the minimum distance!

- Maintain the minimum distance of 300 mm if you mount two BPS next to or above one another.

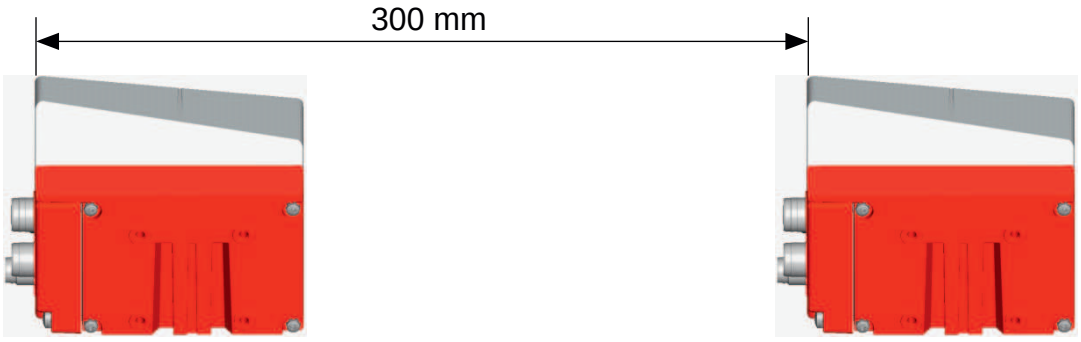


Fig. 6.8: Minimum distance for parallel mounting

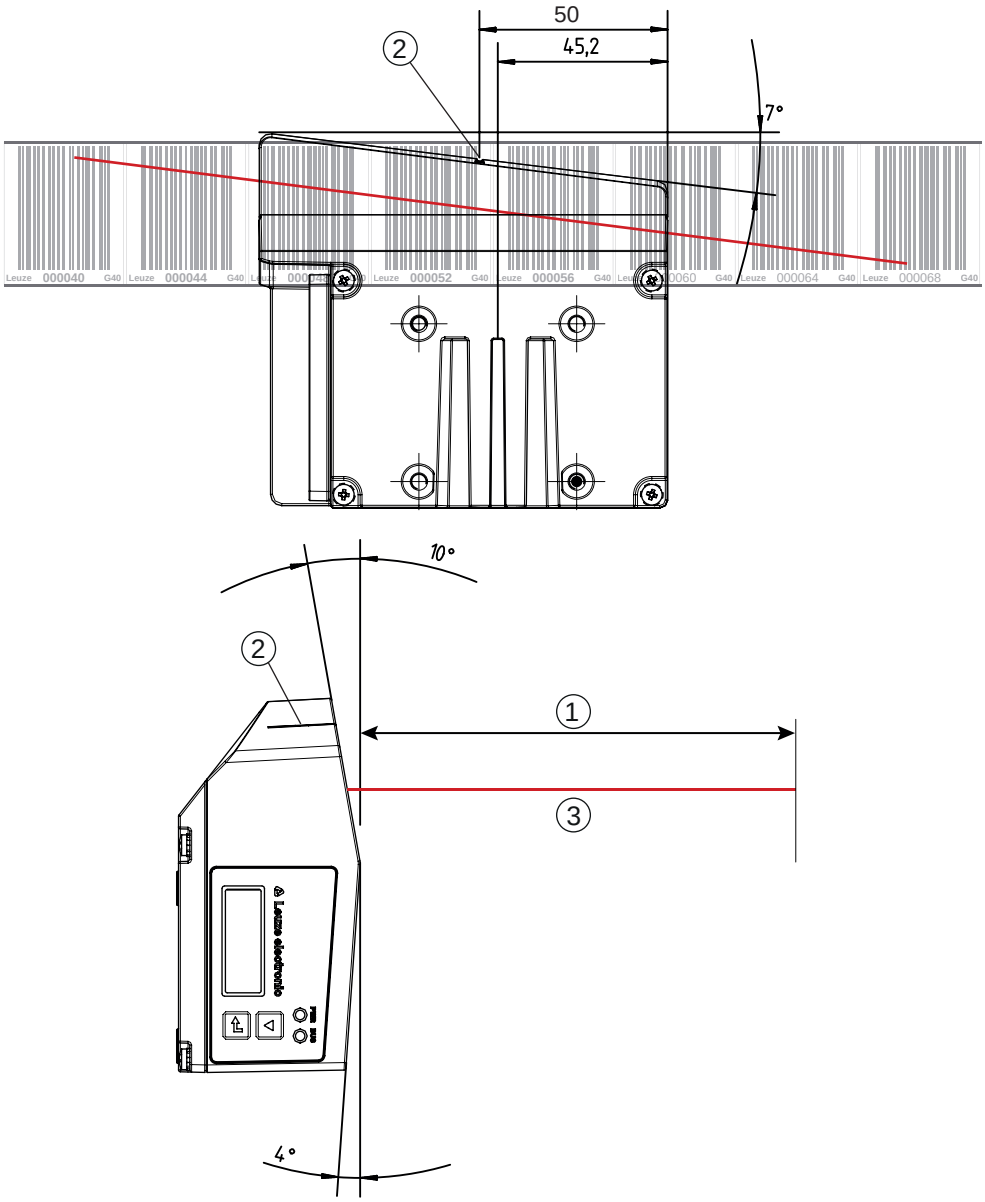
NOTICE

Install the connection hood before mounting the BPS!

- Screw the MS 338, ME 338 or MK 338 connection hood to the device housing with two M4 screws.
- Tighten the screws on the connection hood with a tightening torque of 1.4 Nm.

6.2.2 Orientation of the BPS to the bar code tape

The beam of the BPS must be oriented at an incline of 7° to the bar code tape (see following figure). When positioning, make certain that the angle of radiation to the rear side of the housing is 90 ° and the reading distance to the bar code tape is maintained.



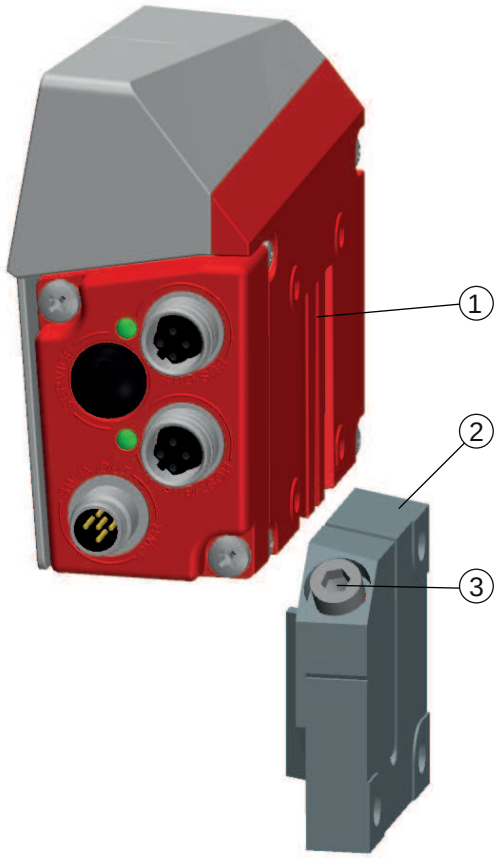
1 Reading distance
2 Reference point for the bar code position
3 Scanning beam

Fig. 6.9: Beam exit

6.2.3 Mounting with the BTU 0300M-W mounting device

Mounting the BPS with a BTU 0300M-W mounting device is intended for wall mounting.

For ordering information see chapter 14 "Order guide and accessories"; for dimensioned drawing see chapter 13.4 "Dimensioned drawings: Accessories".



1 Clamp profile
2 Clamping jaws
3 Screw terminal

Fig. 6.10: Mounting the BPS with the BTU 0300M-W mounting device

- Mount the BTU 0300M-W on the system side with M6 fastening screws (not included in delivery contents).
- Mount the BPS with the dovetail fastening grooves on the clamping jaws of the BTU 0300M-W with limit stop at end.
- Secure the BPS with the M6 screw terminal.
  Maximum tightening torque for the M6 screw terminal: 8 Nm

6.2.4 Mounting with the BT 300 W mounting bracket

Mounting of the BPS with a BT 300 W mounting bracket is intended for wall mounting.

For ordering information see chapter 14 "Order guide and accessories"; for dimensioned drawing see chapter 13.4 "Dimensioned drawings: Accessories".

- Mount the BT 0300 W mounting bracket on the system side with M6 fastening screws (included in delivery contents).
- Mount the BPS on the mounting bracket with M4 fastening screws (included in delivery contents).
  Maximum tightening torque of the M4 fastening screws: 2 Nm

6.2.5 Mounting with BT 56 mounting device

Mounting of the BPS with a BT 56 mounting device is intended for rod mounting.

For ordering information see chapter 14 "Order guide and accessories"; for dimensioned drawing see chapter 13.4 "Dimensioned drawings: Accessories".

- Mount the BT 56 on the rod with the clamp profile (system-side).
- Mount the BPS with its fastening grooves on the clamping jaws of the BT 56 with limit stop at end.
- Secure the BPS with the M6 screw terminal.
  Maximum tightening torque for the M6 screw terminal: 8 Nm

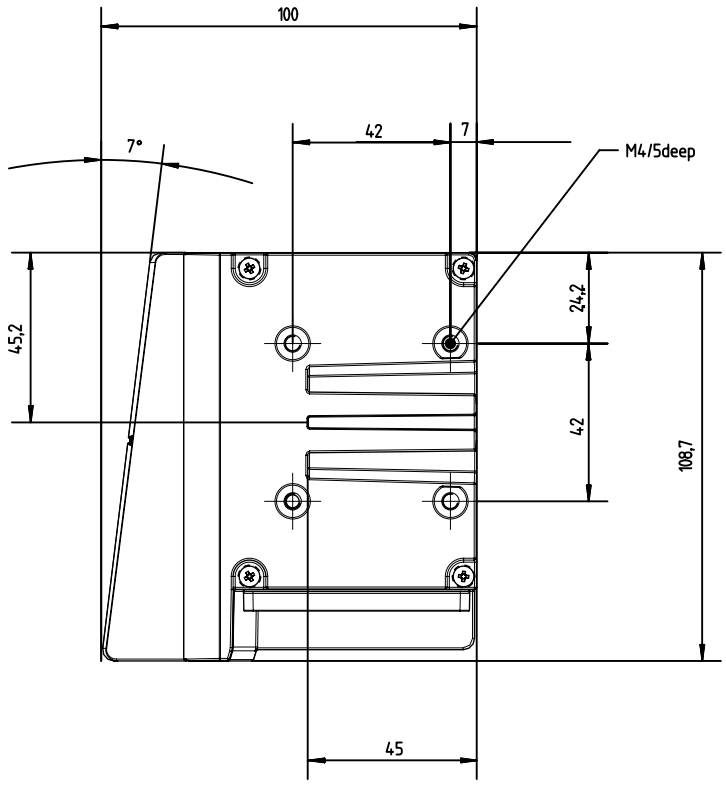
6.2.6 Mounting with BT 300-1 mounting device

Mounting of the BPS with a BT 300-1 mounting device is intended for rod mounting.

For ordering information see chapter 14 "Order guide and accessories"; for dimensioned drawing see chapter 13.4 "Dimensioned drawings: Accessories".

- Mount the BT 300-1 mounting device with the clamp profile on the rod (system-side).
- Mount the BPS on the mounting bracket of the BT 300-1 with M4 fastening screws (included in delivery contents).
  Maximum tightening torque of the M4 fastening screws: 2 Nm

6.2.7 Mounting with M4 fastening screws



all dimensions in mm

Fig. 6.11: Dimensioned drawing of rear of BPS

- Mount the BPS on the system with M4 fastening screws (not included in delivery contents).
  Maximum tightening torque of the fastening screws: 2 Nm

7 Electrical connection

CAUTION

- Before connecting the device, be sure that the supply voltage agrees with the value printed on the name plate.
- Only allow competent persons to perform the electrical connection.
- Ensure that the functional earth (FE) is connected correctly. Fault-free operation is only guaranteed if the functional earth is connected properly.
- If faults cannot be rectified, take the device out of operation. Protect the device from accidentally being started.

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

NOTICE

Protective Extra Low Voltage (PELV)

- The BPS is designed in accordance with protection class III for supply with PELV (protective extra-low voltage).

NOTICE

Connection hood and degree of protection IP 65

- Before connecting, mount the connection hood on the BPS device housing.
- To ensure degree of protection IP 65 is fulfilled, the screws of the connection hood are tightened with a tightening torque of 1.4 Nm for connecting to the BPS.
- Degree of protection IP 65 is not fulfilled until connectors or cable bushings are screwed on and caps are installed.

NOTICE

For all connections (connection cable, interconnection cable, etc.), use only the cables listed in the accessories (see chapter 14 "Order guide and accessories").

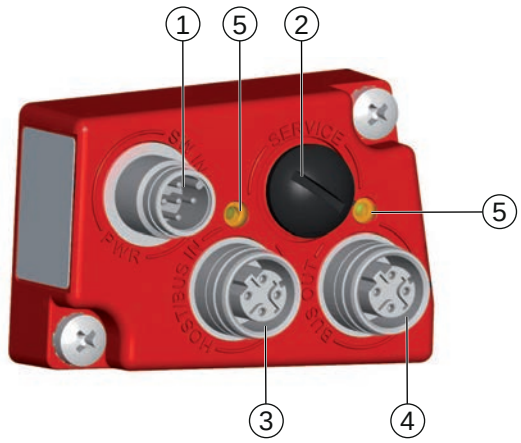
7.1 External parameter memory in the connection hood

A parameter memory is integrated in the MS 338, MK 338 and ME 338 103 connection hoods.

- The settings of the BPS and the network address are stored temporarily in the parameter memory.
- During a BPS device exchange on site, the settings and the network address are automatically transferred to the new BPS.
- The control can immediately access the exchanged BPS.

7.2 MS 338 connection hood with connectors

The MS 338 connection hood features three M12 connector plugs and a Mini-B type USB socket as a service interface.



1 PWR / SW IN/OUT: M12 plug (A-coded)
2 SERVICE: Mini-B USB socket (behind protective cap)
3 HOST / BUS IN: M12 socket (D-coded), EtherCAT IN
4 BUS OUT: M12 socket (D-coded), EtherCAT OUT
5 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 7.1: MS 338 connection hood, connections

NOTICE

Shielding connection and functional earth connection!

- The shielding connection is done via the M12 connector housing.
- Ensure that the functional earth (FE) is connected correctly.
  Unimpaired operation is only guaranteed when the functional earth is connected properly. All electrical disturbances (EMC couplings) are discharged via the functional earth connection.

NOTICE

Network interruption with EtherCAT in a linear topology!

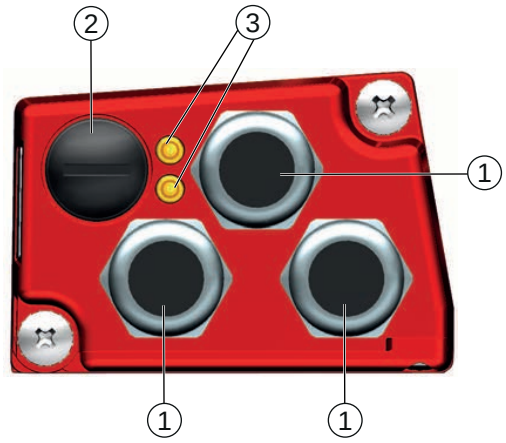
- In the event of a device exchange, the EtherCAT network is interrupted at this location.
- The EtherCAT network is interrupted if the BPS is unplugged from the connection hood.
- If there is no voltage supply for the BPS, the EtherCAT network is interrupted.

- Connect connection PWR / SW IN/OUT to the supply voltage or the switching inputs/outputs connection cable.
- EtherCAT in a linear topology (see chapter 7.6 "EtherCAT topology"): Connect the HOST / BUS IN connection to the BUS OUT connection of the upstream EtherCAT participant with the interconnection cable.
  Connect the BUS OUT connection to the HOST / BUS IN connection of the downstream EtherCAT participant with the interconnection cable. If no continuing EtherCAT participant is present, the connection remains open.

7.3 MK 338 connection hood with spring-cage terminals

With the MK 338 connection hood, the BPS is connected directly and with no additional plug.

- The MK 338 features three cable bushings in which the shielding connection for the interface cable is also located.
- A Mini-B type USB socket is used for service purposes.



1 3x cable bushing, M16 x 1.5
- PWR / SW IN/OUT
- HOST / BUS IN: EtherCAT IN
- BUS OUT: EtherCAT OUT

2 SERVICE: Mini-B USB socket (behind protective cap)

3 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 7.2: Connection hood MK 338, connections

NOTICE

Cable fabrication!

↳ We recommend against using wire-end sleeves.

NOTICE

Functional earth connection!

↳ Ensure that the functional earth (FE) is connected correctly.
Unimpaired operation is only guaranteed when the functional earth is connected properly.
All electrical disturbances (EMC couplings) are discharged via the functional earth connection.

↳ Connect connection PWR / SW IN/OUT to the supply voltage or the switching inputs/outputs connection cable.

↳ EtherCAT in a linear topology (see chapter 7.6 "EtherCAT topology"): Connect the HOST / BUS IN connection to the BUS OUT connection of the upstream EtherCAT participant with the interconnection cable.
Connect the BUS OUT connection to the HOST / BUS IN connection of the downstream EtherCAT participant with the interconnection cable. If no continuing EtherCAT participant is present, the connection remains open.

NOTICE

Network interruption with EtherCAT in a linear topology!

↳ In the event of a device exchange, the EtherCAT network is interrupted at this location.

↳ The EtherCAT network is interrupted if the BPS is unplugged from the connection hood.

↳ If there is no voltage supply for the BPS, the EtherCAT network is interrupted.

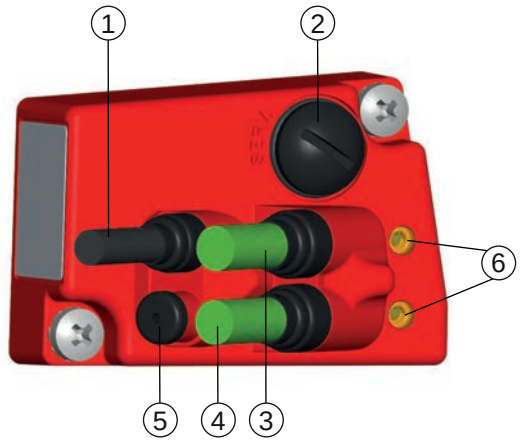
7.4 ME 338 103 connection hood with cables with M12 connector

The ME 338 103 connection hood features three connection cables with M12 connector plugs and a Mini-B type USB socket as a service interface for configuration and diagnostics of the BPS.

NOTICE

The integrated parameter memory for the simple replacement of the BPS is located in the connection hood.

In the integrated parameter memory, the settings of the BPS and the network address are stored temporarily. Upon device exchange, they are automatically transmitted to the new device.



1 PWR / SW IN/OUT: Connection cable with M12 plug (A-coded)
2 SERVICE: Mini-B USB socket (behind protective cap)
3 BUS OUT: Connection cable with M12 socket (D-coded), EtherCAT OUT
4 HOST / BUS IN: Connection cable with M12 socket (D-coded), EtherCAT IN
5 Protection cap (no connection)
6 EtherCAT LEDs (split, two-colored)
- ACT1: EtherCAT OUT
- ACT0: EtherCAT IN

Fig. 7.3: ME 338 103 connection hood, connections

NOTICE

Shielding connection and functional earth connection!

- The shielding connection is done via the M12 connector housing.
- Ensure that the functional earth (FE) is connected correctly.
  Unimpaired operation is only guaranteed when the functional earth is connected properly.
  All electrical disturbances (EMC couplings) are discharged via the functional earth connection.

NOTICE

Network interruption with EtherCAT in a linear topology!

- In the event of a device exchange, the EtherCAT network is interrupted at this location.
- The EtherCAT network is interrupted if the BPS is unplugged from the connection hood.
- If there is no voltage supply for the BPS, the EtherCAT network is interrupted.

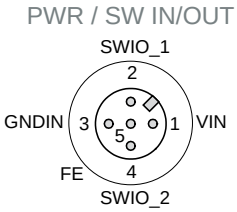
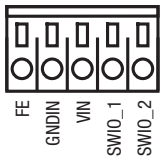
- Connect connection PWR / SW IN/OUT to the supply voltage or the switching inputs/outputs connection cable.
- EtherCAT in a linear topology (see chapter 7.6 "EtherCAT topology"): Connect the HOST / BUS IN connection to the BUS OUT connection of the upstream EtherCAT participant with the interconnection cable.
  Connect the BUS OUT connection to the HOST / BUS IN connection of the downstream EtherCAT participant with the interconnection cable. If no continuing EtherCAT participant is present, the connection remains open.

7.5 Pin assignment

7.5.1 PWR / SW IN/OUT

Power and switching input/output

Tab. 7.1: PWR / SW IN/OUT pin assignment

	Pin	Terminal	Assignment
MS 338 / ME 338 103 5-pin M12 connector (A-coded)  MK 338  	1	VIN	+18 … +30 VDC supply voltage
	2	SWIO1	Sw. input/output 1 (configurable)
	3	GNDIN	Negative supply voltage (0 VDC)
	4	SWIO2	Sw. input/output 2 (configurable)
	5	FE	Functional earth
	Thread	Cable gland	Connection cable shield. The shield of the connection cable is on the thread of the M12 plug or on the screw fitting of the cable bushing. The thread or the screw fitting is part of the metallic housing. The housing is at the potential of the functional earth via pin 5.

Connection cables: see chapter 14 "Order guide and accessories"

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

Switching input/output

The BPS is equipped with two, freely programmable, optically decoupled switching inputs/outputs, SWIO1 and SWIO2.

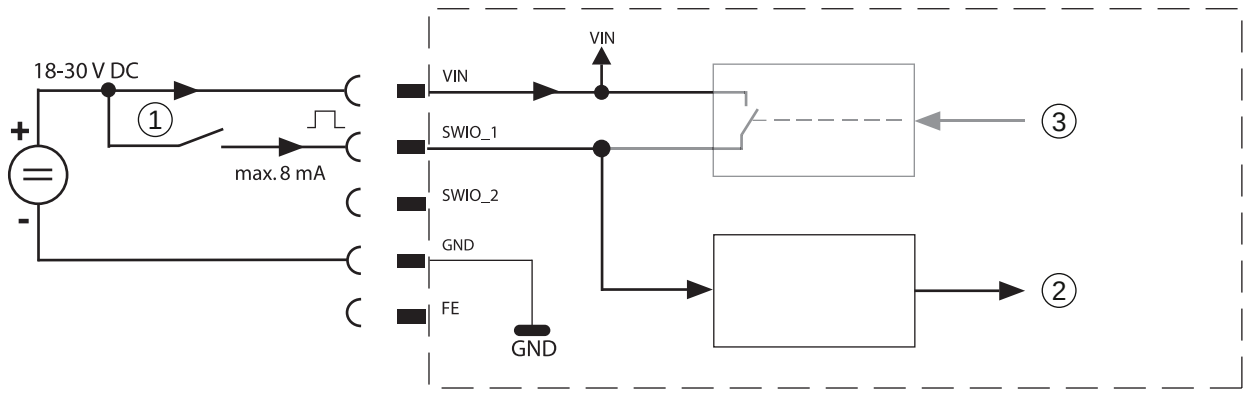
- The switching inputs can be used to activate various internal functions of the BPS (e.g., Measurement Stop/Start, Teach Preset, Reset Preset).
- The switching outputs can be used to signal the state of the BPS and to implement external functions independent of the superior control (e.g. position value/speed value invalid, position and speed limit value exceeded, device error).
- The function as switching input or switching output is set via the webConfig configuration tool (**CONFIGURATION > DEVICE > Switching inputs/outputs**, see chapter 9.3.4 "CONFIGURATION function") or alternatively via the Service Data Objects (SDOs) (see chapter 8.6 "Object index").

NOTICE

The two switching inputs/outputs, SWIO1 and SWIO2, are configured as follows by default:

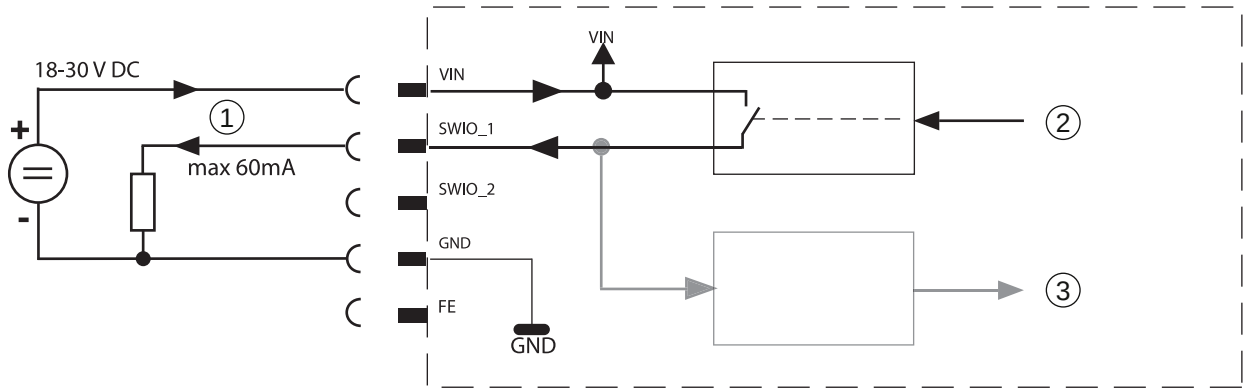
Switching output SWIO1: Position value invalid

Switching input SWIO2: No function



1 Switching input
2 Switching input to controller
3 Switching output from controller (deactivated)

Fig. 7.4: Example: Function as switching input



1 Switching output
2 Switching output from controller
3 Switching input to controller (deactivated)

Fig. 7.5: Example: Function as switching output

NOTICE

Maximum input current!

- The input current of the respective switching input is maximum 8 mA.

NOTICE

Maximum loading of the switching outputs!

- Do not load the respective switching output of the BPS with more than 60 mA at + 18 … 30 VDC in normal operation.
- Each configured switching output is short-circuit proof.

NOTICE

SWIO1 and SWIO2 as switching output!

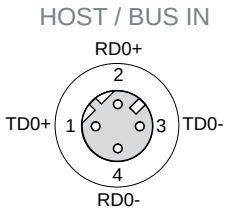
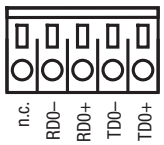
- At the outputs of the BPS (SWIO1 and SWIO2), no switching outputs may be connected from external sensors/devices. The switching output of the BPS may otherwise malfunction.

7.5.2 HOST / BUS IN

Host/bus input, EtherCAT

For the creation of a network with multiple EtherCAT participants, the BPS is equipped with the incoming HOST / BUS IN EtherCAT interface.

Tab. 7.2: HOST / BUS IN pin assignment

	Pin	Terminal	Assignment
MS 338 / ME 338 103 4-pin M12 socket (D-coded)  MK 338  	1	TD+	Transmit Data +
	2	RD+	Receive Data +
	3	TD-	Transmit Data -
	4	RD-	Receive Data -
		n.c.	Not connected
	Thread	Cable gland	Functional earth

NOTICE

Use ready-made cables!

- If possible, use the ready-made cables from Leuze (see chapter 14.3 "Cables accessories").

NOTICE

Self-configured cables!

- Ensure adequate shielding.
- The entire interconnection cable must be shielded and earthed.
- The RD+/RD- and TD+/TD- wires must be stranded in pairs.
- Use CAT 5 cable for the connection.

EtherCAT cable assignments – HOST / BUS IN on RJ-45

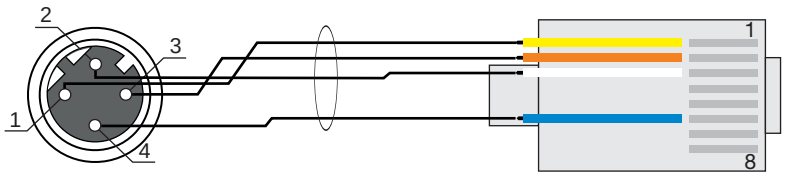


Fig. 7.6: HOST / BUS IN cable assignments on RJ-45

Designed as shielded cable, max. 100 m.

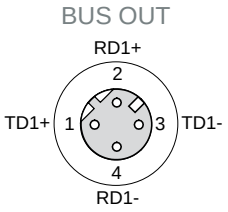
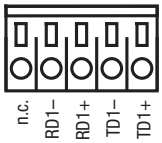
Pin (M12)	Designation	Pin/core color RJ45 (PROFINET)	Pin/core color RJ45 (EIA T568B)
1	TD+	1/yellow	1/white/orange
2	RD+	3/white	3/white/green
3	TD-	2/orange	2/orange
4	RD-	6/blue	6/green

7.5.3 BUS OUT

EtherCAT bus output

For the creation of an EtherCAT network with multiple participants, the BPS is equipped with the outgoing BUS OUT EtherCAT interface. The use of the BUS OUT interface drastically reduces the cabling requirements, as only the first BPS requires a direct connection to the switch, via which it can communicate with the host. All other BPS devices are connected in series to the first BPS (see chapter 7.6 "EtherCAT topology").

Tab. 7.3: BUS OUT pin assignment

	Pin/terminal	Designation	Assignment
MS 338 / ME 338 103 4-pin M12 socket (D-coded)  MK 338  	1	TD+	Transmit Data +
	2	RD+	Receive Data +
	3	TD-	Transmit Data -
	4	RD-	Receive Data -
		n.c.	Not connected
	Thread	Cable gland	Functional earth

NOTICE

Use ready-made cables!

- If possible, use the ready-made cables from Leuze (see chapter 14.3 "Cables accessories").

NOTICE

Self-configured cables!

- Ensure adequate shielding.
- The entire interconnection cable must be shielded and earthed.
- The RD+/RD- and TD+/TD- wires must be stranded in pairs.
- Use CAT 5 cable for the connection.

NOTICE

No BUS OUT termination necessary!

- For the BPS as stand-alone device or as the last participant in a linear EtherCAT topology, termination on the BUS OUT socket is **not** mandatory.

7.5.4 Service USB

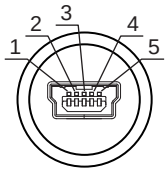
NOTICE

PC connection!

- The service USB interface of the BPS can be connected to the USB interface on the PC with a standard USB cable (plug combination - Mini-B type / Type A).
- If possible, use the specific USB service cable from Leuze (see chapter 14.3 "Cables accessories").

5-pin, Mini-B plug for connecting to the service USB.

Tab. 7.4: Service USB pin assignment

	Pin	Designation	Assignment
	1	VB	Sense input
	2	D-	Data -
	3	D+	Data +
	4	ID	Not connected
	5	GND	Ground

NOTICE

Self-configured cables!

- The entire USB interconnection cable must absolutely be shielded acc. to the USB specifications.
- The maximum cable length of 3 m must not be exceeded.

7.6 EtherCAT topology

EtherCAT permits a multitude of topologies such as line, tree, ring, star and combinations of these. The bus or line structure known from the fieldbuses is thus also available for EtherCAT.

Telegrams are sent on a wire pair in the "processing direction" from the master to the slave. The EtherCAT device processes the frames only in this direction and passes them on to the subsequent device until the telegram has passed through all devices. The last device sends the telegram back to the master on the second wire pair of the bus cable in the "forward direction". Here, the EtherCAT always forms a logical ring structure regardless of the topology installed.

From an Ethernet point of view, an EtherCAT bus segment is a single, large Ethernet participant which sends and receives Ethernet telegrams. Within the "participant", however, there is a multitude of EtherCAT slaves rather than one single Ethernet controller.

Each participating device is automatically assigned its address by a DHCP server. For "Ethernet over EtherCAT" communication, each device can be assigned the respective network address via the webConfig tool.

Notices on the necessary configuration steps: see chapter 8 "Starting up the device – Configuring EtherCAT interface".

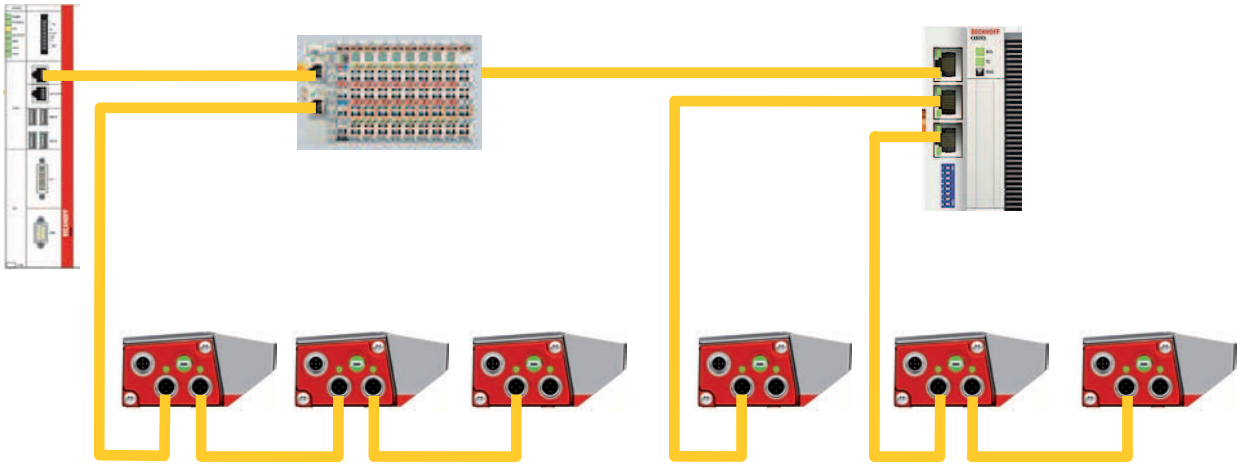
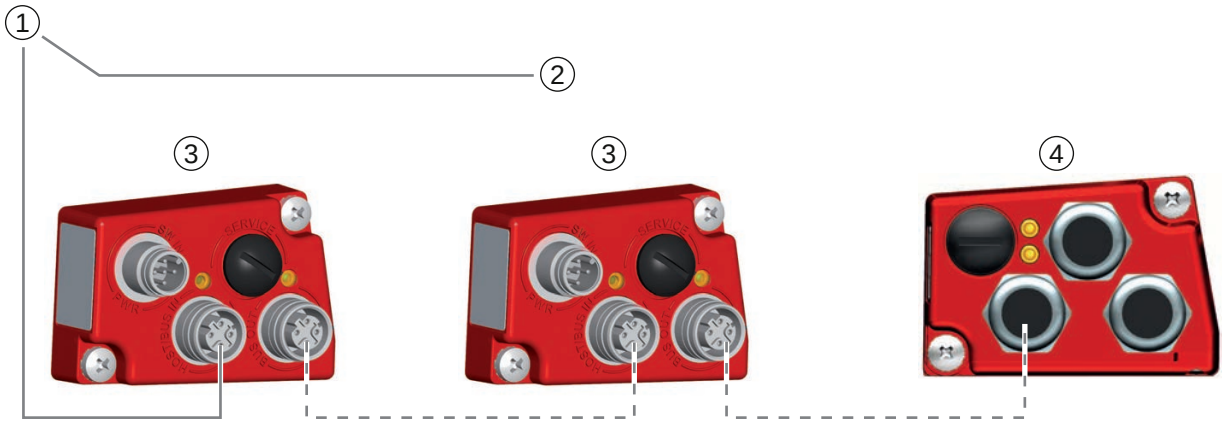


Fig. 7.7: Topology example

7.6.1 Linear topology

When the network is wired in a linear topology, the network connection is looped through from one participant to the next.

- The maximum length of a segment (connection from one participant to the next) is limited to 100 m.
- Up to 254 BPS can be networked. They must all be located in the same subnet.



1 PLC / EtherCAT controller
2 Other network participants
3 BPS 338i with MS 338
4 BPS 338i with MK 338

Fig. 7.8: EtherCAT in a linear topology

7.6.2 EtherCAT wiring

NOTICE

Strictly observe during EtherCAT wiring!

- Use the ready-made cables from Leuze (see chapter 14.3 "Cables accessories") or the recommended connectors/sockets.
- Always use a CAT 5 Ethernet cable for the wiring.
- If standard network cables are not used, you can use user-configurable cables on the BPS end depending on which connection hood is used (see chapter 14.3 "Cables accessories").
- The connection between the individual devices in a linear topology with M12 connection technology is performed with the "KSS ET-M12-4A-M12-4A-P7-…" cables (see chapter 14.3 "Cables accessories").

NOTICE

Observe for self-configured or ready-made cables!

For cable lengths that are not available, you can configure your cables yourself.

- Use the recommended connectors or sockets or the ready-made cables (see chapter 14 "Order guide and accessories").
- Connect TDx+ on the M12 connector to RD+ on the RJ-45 connector.
- Connect TDx- on the M12 connector to RD- on the RJ-45 connector, etc.

7.7 Cable lengths and shielding

Observe the maximum cable lengths and the shielding types:

Connection	Interface	Max. cable length	Shielding
BPS service	USB	3 m	Shielding absolutely necessary acc. to USB specifications
BPS host	EtherCAT	100 m	Shielding absolutely necessary
Network from the first BPS to the last BPS	EtherCAT	Max. segment length: 100 m for 100Base-TX twisted pair (min. CAT 5)	Shielding absolutely necessary
Switching input		10 m	Not necessary
Switching output		10 m	Not necessary
BPS power supply unit		30 m	Not necessary

8 Starting up the device – Configuring EtherCAT interface

8.1 Ethernet over EtherCAT - EoE

In an EtherCAT network, only EtherCAT communication is permitted. All Ethernet-based, non-EtherCAT communication (e.g., TCP/IP, UDP/IP, etc.) with the EtherCAT slave (e.g.: HTTP, FTP, Telnet, etc.) is tunneled via the EoE EtherCAT protocol. Used here is a mailbox channel which does not influence the cyclical, real-time process data exchange.

With the Ethernet-over-EtherCAT protocol, it is possible to transport all Ethernet data communication of the IT infrastructure in an EtherCAT network segment: Ethernet devices are connected to the EtherCAT network segment via switchports.

The Ethernet frames are tunneled via EtherCAT. In the same way that, e.g., Internet protocols (TCP/IP, http, etc.) are tunneled in Ethernet frames, these are embedded in EtherCAT frames. As a result, the EtherCAT network is fully transparent for these protocols.

The EoE telegrams are embedded by the EoE-capable slave device. The real-time properties of the network are not affected by this, as the sending and processing is handled via acyclic mailbox data communication, which has a much lower priority than the cyclical process-data exchange.

Because the EoE master functions as a Layer 2 switch, it sends telegrams to the MAC addresses of the EoE nodes via EoE.

NOTICE

The IP address parameters needed for the EoE protocol are set for each slave in the configuration software (e.g., TwinCAT). Make certain that a valid IP address (i.e., not equal to x.x.x.0) is assigned in the EtherCAT master. The device otherwise signals a warning and the PWR LED flashes red.

With the exception of the IP address parameters necessary for the EoE protocol, device configuration takes place via the webConfig tool.

NOTICE

The firmware can be updated via USB with the webConfig tool or via EoE.

If USB either should not or cannot be used, the EtherCAT master must support the EoE service.

8.2 CANopen over EtherCAT - CoE

EtherCAT makes the following communication mechanisms available:

- Object index
- PDO, process data object
- SDO, service data object
- NMT, network management

NOTICE

Note the following:

- SDO accesses to the online dictionary take place via CoE (CANopen over EtherCAT) mailbox services.
- PDO services via CoE mailboxes are not supported.
- Master and slave must be located in the same EtherCAT network.

NOTICE

Second Station Address (Configured Station Alias)

The *Second Station Address* is set by the EtherCAT master. The address is assigned in the configuration software (e.g., TwinCAT).

In the webConfig tool as well as in the display of the BPS338i, you can display the address but cannot make any settings.

8.3 Starting up the device in the EtherCAT system

During startup, the device passes through various states:

INIT

Device is being initialized. No cyclic or acyclic communication between the master and device is possible. The EtherCAT master will transit the device step by step into the "operational" state.

In the status change from *INIT* to *PRE-OPERATIONAL*, the TwinCAT or master writes the so-called EtherCAT address (= station address) to the respective register of the EtherCAT slave controller (here: BPS 338i). This EtherCAT address is typically specified in relation to the position, i.e., the master's address is 1000, the first slave's address is 1001, etc. This is also called the auto-increment method.

PRE-OPERATIONAL

The master and the device exchange application-specific initializations and device-specific parameters. In the *PRE-OPERATIONAL* state, configuration is initially possible via SDOs only. Mailbox communication is possible.

SAFE-OPERATIONAL

In the Safe-Operational state, only the input data (BPS 338i transmit data) is evaluated. The output data of the control is not evaluated in the BPS 338i. Mailbox communication is possible.

OPERATIONAL

In the Operational state, the device supplies valid input data. The master supplies valid output data. After the device has detected the data received via the process data service, the state transition is confirmed by the device. If the activation of the output data was not possible, the device remains in the *SAFE-OPERATIONAL* state and outputs an error message.

8.4 Device description file

For EtherCAT, all process data and parameters are described in objects. The compilation of all process data and parameters – the object directory – is stored in an EtherCAT description file (ESI file; EtherCAT Slave Information).

This ESI file contains all objects with index, sub-index, name, data type, data access as well as the value range with minimum, maximum and default value. The complete functionality of the device is described with the ESI file. It is possible to adapt the communication between the device and the control via these objects.

For the BPS 338i, an ESI file is created and made available via the webConfig tool and the Leuze website. The ESI file is used for the device description in the configuration tool, e.g., TwinCAT, and is created according to the current ESI specification to ensure problem-free interpretation.

- The ESI file has the designation **BPS338i.xml** and is made available for download on the Leuze website (**www.leuze.com**).
- Leuze *Vendor ID* for the BPS 338i: 0x121.
- *Product code* of the BPS 338i: 0x07.

8.5 Distributed Clock

Distributed Clock (DC) is an EtherCAT functionality that is used for the very precisely timed value updating in the entire EtherCAT network. This is intended to ensure that the output data is present at the bus at a defined time.

The BPS calculates the position value using moving averaging. The calculation is performed asynchronously to the bus activity.

The number of measurement values used for the average calculation is preset to *8*. By means of a PT sequence of address 0x0008 (see chapter 8.9.2 "PT sequence"), the number can be set to a value between 1 and 16.

The moving average calculation yields a difference between the actual position of the system (actual position) and the currently calculated position of the BPS. This deviation is referred to as contouring error.

The size of the contouring error is proportional to the speed traveled by the system. As the nominal position is approached, the speed is reduced to zero. This reduces the contouring error and is equal to zero when at a standstill. Excluded from this is the system-related exchange of measurement value noise in the amount of 0.15 mm (3 sigma) that occurs while at a standstill.

To avoid another contouring error resulting from excessively long EtherCAT cycle times that can occur during a pure SM event synchronization, the BPS supports synchronization by means of SYNC0-Event. Here, the current internal position data is placed on the bus at the time of the SYNC0-Event and is then already available on the next EtherCAT cycle.

The minimum cycle time for the SYNC0-Event is 1000 µs.

8.6 Object index

8.6.1 Overview

The object directory is the compilation of all process data and parameters of the bar code positioning system.

Index	Name	Flags	Value	Unit
1000	Device type	M RO	0x00001389 (5001)	
1008	Device Name	RO	BPS 338i SM 100 D	
1009	Hardware version	RO	3	
100A	Software Version	RO	T 1.7.0	
1018:0	Identity	RO	> 4 <	
1600:0	RxPDO1 Mapping	RO	> 10 <	
1601:0	RxPDO2 Mapping	RO	> 10 <	
1602:0	RxPDO3 Mapping	RO	> 11 <	
160A:0	RxPDO Binary Control Mapping	RO	> 9 <	
1620:0	RxPDO Fragmentation Mapping	RO	> 3 <	
1A00:0	TxPDO1 Mapping	RO	> 13 <	
1A01:0	TxPDO2 Mapping	RO	> 13 <	
1A02:0	TxPDO3 Mapping	RO	> 14 <	
1A10:0	TxPDO Binary Mapping	RO	> 27 <	
1A20:0	TxPDO Fragmentation Mapping	RO	> 3 <	
1C00:0	Sync Manager type	RO	> 4 <	
1C12:0	RxPDO Assign	RW	> 1 <	
1C13:0	TxPDO Assign	RW	> 1 <	
1C32:0	SM output parameter	RO	> 32 <	
1C33:0	SM input parameter	RO	> 32 <	
2000:0	Result Data 1		> 8 <	
2001:0	Result Data 2		> 16 <	
2002:0	Result Data 3		> 32 <	
2013:0	Binary Result Data	RO	> 27 <	
2050:0	Result Data Settings	RO	> 8 <	
2100:0	Submission Data 1		> 8 <	
2101:0	Submission Data 2		> 16 <	
2102:0	Submission Data 3		> 32 <	
2150:0	Submission data settings	RW	> 6 <	
2200:0	Activation	RW	> 6 <	
2300:0	Fragmented result	RW	> 6 <	
2400:0	Fragmented submission	RW	> 6 <	
2450:0	Device Status and Device Control	RW	> 2 <	
2610:0	Binary Command	RW	> 9 <	
2900	Serial Number	RO	1402-000777 004	

Fig. 8.1: Configuration options

Communication objects

Tab. 8.1: Supported communication objects

Object address (index)	Service Data Objects (SDOs)
Communication objects	
0x1000	Device type
0x1008	Manufacturer Device Name
0x1009	Manufacturer Hardware Version
0x100A	Manufacturer Software Version
0x1018	Identity Object (contains general information regarding the device)
0x1600	RxPDO1 Mapping 8 Byte (control → BPS)
0x1601	RxPDO2 Mapping 16 Byte (control → BPS)
0x1602	RxPDO3 Mapping 32 Byte (control → BPS)
0x1620	RxPDO Fragmentation Mapping (control → BPS)
0x160A	RxPDO Binary Control Mapping (control → BPS)
0x1A00	TxPDO1 Mapping 8 Byte (BPS → control)
0x1A01	TxPDO2 Mapping 16 Byte (BPS → control)
0x1A02	TxPDO3 Mapping 32 Byte (BPS → control)
0x1A10	TxPDO Binary Mapping (BPS → control)
0x1A20	TxPDO Fragmentation Mapping (BPS → control)
0x1C00	Sync Manager Communication Type
0x1C12	Sync Manager 2 PDO Assignment
0x1C13	Sync Manager 3 PDO Assignment
0x1C32	Sync Manager 2 Parameter
0x1C33	Sync Manager 3 Parameter

Service Data Objects (SDOs)	
0x2000 … 0x2002	Result Data 1 - 3, user data length 8, 16, or 32 bytes
0x2013	Binary Result Data, user data length 10 bytes
0x2050	Result Data Settings
0x2100 … 0x2102	Submission Data 1 - 3, user data length 8, 16, or 32 bytes
0x2150	Submission Data Settings
0x2200	Activation
0x2300	Fragmented result
0x2400	Fragmented submission
0x2450	Device Status and Device Control
0x2610	Binary Command
0x2900	Serial number

8.6.2 Definition of output data (submission data)

- Output data: Data that is transferred from the control (master) to the BPS.
- Receive objects: Objects that are transferred from the control (master) to the BPS.

8.6.3 Definition of input data (result data)

- Input data: Data that is transferred from the BPS to the control (master).
- Transmit objects: Objects that are transferred from the BPS to the control (master).

NOTICE	
	Process data mappings that reflect process data objects (PDO) larger than 30 bytes in length make use of so-called padding bytes as described in ETG.1020 ("EtherCAT Protocol Enhancement"). The EtherCAT master or the configuration tool of the master must support this mechanism.

8.6.4 Data type

The data type determines the form and length of the parameter value.

Tab. 8.2: Available data types

Data type	Description
BOOL	Contains the logical value True (= 1) or False (= 0).
BYTE	Whole or natural numbers with 8-bit length
WORD	Whole or natural numbers with 16-bit length
DWORD	Whole or natural numbers with 32-bit length
STR	Character string of arbitrary length

8.7 Communication objects

8.7.1 Object 0x1000 – Device Type

This object contains the device type as 32-bit value (DWORD). The BPS does not implement a predefined or standardized device profile but rather uses the proprietary Leuze "device access functions" with "binary process data extension". This object is implemented and filled according to the recommendations of the ETG.

Only read access is allowed (*read only* = *ro*) by the EtherCAT master.

Tab. 8.3: Index 0x1000

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Device type	DWORD	ro	--	--	0x00000000	Not a standardized device profile

8.7.2 Object 0x1008 – Manufacturer Device Name

This object contains the slave device names as readable string (visible STR). Here, the BPS transfers the string "BPS 338i SM100" as the device name.

Only read access is allowed (*read only* = *ro*) by the EtherCAT master.

Tab. 8.4: Index 0x1008

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Manufacturer Device Name	STR	ro	--	--	"BPS338i SM100"	

8.7.3 Object 0x1009 – Manufacturer Hardware Version

This object contains the hardware version of the main board (slave device hardware version) as readable string (visible STR). Here, the BPS transfers its current hardware version (Ident item "gen_cpu_hw") as a string, e.g., "3".

Only read access is allowed (*read only* = *ro*) by the EtherCAT master.

Tab. 8.5: Index 0x1009

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Manufacturer Hardware Version	STR	ro	--	--	0x03	

8.7.4 Object 0x100A – Manufacturer Software Version

This object contains the current software version of the firmware (slave device software version) as readable string (visible STR). Here, the BPS transfers its current software version as a string, e.g., "V 1.7.0".

Only read access is allowed (*read only* = *ro*) by the EtherCAT master.

Tab. 8.6: Index 0x100A

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Manufacturer Software Version	STR	ro	--	--	"V1.7.0"	

NOTICE

The firmware can be updated via USB with the webConfig tool or via EoE. If USB either should not or cannot be used, the EtherCAT master must support the EoE service.

8.7.5 Object 0x1018 – Identity Object

This object contains information for identification and maintenance functionality.

Only read access is allowed (*read only* = *ro*) by the EtherCAT master.

Tab. 8.7: Index 0x1018

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Number of entries	BYTE	ro	0x00	0x04	--	
0x01	Vendor ID	DWORD	ro	--	--	0x121	Manufacturer ID number
0x02	Product Code	DWORD	ro	--	--	0x07	Product code
0x03	Revision	DWORD	ro	--	--	0x01	Example (is incremented if there is a change to the EtherCAT-relevant data)
0x04		DWORD	ro			„???“	Serial number

Sub-index information

The following information is made available via several sub-indicies:

Tab. 8.8: Sub-indecies

Sub-index	Name	Description
0x01	Vendor ID	The manufacturer designation (Vendor ID) is transferred as a 32-bit value (DWORD). For Leuze: 0x00000121
0x02	Product Code	The product code is transferred as a 32-bit value (DWORD). For the BPS 338i: 0x00000007
0x03	Revision	The revision number is transferred as a 32-bit value (DWORD). For the BPS 338i: 0x00000001.
0x04		The serial number is transferred as a 32-bit value (DWORD). Because the Leuze serial number contains more than ten digits, a conversion to a 32-bit value takes place. Up to the last ten digits of the serial number are used, i.e., special characters and letters are ignored. The complete serial number is represented in object 0x2900 as a STRING.

8.8 Process data objects

8.8.1 Object 0x1600 – Receive-PDO (control > BPS) ASCII 8 bytes

By activating object 0x1600 "Receive-PDO", the control (EtherCAT master) can send ASCII online commands with a length of 8 bytes to the BPS.

If, for example, the configuration of the BPS is to be changed via the control (EtherCAT master), this is performed using PT commands (Parameter Transmit).

- A PT command contains at least 11 bytes of user data.
- For parameters with "larger" data types, the command is lengthened by two characters for each data byte, as the data content is transferred in ASCII hex format.

Example: Command "PT00010000A" writes the value 0xA to the BPS-internal address 1000.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.9: Index 0x1600

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0A	0x0B	--	Number of mapping entries
0x01	New input toggle	DWORD	ro	--	--	0x01035021	Object 0x2150 sub-index 0x03
0x02	Data acknowledge	DWORD	ro	--	--	0x01050022	Object 0x2200 sub-index 0x05
0x03	Data reset	DWORD	ro	--	--	0x01060022	Object 0x2200 sub-index 0x06
0x04	Error acknowledge	DWORD	ro	--	--	0x01025024	Object 0x2450 sub-index 0x02
0x05	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x06	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x07	1-bit alignment	DWORD	--	--		0x1000000	Fill bit
0x08	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x09	Input data length	DWORD	ro	--	--	0x10065021	Object 0x2150 sub-index 0x06
0x0A	Submission-Data1_8Bytes	DWORD	ro	--	--	0x40000021	Object 0x2100 for 8 bytes of user data

NOTICE

Object 0x1620 is available for fragmentation of the commands into objects 0x1600 to 0x1602.

8.8.2 Object 0x1601 – Receive-PDO (control > BPS) ASCII 16 bytes

By activating object 0x1601 "Receive-PDO", the control (EtherCAT master) can send ASCII online commands with a length of 16 bytes to the BPS.

If, for example, the configuration of the BPS is to be changed via the control (EtherCAT master), this is performed using PT commands (Parameter Transmit).

- A PT command contains at least 11 bytes of user data.
- For parameters with "larger" data types, the command is lengthened by two characters for each data byte, as the data content is transferred in ASCII hex format.

Example: Command "PT00010000A" writes the value 0xA to the BPS-internal address 1000.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.10: Index 0x1601

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0A	0x0B	--	Number of mapping entries
0x01	New input toggle	DWORD	ro	--	--	0x01035021	Object 0x2150 sub-index 0x03
0x02	Data acknowledge	DWORD	ro	--	--	0x01050022	Object 0x2200 sub-index 0x05
0x03	Data reset	DWORD	ro	--	--	0x01060022	Object 0x2200 sub-index 0x06
0x04	Error acknowledge	DWORD	ro	--	--	0x01025024	Object 0x2450 sub-index 0x02
0x05	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x06	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x07	1-bit alignment	DWORD	--	--		0x1000000	Fill bit
0x08	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x09	Input data length	DWORD	ro	--	--	0x10065021	Object 0x2150 sub-index 0x06
0x0A	Submission-Data2_16Bytes	DWORD	ro	--	--	0x80000121	Object 0x2101 for 16 bytes of user data

8.8.3 Object 0x1602 – Receive-PDO (control > BPS) ASCII 32 bytes

By activating object 0x1602 "Receive-PDO", the control (EtherCAT master) can send ASCII online commands with a length of 32 bytes to the BPS.

If, for example, the configuration of the BPS is to be changed via the control (EtherCAT master), this is performed using PT commands (Parameter Transmit).

- A PT command contains at least 11 bytes of user data.
- For parameters with "larger" data types, the command is lengthened by two characters for each data byte, as the data content is transferred in ASCII hex format.

Example: Command "PT00010000A" writes the value 0xA to the BPS-internal address 1000.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.11: Index 0x1602

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0A	0x0B	--	Number of mapping entries
0x01	New input toggle	DWORD	ro	--	--	0x01035021	Object 0x2150 sub-index 0x03
0x02	Data acknowledge	DWORD	ro	--	--	0x01050022	Object 0x2200 sub-index 0x05
0x03	Data reset	DWORD	ro	--	--	0x01060022	Object 0x2200 sub-index 0x06
0x04	Error acknowledge	DWORD	ro	--	--	0x01025024	Object 0x2450 sub-index 0x02
0x05	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x06	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x07	1-bit alignment	DWORD	--	--		0x1000000	Fill bit
0x08	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x09	Input data length	DWORD	ro	--	--	0x10065021	Object 0x2150 sub-index 0x06
0x0A	Submission-Data3_32Bytes	DWORD	ro	--	--	0xF0000221	Object 0x2102 for 30 bytes of user data
0x0B	Submission-Data3_32Bytes	DWORD	ro	--	--	0x10000000	Object 0x2102 for 2 bytes of user data

NOTICE
Only one Receive PDO mapping object (0x1600; 0x1601; 0x1602) can be selected and activated at any given time. ↳ Select the Receive PDO mapping object depending on the required data length. ↳ The length of a mapping entry is limited to 255 bits (DWORD = 32 bytes). PDO mapping entries > 31 bytes must be split over multiple entries with a maximum length of 30 bytes each. ↳ The first mapping entry contains index and sub-index, all other entries are realized as padding entries (index 0 and sub-index 0). The used EtherCAT master must be able to read and support these padding entries. ↳ For further information, see also the ETG.1020 Protocol Enhancements document from the ETG.

8.8.4 Object 0x1620 – Fragmentation of the Receive-PDO (control > BPS) ASCII data

By activating object 0x1620 "Fragmentation of the Receive-PDO", the control (EtherCAT master) can fragment the ASCII output data and transfer this fragmented data to the BPS.

- The maximum fragment length is defined in the PRE-OP state via CoE in object 0x2400.
- By selecting the PDO, fragmentation is automatically activated; deselect to deactivate.

Tab. 8.12: Index 0x1620

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	--	--	0x03	Number of mapping entries
0x01	Fragment Number	DWORD	ro	--	--	0x08040024	Object 0x2400 sub-index 0x04
0x02	Remaining fragments	DWORD	ro	--	--	0x08050024	Object 0x2400 sub-index 0x05
0x03	Fragment Size	DWORD	ro	--	--	0x08050024	Object 0x2400 sub-index 0x06

8.8.5 Object 0x160A – Receive-PDO (control > BPS) binary process data control command (byte)

By activating object 0x160A "Receive-PDO process data", the control (EtherCAT master) can transfer control commands to the BPS.

Tab. 8.13: Index 0x160A

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	--	--	0x09	Number of mapping entries
0x01	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x02	New input toggle	DWORD	ro	--	--	0x01021026	Object 0x2610 sub-index 0x02
0x03	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x04	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x05	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x06	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x07	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x08	1-bit alignment	DWORD	--	--	--	0x1000000	Fill bit
0x09	Binary Command	DWORD	ro	--	--	0x08091026	Object 0x2610 sub-index 0x09

Sub-index information

The following binary commands are supported in object 0x160A in sub-index 9:

Tab. 8.14: Sub-index 0x09 Command byte

Command	Description
0xF4	Start positioning
0xF5	Stop positioning
0xFC	Acknowledge diagnostic information
0xFD	Activate standby
0xFE	Preset teach
0xFF	Preset reset

8.8.6 Object 0x1A00 – Transmit-PDO (BPS > control) ASCII 8 bytes

By activating object 0x1A00 "Transmit-PDO", the BPS will answer ASCII online commands from the control (EtherCAT master) with a length of 8 bytes of user data.

If, for example, the configuration of the BPS is to be changed via the control, this can be realized by using PT commands in the Receive-PDOs (0x1600, 0x1601, 0x1602).

- Each PT command has an answer in the format "PS=xx", whereby, e.g., xx=00 corresponds to the status "command OK".
- Answer "PS=00" includes 5 bytes of user data and can, thus, be transferred in the smallest Transmit-PDO (0x1A00) with 8 bytes of user data.
- For answers with longer user data content, transmit PDOs 0x1A01 (16 bytes) and 0x1A02 (32 bytes) are available.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.15: Index 0x1A00

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0D	0x0D	0x0D	Number of mapping entries
0x01	Device state	DWORD	ro	--	--	0x08015024	Object 0x2450 sub-index 0x01
0x02	Number of results	DWORD	ro	--	--	0x08030022	Object 0x2200 sub-index 0x03
0x03	Toggle bit data rejection	DWORD	ro	--	--	0x01025021	Object 0x2150 Sub-index 0x02
0x04	Toggle bit data transfer	DWORD	ro	--	--	0x01015021	Object 0x2150 sub-index 0x01
0x05	More results in buffer	DWORD	ro	--	--	0x01035020	Object 0x2050 Sub-index 0x03
0x06	Buffer overflow	DWORD	ro	--	--	0x01045020	Object 0x2050 Sub-index 0x04
0x07	New result toggle	DWORD	ro	--		0x01055020	Object 0x2050 Sub-index 0x05
0x08	Wait for acknowledge	DWORD	ro	--	--	0x01065020	Object 0x2050 Sub-index 0x06
0x09	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0A	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0B	Result data length	DWORD	ro	--	--	0x10085020	Object 0x2050 sub-index 0x08
0x0C	Error Code	DWORD	ro	--	--	0x08055021	Object 0x2150 sub-index 0x05
0x0D	Result-Data1_8Bytes	DWORD	ro	--	--	0x40000020	Object 0x2000 for 8 bytes of user data

NOTICE

Object 0x1A20 is available for fragmentation of the answer into objects 0x1A00 to 0x1A02.

8.8.7 Object 0x1A01 – Transmit-PDO (BPS > control) ASCII 16 bytes

By activating object 0x1A01 "Transmit-PDO", the BPS will answer ASCII online commands from the control (EtherCAT master) with a length of 16 bytes of user data.

If, for example, the configuration of the BPS is to be changed via the control, this can be realized by using PT commands in the Receive-PDOs (0x1600, 0x1601, 0x1602).

- Each PT command has an answer in the format "PS=xx", whereby, e.g., xx=00 corresponds to the status "command OK".
- Answer "PS=00" includes 5 bytes of user data and can, thus, be transferred in the smallest Transmit-PDO (0x1A00) with 8 bytes of user data.
- Transmit-PDO 0x1A02 (32 bytes) is available for answers with longer user data content.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.16: Index 0x1A01

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0D	0x0D	0x0D	Number of mapping entries
0x01	Device state	DWORD	ro	--	--	0x08015024	Object 0x2450 sub-index 0x01
0x02	Number of results	DWORD	ro	--	--	0x08030022	Object 0x2200 sub-index 0x03
0x03	Toggle bit data rejection	DWORD	ro	--	--	0x01025021	Object 0x2150 Sub-index 0x02
0x04	Toggle bit data transfer	DWORD	ro	--	--	0x01015021	Object 0x2150 sub-index 0x01
0x05	More results in buffer	DWORD	ro	--	--	0x01035020	Object 0x2050 Sub-index 0x03
0x06	Buffer overflow	DWORD	ro	--	--	0x01045020	Object 0x2050 Sub-index 0x04
0x07	New result toggle	DWORD	ro	--		0x01055020	Object 0x2050 Sub-index 0x05
0x08	Wait for acknowledge	DWORD	ro	--	--	0x01065020	Object 0x2050 Sub-index 0x06
0x09	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0A	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0B	Result data length	DWORD	ro	--	--	0x10085020	Object 0x2050 sub-index 0x08
0x0C	Error Code	DWORD	ro	--	--	0x08055021	Object 0x2150 sub-index 0x05
0x0D	Result-Data2_16Bytes	DWORD	ro	--	--	0x80000120	Object 0x2001 for 16 bytes of user data

8.8.8 Object 0x1A02 – Transmit-PDO (BPS > control) ASCII 32 bytes

By activating object 0x1A02 "Transmit-PDO", the BPS will answer ASCII online commands from the control (EtherCAT master) with a length of 32 bytes of user data.

If, for example, the configuration of the BPS is to be changed via the control, this can be realized by using PT commands in the Receive-PDOs (0x1600, 0x1601, 0x1602).

- Each PT command has an answer in the format "PS=xx", whereby, e.g., xx=00 corresponds to the status "command OK".
- Answer "PS=00" includes 5 bytes of user data and can, thus, be transferred in the smallest Transmit-PDO (0x1A00) with 8 bytes of user data.

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

Tab. 8.17: Index 0x1A02

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	0x0E	0x0E	0x0E	Number of mapping entries
0x01	Device state	DWORD	ro	--	--	0x08015024	Object 0x2450 sub-index 0x01
0x02	Number of results	DWORD	ro	--	--	0x08030022	Object 0x2200 sub-index 0x03
0x03	Toggle bit data rejection	DWORD	ro	--	--	0x01025021	Object 0x2150 Sub-index 0x02
0x04	Toggle bit data transfer	DWORD	ro	--	--	0x01015021	Object 0x2150 sub-index 0x01
0x05	More results in buffer	DWORD	ro	--	--	0x01035020	Object 0x2050 Sub-index 0x03
0x06	Buffer overflow	DWORD	ro	--	--	0x01045020	Object 0x2050 Sub-index 0x04
0x07	New result toggle	DWORD	ro	--		0x01055020	Object 0x2050 Sub-index 0x05
0x08	Wait for acknowledge	DWORD	ro	--	--	0x01065020	Object 0x2050 Sub-index 0x06
0x09	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0A	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0B	Result data length	DWORD	ro	--	--	0x10085020	Object 0x2050 sub-index 0x08
0x0C	Error Code	DWORD	ro	--	--	0x08055021	Object 0x2150 sub-index 0x05
0x0D	Result-Data3_32Bytes	DWORD	ro	--	--	0xF0000220	Object 0x2002 for 30 bytes of user data
0x0E	Result-Data3_32Bytes	DWORD	ro	--	--	0x10000000	Object 0x2002 for 2 bytes of user data

8.8.9 Object 0x1A20 – Fragmentation of the Transmit-PDO (BPS > control) ASCII data

The BPS can fragment the ASCII data by activating object 0x1A20 "Fragmentation of the Transmit-PDO ASCII data".

- The maximum fragment length is defined in the PRE-OP state via CoE in object 0x2300.
- By selecting the PDO, fragmentation is automatically activated; deselect to deactivate.

Example for the BPS 338i:

If an answer is sent in object 0x1A00 (8 bytes of ASCII data from the BPS 338i to the control) that is longer than 8 bytes (such as the answer to the "v" command), the answer must be fragmented. Object 0x1A20 must be activated.

Tab. 8.18: Index 0x1A20

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	--	--	0x03	Number of mapping entries
0x01	Fragment Number	DWORD	ro	--	--	0x08040023	Object 0x2300 sub-index 0x04
0x02	Remaining fragments	DWORD	ro	--	--	0x08050023	Object 0x2300 sub-index 0x05
0x03	Fragment Size	DWORD	ro	--	--	0x08060023	Object 0x2300 sub-index 0x06

8.8.10 Object 0x1A10 – Transmit-PDO (BPS > control) binary data

By activating object 0x1A10 "Transmit-PDO binary data", the BPS transfers its process data (position value, speed, quality, status information) to the control (EtherCAT master) in binary form.

Tab. 8.19: Index 0x1601

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	No. of sub-index	BYTE	ro	--	-	0x01B	Number of mapping entries
0x01	Current position	DWORD	ro	--	--	0x20011320	Object 0x2013 sub-index 0x01
0x02	Current speed	DWORD	ro	--	--	0x10021320	Object 0x2013 sub-index 0x02
0x03	Reading Quality	DWORD	ro	--	--	0x08031320	Object 0x2013 sub-index 0x03
0x04	Position value invalid	DWORD	ro	--	--	0x01041320	Object 0x2013 sub-index 0x04
0x05	Measurement not active	DWORD	ro	--	--	0x01051320	Object 0x2013 sub-index 0x05
0x06	Preset active	DWORD	ro	--	--	0x01061320	Object 0x2013 sub-index 0x06
0x07	Preset teach	DWORD	ro	--	--	0x01071320	Object 0x2013 sub-index 0x07
0x08	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
0x09	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0A	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0B	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0C	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0D	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x0E	Temperature warning	DWORD	ro	--	--	0x010E1320	Object 0x2013 sub-index 0x0E
0x0F	Temperature error	DWORD	ro	--	--	0x010F1320	Object 0x2013 sub-index 0x0F
0x10	Hardware error	DWORD	ro	--	--	0x01101320	Object 0x2013 sub-index 0x10
0x11	Warning threshold reading quality	DWORD	ro	--	--	0x01111320	Object 0x2013 sub-index 0x11
0x12	Error threshold reading quality	DWORD	ro	--	--	0x01121320	Object 0x2013 sub-index 0x12
0x13	Standby active	DWORD	ro	--	--	0x01131320	Object 0x2013 sub-index 0x13
0x14	Speed measurement error	DWORD	ro	--	--	0x01141320	Object 0x2013 sub-index 0x14
0x15	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x16	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x17	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x18	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x19	1-bit alignment	DWORD	ro	--	--	0x01000000	Fill bit
0x1A	Movement status	DWORD	ro	--	--	0x011A1320	Object 0x2013 sub-index 0x1A
0x1B	Direction of Movement	DWORD	ro	--	--	0x011B1320	Object 0x2013 sub-index 0x1B

8.8.11 Object 0x1C00 – Sync Manager Communication Type

This object defines which Sync Manager realizes which data channel.

The Sync Managers are configured in the BPS as follows:

Tab. 8.20: Index 0x1C00

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
	SyncManager Communication Type	RECORD					
0x00	Number of entries	BYTE	ro	0x00	0x04	0x04	Number of entries
0x01	Communication Type SyncManager 0	BYTE	ro	--	--	0x01	Mailbox Receive (master to slave)
0x02	Communication Type SyncManager 1	BYTE	ro	--	--	0x02	Mailbox Send (slave to master)
0x03	Communication Type SyncManager 2	BYTE	ro	--	--	0x03	Process Data Output (master to slave)
0x04	Communication Type SyncManager 3	BYTE	ro	--	--	0x04	Process Data Input (slave to master)

Sub-index information

Tab. 8.21: Sub-indecies

Sub-index	Name	Description
0x01	Communication Type SyncManager 0	Defines the behavior of Sync Manager 0: Mailbox Receive (master to slave)
0x02	Communication Type SyncManager 1	Defines the behavior of Sync Manager 1: Mailbox Send (slave to master)
0x03	Communication Type SyncManager 2	Defines the behavior of Sync Manager 2: Process Data Output (master to slave)
0x04	Communication Type SyncManager 3	Defines the behavior of Sync Manager 3: Process Data Input (slave to master)

8.8.12 Object 0x1C12 – Sync Manager 2 PDO-Assignment

This object defines the Receive-PDO objects assigned to Sync Manager 2 and allows the mapping of 0 to 3 Receive-PDOs.

The BPS processes the configuration and uses the configured Receive-PDOs.

Tab. 8.22: Index 0x1C12

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
	SyncManager 2 PDO Assignment	RECORD					
0x00	Number of assigned RxPDOs	BYTE	rw	0x00	0x03	0x03	Number of entries
0x01	PDO Mapping object index of assigned PDO	WORD	rw	--	--	0x160A	Assigned PDO
0x02	PDO Mapping object index of assigned PDO	WORD	rw	0x1600	0x1602	0x1600	Assigned PDO
0x03	PDO Mapping object index of assigned PDO	WORD	rw	--	0x1620	0x1620	Assigned PDO

8.8.13 Object 0x1C13 – Sync Manager 3 PDO-Assignment

This object defines the Transmit-PDO objects assigned to Sync Manager 3 and allows the mapping of 1 to 3 Transmit-PDOs.

The BPS processes the configuration and fills the configured Transmit-PDOs.

Tab. 8.23: Index 0x1C13

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
	SyncManager 3 PDO Assignment	RECORD					
0x00	Number of assigned RxPDOs	BYTE	rw	0x01	0x03	0x03	Number of entries
0x01	PDO Mapping object index of assigned PDO	WORD	rw	--	--	0x1A10	Assigned PDO
0x02	PDO Mapping object index of assigned PDO	WORD	rw	0x1A00	0x1A02	0x1A00	Assigned PDO
0x03	PDO Mapping object index of assigned PDO	WORD	rw	--	0x1A20	0x1A20	Assigned PDO

8.8.14 Object 0x1C32 – Sync Manager 2 Parameter

This object defines the parameters belonging to Sync Manager 2.

The object, or the individual sub-indices, can be read from the EtherCAT master and supply the specified values. The corresponding writable values (RW) can be written.

Tab. 8.24: Index 0x1C32

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
	Sync Manager 2 Parameter	RECORD					
0x00	No. of sub-index	BYTE	ro	--	-	0x20	Number of entries
0x01	Sync Mode	WORD	rw	--	--	0x0001	Current synchronization mode: • 1: Synchronization with SM-3-Event • 2: DC mode - synchronization with SYNC0-Event
0x02	Cycle time [ns]: as 1C32:02	DWORD	rw	--	--	0x00000000	
0x04	Supported synchronization modes	WORD	ro	--	--	0x0006	Supported synchronization modes: • Bit 1 = 1: Synchronization with SM-3-Event is supported • Bits 2-3 = 01: DC SYNC0 is supported
0x05	Minimum cycle time [ns]	DWORD	ro	--	--	0x000F4240	
0x0B	as 1C32:0B	WORD	ro	--	--	0x0000	
0x0C	as 1C32:0C	WORD	ro	--	--	0x0000	
0x20	as 1C32:20	BOOL	ro	--	--	False(0)	

8.8.15 Object 0x1C33 – Sync Manager 3 Parameter

This object defines the parameters belonging to Sync Manager 3.

The object, or the individual sub-indices, can be read from the EtherCAT master and supply the specified values. The corresponding writable values (RW) can be written.

Tab. 8.25: Index 0x1C33

Sub-index	Name	Data type	Access	Value range minimum	Value range maximum	Value range default	Comment
	Sync Manager 3 Parameter	RECORD					
0x00	No. of sub-index	BYTE	ro	--	-	0x20	Number of entries
0x01	Sync Mode	WORD	rw	--	--	0x0001	Current synchronization mode: • 1: Synchronization with SM-3-Event • 2: DC mode – synchronization with SYNC0-Event
0x02	Cycle time [ns]: as 1C32:02	DWORD	rw	--	--	0x00000000	
0x04	Supported synchronization modes	WORD	ro	--	--	0x0006	Supported synchronization modes: • Bit 1 = 1: Synchronization with SM-3-Event is supported • Bits 2-3 = 01: DC SYNC0 is supported
0x05	Minimum cycle time [ns]	DWORD	ro	--	--	0x000F4240	
0x0B	as 1C32:0B	WORD	ro	--	--	0x0000	
0x0C	as 1C32:0C	WORD	ro	--	--	0x0000	
0x20	as 1C32:20	BOOL	ro	--	--	False(0)	

8.8.16 Object 0x2000-0x2002 – ASCII-answer to master

This object defines the ASCII answer data of the BPS to ASCII queries from the control (EtherCAT master). Objects 0x2000-0x2002 define a user data length of 8, 16 and 32 bytes.

Tab. 8.26: Index 0x2000

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Result data 1	ARRAY OF BYTE	64	r	0x00	0xFF	0x00	Result data 1 (max. 8 bytes)

Tab. 8.27: Index 0x2001

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Result data 2	ARRAY OF BYTE	128	r	0x00	0xFF	0x00	Result data 2 (max. 16 bytes)

Tab. 8.28: Index 0x2002

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Result data 3	ARRAY OF BYTE	256	r	0x00	0xFF	0x00	Result data 3 (max. 32 bytes)

8.8.17 Object 0x2013 – Binary process data to master

The object defines the binary process data of the BPS that can be transferred to the EtherCAT master.

Tab. 8.29: Index 0x2013

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
	Binary Result Data	RECORD	80					
0x00	No. of sub-index	UNSIGNED INT 16	16	R	0	27	27	Number of entries
0x01	Current position	UNSIGNED INT 32	32	R	0	MAX U32	0	Position value
0x02	Current velocity	UNSIGNED INT 16	16	R	0	MAX U16	0	Speed value
0x03	Reading quality	BYTE	8	R	0	100	0	Reading quality (see note)
0x04	Position value invalid	BIT1	1	R	0	1	0	Invalid position value
0x05	Measurement not active	BIT1	1	R	0	1	0	Deactivated measurement
0x06	Preset active	BIT1	1	R	0	1	0	Position output with active preset
0x07	Preset teach	BIT1	1	R	0	1	0	Toggle Bit Preset Teach
0x08	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x09	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x0A	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x0B	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x0C	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x0D	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x0E	Temperature warning	BIT1	1	R	0	1	0	Temperature warning
0x0F	Temperature error	BIT1	1	R	0	1	0	Temperature error
0x10	Hardware error	BIT1	1	R	0	1	0	Hardware defect

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x11	Warning threshold reading quality	BIT1	1	R	0	1	0	Reading quality below configured warning threshold
0x12	Error threshold reading quality	BIT1	1	R	0	1	0	Reading quality below configured error threshold
0x13	Standby active	BIT1	1	R	0	1	0	Standby active
0x14	Speed measurement error	BIT1	1	R	0	1	0	Speed cannot be determined
0x15	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x16	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x17	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x18	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x19	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x1A	Movement status	BIT1	1	R	0	1	0	Speed > 0.1 m/s
0x1B	Direction of movement	BIT1	1	R	0	1	0	Direction of movement

Sub-index information

Tab. 8.30: Information on the sub-indecies

Sub-index	Name	Description
0x00	No. of sub-index	Contains the number of sub-indecies.
0x01	Current position	Contains the position value in the configured resolution (configuration via webConfig tool).
0x02	Current velocity	Indicates the speed in the configured resolution (configuration via webConfig tool).
0x03	Reading quality	Indicates the reading quality in percent (see note).
0x04	Position value invalid	Signals that no valid position can be ascertained.
0x05	Measurement not active	Signals an inactive measurement.
0x06	Preset active	Signals a position value output with active preset.
0x07	Preset teach	This toggle bit changes its state on each Teach Preset event.

Sub-index	Name	Description	
0x0E	Temperature warning	Signals that temperature is no longer within the specified temperature range.	
0x0F	Temperature error	Signals that the maximum permissible temperature has been exceeded.	
0x10	Hardware error	Signals a hardware defect.	
0x11	Warning threshold reading quality	Signals that the ascertained reading quality has dropped below the configured warning threshold (configuration via webConfig tool).	
0x12	Error threshold reading quality	Signals that the ascertained reading quality has dropped below the configured error threshold (configuration via webConfig tool).	
0x13	Standby active	Signals an active standby.	
0x14	Speed measurement error	Signals that no valid speed could be ascertained.	
		0	No speed limit value violation
		1	Speed limit value violation
0x1A	Movement status	Signals whether a movement > 0.1 m/s is currently being detected.	
		0	No movement
		1	Movement
0x1B	Direction of movement	If the "Movement status" bit is set, this bit indicates the direction.	
		0	Positive direction
		1	Negative direction

NOTICE

Correct calculation of the reading quality

The evaluation of the reading quality is influenced by several factors, see chapter 4.5 "Evaluation of the reading quality".

8.8.18 Object 0x2050 – Status ASCII answer

This object contains the status information on ASCII answer objects 0x2000 to 0x2002.

Tab. 8.31: Index 0x2050

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Result Data Settings	RECORD	40	--	--	--	--	Result data status
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x07	0x00	
0x01	Alignment bit	BIT1	1	--	--	--	--	Fill bit
0x02	Alignment bit	BIT1	1	--	--	--	--	Fill bit
0x03	More results in buffer	BOOL	1	r	0x00	0x01	0x00	Further results in the buffer
0x04	Buffer overflow	BOOL	1	r	0x00	0x01	0x00	Further results in the buffer
0x05	New result toggle	BOOL	1	r	0x00	0x01	0x00	New result toggle
0x06	Wait for acknowledge	BOOL	1	r	0x00	0x01	0x00	Waiting for acknowledgment
0x07	2-bit alignment	BIT2	2	--	--	--	--	Fill bit
0x08	Result data length	UNSIGNED 16	16	r	0x00	0xFFFF	0x00	Data length result

Sub-index information

Tab. 8.32: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Contains the number of sub-indecies.	
0x01	Alignment bit	1 bit	
0x02	Alignment bit	1 bit	
0x03	More results in buffer	This signal indicates whether further results are in the buffer.	
		0	No
		1	Yes
0x04	Buffer overflow	This signal indicates that all result buffers are occupied and that the device rejects data.	
		0	No
		1	Yes
0x05	New result toggle	The toggle bit indicates whether a new result is present. 0→1 New result 1→0 New result	

Sub-index	Name	Description	
0x06	Wait for acknowledge	This signal represents the internal state of the control.	
		0	Base state
		1	Control waiting for acknowledgment from the master
0x08	Result data length	Data length of the actual result information. • If the result data length is less than or equal to the length of the result data object mapped in the process image, this value corresponds to the length of the actually transmitted data. • If the result data length is greater than the selected result data object, this means an information loss during transmission.	

8.8.19 Object 0x2100-0x2102 – ASCII commands to BPS

This object transfers the ASCII commands from the control (EtherCAT master) to the BPS. Objects 0x2100-0x2102 are defined with a user data length of 8, 16 and 32 bytes.

These objects enable the transmission of "arbitrary" commands from the EtherCAT master to the command interpreter of the BPS.

Objects 0x2100 to 0x2102 are to be considered as alternatives and cannot be assigned simultaneously to the process image via process data mapping.

The three specified objects differ by the number of ASCII user data bytes:

- Object 0x2100 with 8 ASCII user data bytes
- Object 0x2101 with 16 ASCII user data bytes
- Object 0x2102 with 32 ASCII user data bytes

Tab. 8.33: Index 0x2100

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Submission data 1	ARRAY OF BYTE	64	rw	0x00	0xFF	0x00	Entry data 1 (max. 8 bytes)

Tab. 8.34: Index 0x2101

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Submission data 2	ARRAY OF BYTE	128	rw	0x00	0xFF	0x00	Entry data 2 (max. 16 bytes)

Tab. 8.35: Index 0x2102

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
0x00	Submission data 3	ARRAY OF BYTE	256	rw	0x00	0xFF	0x00	Entry data 3 (max. 32 bytes)

NOTICE
The objects do not support direct configuration of the device functionality. Configuration is not generally performed via the fieldbus protocol, but rather via the webConfig tool. It is, however, possible to configure the BPS using PT sequences from within the control (see chapter 8.9 "Online commands").

For the set-up and structure of PT commands: see chapter 8.9.2 "PT sequence".

8.8.20 Object 0x2150 – Status ASCII command

This object contains the status information on ASCII command objects 0x2100 to 0x2102.

Tab. 8.36: Index 0x2150

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Submission Data Settings	RECORD	48	--	--	--	--	Output data status
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x06	0x06	Number of sub-indecies
0x01	Toggle bit data transfer	BOOL	1	r	0x00	0x01	0x00	Data acceptance toggle bit
0x02	Toggle bit data rejection	BOOL	1	r	0x00	0x01	0x00	Toggle bit data rejection
0x03	New input toggle	BOOL	1	rw	0x00	0x01	0x00	New entry toggle
0x04	5-bit alignment	BOOL	5	r	--	--	-	Fill bit
0x05	Error code	BYTE	8	r	0x00	0x08	0x00	Error code
0x06	Input data length	UNSIGNED 16Bit	16	rw	0x00	0xFFFF	0x00	Input data length

Sub-index information

Tab. 8.37: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Contains the number of sub-indecies.	
0x01	Toggle bit data transfer	The signal shows that the device has accepted the data or the data fragment (see also Toggle bit data rejection). 0→1 Data have been accepted 1→0 Data have been accepted	
0x02	Toggle bit data rejection	The device has rejected the acceptance of the data or the data fragment (see also Toggle bit data acceptance). 0→1 Data have been rejected 1→0 Data have been rejected	
0x03	New input toggle	Toggle bit signals whether new input data is present. 0→1 New result 1→0 New result	
0x04	5-bit alignment	5 fill bits	
0x05	Error code	Cause of error if a message is rejected.	
		0	No error
		1	Receive Buffer Overflow
		2	Sequence error, i.e. an error was detected with the fragment number transferred from the control, the number of remaining fragments or the fragment size.
		3	No available command-interpreter buffer
		4	Invalid maximum fragment length
		5	Invalid fragment size
		6	No provision made for further fragments although additional fragments were sent.
0x06	Input data length	Data length of the actual entry information.	

Comments:

Data reset does **not** affect the output data toggle bits.

If fragmentation is used, it must always be ensured on the application side for each fragment that is to be transferred that the output data of input fragmentation object 0x2400 is set before toggle bit is toggled in an input data object.

8.8.21 Object 0x2200 – Activation

The object 0x2200 defines the control signals for activating the device as well as the signals for the control of the result output. It is possible to select between standard data output operation and acknowledge mode.

In acknowledge mode, the control must acknowledge the data reception via the ACK bit before the new data is written into the input area.

After acknowledging the last result, the input data is reset (filled with zeros).

Tab. 8.38: Index 0x2200

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
	Activation	RECORD	40					
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x07	0x07	Number of sub-indecies
0x01	Mode	BOOL	1	PREOP rw	0x00	0x01	0x00	Acknowledge mode
0x02	7-bit alignment	BIT7	7	-	-	-	-	Fill bit
0x03	Number of results	BYTE	8	r	0x00	0xFF	0x00	Number of results
0x04	1-bit alignment	BIT1	1	-	-	-	-	Fill bit
0x05	Data Acknowledge	BOOL	1	rw	0x00	0x01	0x00	Data acknowledgment
0x06	Data Reset	BOOL	1	rw	0x00	0x01	0x00	Data reset
0x07	5-bit alignment	BIT5	5	-	-	-	-	Fill bit

Sub-index information

Tab. 8.39: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Specifies the number of sub-indexes.	
0x01	Mode	The parameter defines the mode in which the communication is operated. This can only be changed via the CoE mailbox service in the PRE-OP state.	
		0	Without ACK
		1	With ACK
0x03	Number of results	This value specifies how many messages are ready to be picked up in the device. Only the messages that are not yet in the buffer are counted!	
0x05	Data acknowledge	This control bit signals that the transmitted data have been processed by the master. Only relevant in handshake mode (with ACK). 0→1 Data has been processed by the master 1→0 Data has been processed by the master	
0x06	Data reset	Deletes results that may have been stored and resets the input data. 0→1 Data reset If the data reset control bit is activated, the following actions are carried out: 1. Deletion of results that may still be stored. 2. Reset of object 0x2300, fragmented result, i.e., even a partially transmitted read result is deleted. 3. Deletion of the input data areas (result data) of objects 0x2000 to 0x2007. The input data of object 0x2450 (device status and control) is not deleted. **Note:** If the device generates several results in sequence without the acknowledge mode having been activated, the input data of the result modules are overwritten with the respective most recently generated result. If a data loss in the control is to be avoided in such a case, mode 1 (with ACK) must be activated.	

8.8.22 Object 0x2300 – Result - fragmented ASCII answers

This object can be used to switch on the fragmentation of the result data. The result data is dependent on the selected result formatting. This can be selected with the webConfig tool.

- Object 0x2300 defines the output of fragmented results (from BPS to control / EtherCAT master).
- To occupy few I/O data, the results may be split into several fragments with this object. The fragments can then be transmitted one after another with a handshake.
- These settings apply to result data objects 0x2000 to 0x2002.

Tab. 8.40: Index 0x2300

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Fragmented result	RECORD	56	--	--	--	--	Fragmented result
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x06	0x06	Number of sub-indecies
0x01	Activate result fragmentation	BOOL	1	r	0x00	0x01	0x00	Result fragmentation activated
0x02	7-bit alignment	BIT7	7	--	--	--	--	Fill bit
0x03	Fragment length	BYTE	8	PREOP rw	0x01	0xFF	0x01	Fragment length
0x04	Fragment number	BYTE	8		0x01	0xFF	0x00	Fragment number
0x05	Remaining fragments	BYTE	8	r	0x01	0xFF	0x00	Remaining fragments
0x06	Fragment size	BYTE	8	r	0x01	0xFF	0x00	Fragment size

Sub-index information

Tab. 8.41: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Specifies the number of sub-indexes.	
0x01	Activate result fragmentation	This sub-object specifies whether the messages are transferred from the device to the control in fragmented form. Fragmentation is automatically activated if the corresponding process data mapping is active.	
		0	Fragmentation inactive
		1	Fragmentation active
0x02	7-bit alignment	7 fill bits	
0x03	Fragment length	The parameter defines the maximum length of the result information per fragment.	
0x04	Fragment number	Current fragment number	
0x05	Remaining fragments	Number of fragments which still have to be read for a complete result.	
0x06	Fragment size	Fragment size always corresponds to the configured fragment length, except for the last fragment.	

8.8.23 Object 0x2400 – Result - fragmented input data

This object can be used to switch on the fragmentation of the entry data. The result data is dependent on the selected result formatting. This can be selected with the webConfig tool.

- Object 0x2400 defines the transfer of fragmented input data (from the control / EtherCAT master to the BPS) to a command interpreter in the device.
- To occupy few I/O data, the entry data may be split into several fragments with this object. The fragments can then be transmitted one after another with a handshake.
- These settings act on input data objects 0x2100 to 0x2102.

Tab. 8.42: Index 0x2400

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Fragmented submission	RECORD	56	--	--	--	--	Fragmented entry
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x06	0x06	Number of sub-indecies
0x01	Activate submission fragmentation	BOOL	1	r	0x00	0x01	0x00	Result - input fragmentation activated
0x02	7-bit alignment	BIT7	7	--	--	--	--	Fill bit
0x03	Fragment length	BYTE	8	PREOP rw	0x01	0xFF	0x01	Fragment length
0x04	Fragment number	BYTE	8		0x01	0xFF	0x00	Fragment number
0x05	Remaining fragments	BYTE	8	r	0x01	0xFF	0x00	Remaining fragments
0x06	Fragment size	BYTE	8	r	0x01	0xFF	0x00	Fragment size

Sub-index information

Tab. 8.43: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Specifies the number of sub-indexes.	
0x01	Activate submission fragmentation	This sub-object specifies whether or not the device accepts fragmented messages from the control Fragmentation is automatically activated if the corresponding process data mapping is active.	
		0	Fragmented entry is not accepted
		1	Fragmented entry is accepted
0x02	7-bit alignment	7 fill bits	
0x03	Fragment length	The parameter defines the maximum length of the result information per fragment.	
0x04	Fragment number	Current fragment number	
0x05	Remaining fragments	Number of fragments which still have to be read for a complete result.	
0x06	Fragment size	Fragment size always corresponds to the configured fragment length, except for the last fragment.	

NOTICE
If fragmentation is used, it must be ensured in the application for each fragment that is to be transmitted that the output data of this object is set before the toggle bit of the input data is toggled.

8.8.24 Object 0x2450 – Device status

This object contains the display of the device status as well as the possibility for event acknowledgment.

Tab. 8.44: Index 0x2450

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Device Status and Device Control	RECORD	32	--	--	--	--	Device status and control
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x04	0x04	Number of sub-indecies
0x01	Device state	BYTE	8	r	0x00	0x81	0x00	Device status
0x02	Error acknowledge	BOOL	1	rw	0x00	0x01	0x00	Acknowledgment of errors/warnings
0x03	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x04	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x05	5-bit alignment	BIT5	5	--	--	--	--	Fill bit

Sub-index information

Tab. 8.45: Information on the sub-indecies

Sub-index	Name	Description	
0x00	No. of sub-index	Specifies the number of sub-indexes.	
0x01	Device state	This byte represents the device status.	
		0x0A	Standby
		0x0B	Service mode
		0x0F	Device is ready
		0x80	Error
		0x81	Warning
0x03	Error acknowledge	This control bit confirms and deletes errors or warnings that may be present in the system. It acts like a toggle bit. 0→1 Error acknowledge 1→0 Error acknowledge	

8.8.25 Object 0x2610 – Device-specific control functions

This object contains device-specific control functions that are realized via the generic device access function functionality of the device-specific status and control functions.

Tab. 8.46: Index 0x2610

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
--	Binary Command	RECORD	32	--	--	--	--	Binary control data
0x00	No. of sub-index	UNSIGNED INT16	16	r	0x00	0x09	0x09	Number of sub-indecies
0x01	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x02	1-bit alignment	BIT1	1	--	--	--	-	Fill bit
0x03	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x04	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x05	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x06	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x07	New binary command toggle	BOOL	1	rw	0x00	0x01	0x00	Toggle bit for new binary query
0x08	1-bit alignment	BIT1	1	--	--	--	--	Fill bit
0x09	Binary Command	BYTE	8	rw	0x00	0xFF	0x00	Command byte

Sub-index information

The following binary commands are supported in object 0x160A in sub-index 9:

Tab. 8.47: Sub-index 0x09 Command byte

Command	Description
0xF4	Start positioning
0xF5	Stop positioning
0xFC	Acknowledge diagnostic information
0xFD	Activate standby
0xFE	Preset teach
0xFF	Preset reset

8.8.26 Object 0x2900 – Serial number

This string contains the complete Leuze serial number.

Tab. 8.48: Index 0x2900

Sub-index	Name	Data type	Size (bit)	Access	Value range minimum	Value range maximum	Value range default	Comment
	Serial number	STR(16)	8	r	--	--	--	Leuze serial number

8.9 Online commands

8.9.1 General online commands

Tab. 8.49: Software version number

Command	**'V'**
Description	Requests device version information.
Parameter	None
Acknowledgment	**'BPS 338i SM 100 V 1.7.0 2018-08-09'** The first line contains the device type, followed by the device version number and version date. The data which is actually displayed may vary from the values given here.

NOTICE

This command returns the major release number of the software packet. This major release number also appears on the display during start-up.

Tab. 8.50: Software reset

Command	**'H'**
Description	Carries out a software reset. The device is restarted and reinitialized, leaving it in the same state as when the supply voltage is switched on.
Parameter	None
Acknowledgment	**'S'** (start signal)

8.9.2 PT sequence

By means of a **PT** sequence (**P**arameter **T**ransfer), the BPS can be configured via the control (EtherCAT master).

Depending on the length of the PT command structure, three objects are available that differ in the length of the user data bytes:

Tab. 8.51: PT command objects

Object	Description
0x1600	Receive PDO (control → BPS) ASCII for 8-byte PT command structures Mapping with object **0x2100**
0x1601	Receive PDO (control → BPS) ASCII for 16-byte PT command structures Mapping with object **0x2101**
0x1602	Receive PDO (control → BPS) ASCII for 32-byte PT command structures Mapping with object **0x2102**

Structure of the PT sequences

Depending on the data type, the parameters are depicted as follows for the parameter value address:

Tab. 8.52: Parameter conversion from HEX to ASCII

Data type	Decimal value	ASCII-HEX format	Fictive PT sequence (address 1234)
BYTE	10	"0A" (2 characters)	"PT00212340A"
WORD	10	"000A" (4 characters)	"PT0021234000A"
DWORD	10	"0000000A" (8 characters)	"PT00212340000000A"
STRING	10	"313000" (6 characters)	"PT0021234313000"

NOTICE

The default setting for <**BCC type** > is 0, i.e., no check digit.

NOTICE

List of the possible parameters: see chapter 8.10 "PT sequence parameters".

NOTICE

A PS sequence follows each PT sequence as answer.

The syntax command for PT sequences is composed as follows:

Tab. 8.53: PT sequence

Command	**'PT'**		
Description	The parameters of the BPS are grouped together in a parameter set and permanently stored in memory. There is one parameter set in permanent memory and one operating parameter set in main memory. In addition, there is a default or factory parameter set for initialization. With the PT command, the parameters can be changed in permanent memory or main memory.		
Parameter	**PT<BCC type><PS type><Status><Address><Parameter value address><Parameter value address +1> ….[;<Address><Parameter value address><Parameter value address +1>]**		
	<BCC type>	Check-digit function during transmission	
		0	No check digits
	<PS type>	Memory in which the values are to be written	
		0	Store parameters in permanent memory (flash)
		3	Store parameters in main memory (RAM)
	<**Status**>	Mode of parameter processing	
		0	No processing after parameter change, no further parameter messages follow.
		1	No processing after parameter change, further parameter messages follow.
		2	With processing after parameter change, no further parameter messages follow.
	<Address>	*'aaaa'*: Relative address of the data within the data set. Address is entered in the PT sequence with four-digit decimal input	
	<**Parameter value address**>	*'bb'*: Parameter value of the parameter stored at this address. The parameter set data is converted from HEX format to an ASCII format for transfer. During the conversion, two ASCII characters are created for each HEX value. Depending on the data type, the parameters are depicted differently (see table below).	
	<Parameter value address +1>	If parameters whose addresses **<Address>** are listed sequentially are changed, then the subsequent address (**<Address+1>**) does not need to be programmed in the PT syntax. The parameter value **<Parameter value address +1>** of the subsequent address can be directly programmed in the syntax.	
	;<Address><Parameter value address><Parameter value address +1>	If parameters whose addresses **<Address>** are not sequentially listed are changed, then the new parameter address **<Address>** must be programmed in the PT syntax with the subsequent parameter value, using a semicolon **";"** as delimiter. If other parameters successively follow this new address **<parameter value address +1>**, the subsequent address (**<Address+1>**) does not need to be programmed in the PT syntax.	

8.9.3 PS sequence

By means of a **PS** sequence (**P**arameter **S**tatus), the BPS responds to the control (EtherCAT master) and transfers the status or acknowledges the PT command that was sent in advance.

The PS answer always consists of five characters. If exclusively PT sequences are used, only object 0x1A00 makes sense. If other commands, such as "V" or PR sequences are also used, objects 0x1A01 and 0x1A02 make sense as well.

Tab. 8.54: PS answer objects

Object	Description
0x1A00	Transmit-PDO (BPS → control) ASCII for 8-byte PS answers Mapping with object **0x2000**
0x1A01	Transmit-PDO (BPS → control) ASCII for 16-byte PS answers Mapping with object **0x2001**
0x1A02	Transmit-PDO (BPS → control) ASCII for 32-byte PS answers Mapping with object **0x2002**

Structure of the PS sequences

The syntax command for PS sequences is composed as follows:

Tab. 8.55: PS sequence

Command	**'PS'**		
Description	The PS sequence is the status response to the PT command.		
Parameter	**PS = <aa>**		
	<aa>	Status response to the PT command	
		00	Ok
		01	Syntax error
		02	Impermissible command length
		03	Impermissible value for checksum type
		04	Invalid check sum received
		05	Impermissible data length
		06	Invalid data (parameter limits violated)
		07	Invalid start address
		08	Error while saving
		09	Invalid parameter set
		10	Action not allowed – access permissions missing

NOTICE

Status response PS=00 indicates that the parameter transfer (PT command) was successfully completed.

8.9.4 Communication example

In the following communication example, PT sequence "PT002000804" is sent to the BPS 338i with and without fragmentation.

Value 04 is sent to address 0008 (integration depth). For this purpose, object 0x2101 is written with PT sequence "PT002000804" in the control. Object 0x2101 is mapped to PDO 0x1601 and is cyclically transferred to the BPS 338i.

The answer of the BPS 338i "PS=00" is written in object 0x2000. Object 0x2000 is mapped to PDO 0x1A00 and is cyclically transferred to the control.

Case 1 - without fragmentation:

- PDO 0x1601 - Receive-PDO ASCII 16 Byte
- PDO 0x1A00 - Transmit-PDO ASCII 8 Byte

Case 2 - with fragmentation:

- PDO 0x1600 - Receive-PDO ASCII 8 Byte
- PDO 0x1A00 - Transmit-PDO ASCII 8 Byte
- PDO 0x1620 - Fragmentation of the Receive-PDO ASCII data

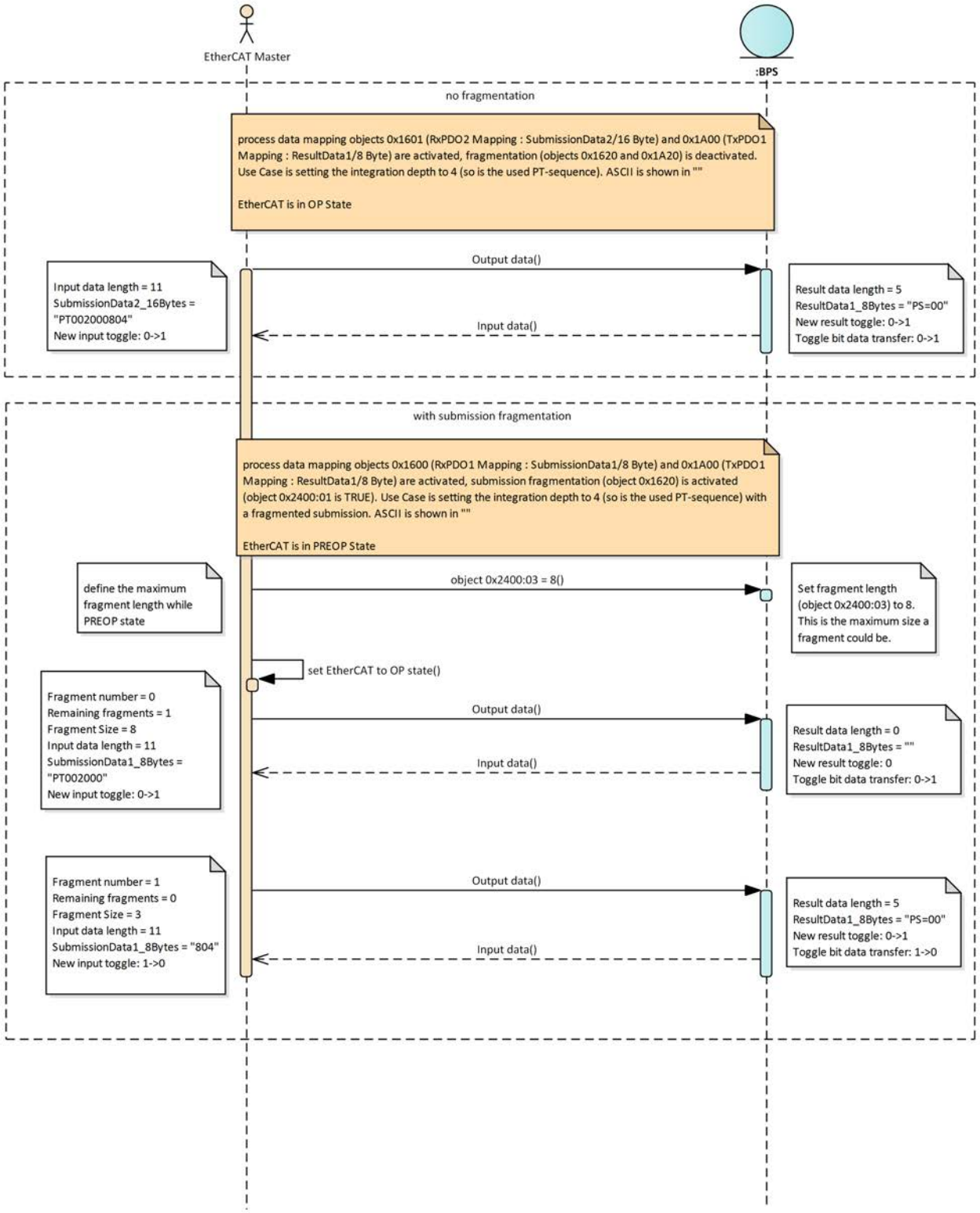


Fig. 8.2: Sequence diagram: integration depth parameter (address 0008) is changed to the value 4 (04).

8.9.5 PR sequence

NOTICE

Following each PR sequence as an answer is a PS or PT sequence.

The syntax command for PR sequences is composed as follows:

Tab. 8.56: PR sequence

Command	**'PR'**		
Description	The parameters of the BPS are grouped together in a parameter set and permanently stored in memory. There is one parameter set in permanent memory (flash) and one operating parameter set in main memory (RAM). With the PR command, the parameters can be read from the permanent memory or the main memory.		
Parameter	**PR<BCC-Type><PS-Type><Status><Address><Data length>**		
	<BCC type>	Check-digit function during transmission	
		0	No check digits
	<PS type>	Memory from which the values are to be read.	
		1	Read parameters from the permanent memory (flash)
		3	Read parameters from the main memory (RAM)
	<Address>	*'aaaa'*: Relative address of the data within the data set. Address is entered in the PR sequence with four-digit decimal input.	
	<Data length>	*'bb'*: The length of the parameter data to be transferred in four digits. The unit/length is in bytes.	
Acknowledgment	The PR command **PR<BCC-Type><PS-Type><Status><Address><File length>** is followed by the positive status response with a PT sequence (see chapter 8.9.2 "PT sequence"). The negative status response takes place by means of a PS sequence. The syntax command for PS sequences is composed as follows: **PS = <aa>**		
	<aa>	Status response to the PR command	
		01	Syntax error
		02	Impermissible command length
		03	Impermissible value for checksum type
		04	Invalid check sum received
		05	Impermissible number of data requested
		06	Requested data does not (any longer) fit in the transmission buffer
		07	Impermissible address value
		08	Read access after end of data set
		09	Impermissible parameter set type
		10	Action not allowed – access permissions missing

NOTICE

The default setting for <**BCC type** > is 0, i.e., no check digit.

NOTICE

A PT sequence indicates that the PR command was successfully performed.

8.9.6 PC sequence

NOTICE

A PS sequence follows each PC sequence as answer.

The syntax command for PC sequences is composed as follows:

Tab. 8.57: PC sequence

Command	**'PC'**		
Description	This command can only be used to copy parameter sets in their entirety. This can be used to replicate the three parameter sets consisting of default (factory parameters), permanent (flash) and operating parameters (RAM) on the basis of one another.		
Parameter	**PC<Source type><Target type>**		
	<Source type>	Parameter set that is to be copied.	
		0	Parameter data set in permanent memory (flash)
		2	Default or factory parameter set
		3	Operating parameter data set in main memory (RAM)
	<Target type>	Parameter set into which the data is to be copied.	
		0	Parameter data set in permanent memory (flash)
		3	Operating parameter data set in main memory (RAM)
		Permissible combinations here include:	
	03	Copy the parameter set from permanent memory (flash) to the memory for operating parameters (RAM).	
	30	Copy the parameter set from the main memory (RAM) to the memory for the permanent data (flash).	
	20	Copy the default parameters (factory parameters) to the memory for permanent data (flash) and to the memory for operating parameters.	

Acknowledgment	The PC command **PC<Source type><Target type>** is followed by the status response with a PS sequence. The syntax command for PS sequences is composed as follows: **PS = <aa>**		
	<aa>	Status response to the PS command	
		00	Ok
		01	Syntax error
		02	Impermissible command length
		06	Impermissible combination of parameter set source type and target type
		08	Error while saving the parameter set
		10	Action not allowed – access permissions missing

NOTICE

Status response PS=00 shows that the PR command was successfully performed.

8.10 PT sequence parameters

The configurable parameters are described in the following tables.

Important details are the address as well as the parameter value of the address, as this data is programmed directly in the PT sequence.

PT<BCC type><PS type><Status><Address><Parameter value address><Parameter value address +1> ….[;<Address><Parameter value address><Parameter value address +1>][<BCC>]

Data type

The data type determines the form and length of the parameter value (BOOL, BYTE, WORD, DWORD or STR).

Tab. 8.58: Data types

Data type	Comment
BOOL	Contains the logical value True (=1) or False (=0).
BYTE	Whole or natural numbers with 8-bit length
WORD	Whole or natural numbers with 16-bit length
DWORD	Whole or natural numbers with 32-bit length
STR	Character string of arbitrary length

8.10.1 Digital switching input/output 1

Port configuration

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Port configuration	550	BYTE	0	2	1	The parameter determines whether the Digital I/O port 1 is to be used as an output, input, or passive port. 0 = Input 1 = Output 2 = Passive

Function: Switching outputs

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Position limit 1	3301	BOOL	0	1	0	The output is activated if the upper or lower switching point of position limit 1 is exceeded. 0 = Not activated 1 = Activated
Position limit 2	3302	BOOL	0	1	0	The output is activated if the upper or lower switching point of position limit 2 is exceeded. 0 = Not activated 1 = Activated
Speed limit	3303	BOOL	0	1	0	The output is activated if an active speed value is exceeded. 0 = Not activated 1 = Activated
Invalid position	3304	BOOL	0	1	1	The output is set in the case of an invalid position value. 0 = Not activated 1 = Activated
Invalid speed	3305	BOOL	0	1	0	The output is set if no valid speed can be calculated. 0 = Not activated 1 = Activated

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Quality warning threshold	3306	BOOL	0	1	0	If the ascertained reading quality is below the configured warning threshold, the output is set. 0 = Not activated 1 = Activated
Quality error threshold	3307	BOOL	0	1	0	If the ascertained reading quality is below the configured error threshold, the output is set. 0 = Not activated 1 = Activated
Device error	3308	BOOL	0	1	0	The output is set if a device error is detected. 0 = Not activated 1 = Activated
Marker bar code or control bar code detected	3314	BOOL	0	1	0	The output is activated as long as a marker bar code or control bar code is detected. 0 = Not activated 1 = Activated
Switching output inverted	580	BOOL	0	1	0	1 = Bias level on output HIGH 0 = Bias level on output LOW = 0 V
Start-up delay	581	WORD	0	65535	0	Start-up delay of the switching output in ms.

Function: Switching inputs

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Switching input functions	3000	BYTE	0	3	0	Switching input function 0 = No function 1 = Measurement start/stop 2 = Preset teach 3 = Preset reset
Switching input inverted	560	BOOL	0	1	0	This parameter determines whether the logic level of the switching input is to be inverted internally or not TRUE (1): External HIGH level at switching input is internally interpreted as LOW level. 0 = Not activated 1 = Activated
Debounce time	561	WORD	0	1000	5 ms	Debounce time in ms
Start-up delay	563	WORD	0	65535	0	Start-up delay of the switching input in ms.
Switch-off delay	567	WORD	0	65535	0	Switch-off delay of the switching input in ms.
Signal delay	570	WORD	0	65535	0	Switching input signal delay of the switching input in ms.
Pulse duration	565	WORD	0	65535	0	The minimum activation period of the switching input is specified in ms. If the value of this parameter is equal to 0, the minimum activation period need only to be greater than the debounce time.

8.10.2 Digital switching input/output 2

Port configuration

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Port configuration	600	BYTE	0	2	0	The parameter determines whether the Digital I/O port 2 is to be used as an output, input, or passive port. 0 = Input 1 = Output 2 = Passive

Function: Switching outputs

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Position limit 1	3331	BOOL	0	1	0	The output is activated if the upper or lower switching point of position limit 1 is exceeded. 0 = Not activated 1 = Activated
Position limit 2	3332	BOOL	0	1	0	The output is activated if the upper or lower switching point of position limit 2 is exceeded. 0 = Not activated 1 = Activated
Speed limit	3333	BOOL	0	1	0	The output is activated if an active speed value is exceeded. 0 = Not activated 1 = Activated
Invalid position	3334	BOOL	0	1	0	The output is set in the case of an invalid position value. 0 = Not activated 1 = Activated
Invalid speed	3335	BOOL	0	1	0	The output is set if no valid speed can be calculated. 0 = Not activated 1 = Activated

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Quality warning threshold	3336	BOOL	0	1	0	If the ascertained reading quality is below the configured warning threshold, the output is set. 0 = Not activated 1 = Activated
Quality error threshold	3337	BOOL	0	1	0	If the ascertained reading quality is below the configured error threshold, the output is set. 0 = Not activated 1 = Activated
Device error	3338	BOOL	0	1	0	The output is set if a device error is detected. 0 = Not activated 1 = Activated
Marker bar code or control bar code detected	3344	BOOL	0	1	0	The output is activated as long as a marker bar code or control bar code is detected. 0 = Not activated 1 = Activated
Switching output inverted	630	BOOL	0	1	0	1 = Bias level on output HIGH 0 = Bias level on output LOW = 0 V
Start-up delay	631	WORD	0	65535	0	Start-up delay of the switching output in ms.

Function: Switching inputs

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Switching input functions	3330	BYTE	0	3	2	Switching input function 0 = No function 1 = Measurement start/stop 2 = Preset teach 3 = Preset reset
Switching input inverted	610	BOOL	0	1	0	This parameter determines whether the logic level of the switching input is to be inverted internally or not. 1 = An external HIGH level at the switching input is internally interpreted as LOW level.
Debounce time	611	WORD	0	1000	5 ms	Debounce time in ms.
Start-up delay	613	WORD	0	65535	0	Start-up delay of the switching input in ms.
Switch-off delay	617	WORD	0	65535	0	Switch-off delay of the switching input in ms
Signal delay	620	WORD	0	65535	0	Switching input signal delay of the switching input in ms.
Pulse duration	615	WORD	0	65535	0	The minimum activation period of the switching input is specified in ms.

8.10.3 Settings for the bar code tape

Bar code tape configuration

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Tape type	0000	BYTE	1	2	2	Configures the used bar code tape 1 = 30 mm (BCB G30 …) 2 = 40 mm (BCB G40 …)

Tape value correction tape 1

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Real length [1/10 mm]	2248	BYTE	1	65535	10000	Real length
Range start [1 mm]	2240	DWORD	0	10000000	0	The tape value is corrected with the real length starting from this position.
Range end [1 mm]	2244	DWORD	0	10000000	10000000	The tape value is corrected with the real length up to this position.

Tape value correction tape 2

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Real length [1/10 mm]	2258	BYTE	1	65535	10000	Real length
Range start [1 mm]	2250	DWORD	0	10000000	0	The tape value is corrected with the real length starting from this position.
Range end [1 mm]	2254	DWORD	0	10000000	10000000	The tape value is corrected with the real length up to this position.

Tape value correction tape 3

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Real length [1/10 mm]	2268	BYTE	1	65535	10000	Real length
Range start [1 mm]	2260	DWORD	0	10000000	0	The tape value is corrected with the real length starting from this position.
Range end [1 mm]	2264	DWORD	0	10000000	10000000	The tape value is corrected with the real length up to this position.

Tape value correction tape 4

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Real length [1/10 mm]	2278	BYTE	1	65535	10000	Real length
Range start [1 mm]	2270	DWORD	0	10000000	0	The tape value is corrected with the real length starting from this position.
Range end [1 mm]	2274	DWORD	0	10000000	10000000	The tape value is corrected with the real length up to this position.

8.10.4 Configuration of position monitoring

Detection

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Integration depth	0008	BYTE	1	16	8	Number of successive measurements (1 ms per measurement interval) that the BPS uses for position determination.

Preset

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Preset activated	2032	BOOL	0	1	0	Activates the preset function 0 = Not activated 1 = Activated
Preset value (mm)	2036	DWORD	-10000000	10000000	0	Preset value for correction of the position value. The preset value is accepted following a corresponding event (switching input or object 0x2010 sub-index 09). Afterward, the output value corresponds to the preset value.

Offset

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Offset activated	2024	BOOL	0	1	0	Activates the offset function 0 = Not activated 1 = Activated
Offset value [mm]	2028	DWORD	-10000000	10000000	0	The offset value is added to the measurement value, i.e., output value = measurement value + offset. The offset is only used if there is no preset activated.

Error case

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Delay period	2074	WORD	10	10000	50	If an invalid measurement value is detected, the delay time (ms) starts. During this time, the last ascertained measurement value and status are output.
Status delayed	2076	BOOL	0	1	1	The status that an invalid measurement value is detected can be delayed with the parameter. 0 = Not activated 1 = Activated
Measurement value error delay	2077	BOOL	0	1	1	Defines whether the last-valid measurement value is output during the delay period. 0 = Not activated 1 = Activated
Position value in the case of failure	2078	BYTE	0	1	1	Position values in the case of failure: 0 = Last valid value 1 = Zero

Position limit value range 1

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2079	BOOL	0	1	0	Defines a distance range with lower and upper limits. If the measured position value lies outside of configured range, the corresponding status bit is set. 0 = Not activated 1 = Activated
Lower limit value	2093	DWORD	-10000000	10000000	0	Lower position limit value
Upper limit value	2083	DWORD	-10000000	10000000	0	Upper position limit value

Position limit value range 2

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2099	BOOL	0	1	0	Defines a distance range with lower and upper limits. If the measured position value lies outside of configured range, the corresponding status bit is set. 0 = Not activated 1 = Activated
Lower limit value	2113	DWORD	-10000000	10000000	0	Lower position limit value
Upper limit value	2103	DWORD	-10000000	10000000	0	Upper position limit value

8.10.5 Configuration of speed monitoring

Detection

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Speed value averaging	2120	BYTE	1	32	4	Number of sequential values that are averaged for calculating the output speed.

Error case

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Status delayed	2130	BOOL	0	1	1	If an invalid measurement value is detected, the status can be signaled either immediately or not until after the delay time has elapsed. Brief disturbances can thereby be suppressed in the measurement value determination. 0 = Not activated 1 = Activated
Delay period	2128	WORD	10	10000	50	If an invalid measurement value is detected, the delay time (ms) starts. During this time, the last ascertained measurement value and status are output.
Measurement value error delay	2131	BOOL	0	1	1	Defines whether the last-valid speed value is output during the delay period. 0 = Not activated 1 = Activated
Speed in the case of failure	2132	WORD	0	1	1	Speed values in the case of failure 0 = Last valid value 1 = Zero

Speed limit value range 1

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2136	BOOL	0	1	0	Activates the speed limit value function. 0 = Not activated 1 = Activated
Limit value [mm/s]	2140	WORD	0	20000	0	Defines the switching point for the speed limit value.
Hysteresis [mm/s]	2137	WORD	0	1000	100	Relative shift of the switching point to prevent signal bouncing.

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Switching type	2139	BYTE	0	1	1	Defines whether the speed limit value switches if the value is exceeded or is not met. 0 = If below limit value 1 = If above limit value
Activate direction dependence	2142	BOOL	0	1	0	Configured here is whether the speed test is dependent on direction. 0 = Direction independent 1 = Direction dependent
Range start [mm]	2143	DWORD	-10000000	10000000	0	The speed limit value is monitored beginning at this position.
Range end [mm]	2147	DWORD	-10000000	10000000	0	The speed limit value is monitored up to this position.

Speed limit value range 2

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2154	BOOL	0	1	0	Activates the speed limit value function. 0 = Not activated 1 = Activated
Limit value [mm/s]	2158	WORD	0	20000	0	Defines the switching point for the speed limit value.
Hysteresis [mm/s]	2155	WORD	0	1000	100	Relative shift of the switching point to prevent signal bouncing.
Switching type	2157	BYTE	0	1	1	Defines whether the speed limit value switches if the value is exceeded or is not met. 0 = If below limit value 1 = If above limit value

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate direction dependence	2160	BOOL	0	1	0	Configured here is whether the speed test is dependent on direction. 0 = Direction independent 1 = Direction dependent
Range start [mm]	2161	DWORD	-10000000	10000000	0	The speed limit value is monitored beginning at this position.
Range end [mm]	2165	DWORD	-10000000	10000000	0	The speed limit value is monitored up to this position.

Speed limit value range 3

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2172	BOOL	0	1	0	Activates the speed limit value function. 0 = Not activated 1 = Activated
Limit value [mm/s]	2176	WORD	0	20000	0	Defines the switching point for the speed limit value.
Hysteresis [mm/s]	2173	WORD	0	1000	100	Relative shift of the switching point to prevent signal bouncing.
Switching type	2175	BYTE	0	1	1	Defines whether the speed limit value switches if the value is exceeded or is not met. 0 = If below limit value 1 = If above limit value
Activate direction dependence	2178	BOOL	0	1	0	Configured here is whether the speed test is dependent on direction. 0 = Direction independent 1 = Direction dependent
Range start [mm]	2179	DWORD	-10000000	10000000	0	The speed limit value is monitored beginning at this position.

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Range end [mm]	2183	DWORD	-10000000	10000000	0	The speed limit value is monitored up to this position.

Speed limit value range 4

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Activate limit value range	2190	BOOL	0	1	0	Activates the speed limit value function. 0 = Not activated 1 = Activated
Limit value [mm/s]	2194	WORD	0	20000	0	Defines the switching point for the speed limit value.
Hysteresis [mm/s]	2191	WORD	0	1000	100	Relative shift of the switching point to prevent signal bouncing.
Switching type	2193	BYTE	0	1	1	Defines whether the speed limit value switches if the value is exceeded or is not met. 0 = If below limit value 1 = If above limit value
Activate direction dependence	2196	BOOL	0	1	0	Configured here is whether the speed test is dependent on direction. 0 = Direction independent 1 = Direction dependent
Range start [mm]	2197	DWORD	-10000000	10000000	0	The speed limit value is monitored beginning at this position.
Range end [mm]	2201	DWORD	-10000000	10000000	0	The speed limit value is monitored up to this position.

8.10.6 Configuration of the measurement value display

Measurement value display

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Unit	2000	BYTE	0	1	0	Unit 0 = Metric 1 = Inch
Counting direction	2001	BYTE	0	1	0	Counting direction 0 = Positive 1 = Negative
Sign of position value	2017	BYTE	0	1	0	Output mode of the sign as two's complement or as sign and magnitude. 0 = Two's complement 1 = Sign + magnitude
Sign of speed value	2121	BYTE	0	1	0	Output mode of the sign as two's complement or as sign and magnitude. 0 = Two's complement 1 = Sign + magnitude

8.10.7 Configuration of the read quality

Reading quality

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Reading quality warning threshold	178	BYTE	0	100	60	Below the threshold, the BPS generates a warning message.
Reading quality error threshold	179	BYTE	0	100	30	Below the threshold, the BPS generates an error message.
Smoothing factor	175	BYTE	0	100	5	Insensitivity towards changes of the quality. The higher this value is, the less of an effect a change has on the reading quality.

8.10.8 Output preparation for the EtherCAT interface

Output preparation

Function	Address	Data type	Parameter value range minimum	Parameter value range maximum	Parameter value range default	Comment
Resolution of the position value	3666	BYTE	2	5	3	Resolution of the position value: 2 = 1/100 mm 3 = 1/10 mm 4 = 1 mm 5 = 10 mm
Speed value resolution	3667	BYTE	1	3	1	Resolution of the speed value: 1 = 1 mm/s 2 = 10 mm/s 3 = 100 mm/s

9 Starting up the device – webConfig tool

With the Leuze webConfig tool, a web-technology based, graphical user interface is available for configuring the BPS.

The webConfig tool can be run on any Internet-ready PC. The webConfig tool uses HTTP as communication protocol and the client-side restriction to standard technologies (HTML, JavaScript and AJAX) that are supported by modern browsers.

NOTICE
The webConfig tool is offered in the following languages: German, English, French, Italian, Spanish

9.1 Installing software

In order for the BPS to be automatically detected by the connected PC, the USB driver must be installed once on your PC. Administrator rights are required for driver installation.

NOTICE
If a USB driver for the webConfig tool is already installed on your computer, the USB driver does not need to be installed again. If USB either should not or cannot be used, the EtherCAT master must support the EoE service.

9.1.1 System requirements

NOTICE
Regularly update the operating system and the Internet browser. Install the current Windows Service Packs.

Tab. 9.1: webConfig system requirements

Operating system	Windows 10 (recommended) Windows 8, 8.1 Windows 7
Computer	PC, laptop or tablet with USB interface, version 1.1 or higher
Graphics card	Min. resolution: 1280 x 800 pixels
Required disk space for USB driver	10 MB
Internet browser	Recommended is a current version of Mozilla Firefox Google Chrome Microsoft Edge Note: Other Internet browsers are possible but have not been tested with the current device firmware.

9.1.2 Install USB driver

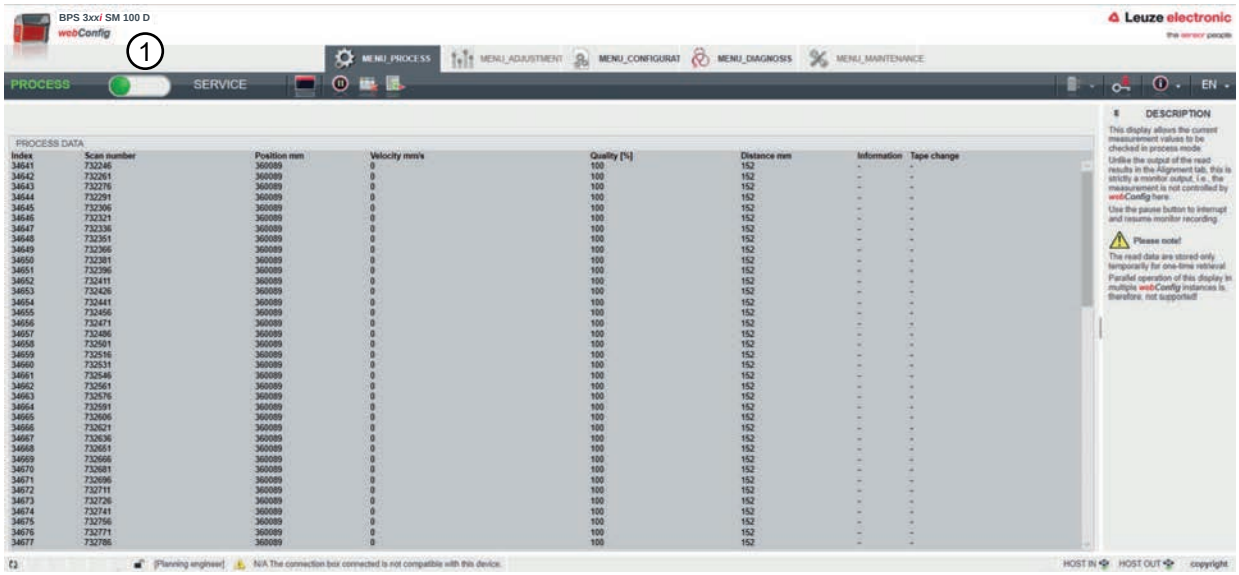
- Start your PC with administrator privileges and log on.
- Download the setup program from the Internet:
  www.leuze.com > Products > Measuring Sensors > Bar Code Positioning Systems > BPS 300i > (Name of the BPS) > Tab **Downloads > Software/driver**.
- Start the setup program and follow the instructions.

NOTICE
Alternatively, you can manually install the **LEO_RNDIS.inf** USB driver. Contact your network administrator if the installation fails.

9.2 Start webConfig tool

Prerequisite: The Leuze USB driver for the webConfig tool is installed on the PC.

- Connect the operating voltage to the BPS.
- Connect the SERVICE USB interface of the BPS to the PC.
  The connection to the SERVICE USB interface of the BPS is established via the PC-side USB interface.
  Use a standard USB cable with one Type A plug and one Mini-B type plug.
- Start the webConfig tool using your PC's Internet browser with IP address **192.168.61.100**
  This is the default Leuze service address for communication with bar code positioning systems of the BPS 300i series.
- ⇨ The webConfig start page appears on your PC.



1 Changing the operating mode **Process** – **Service** (upper left)

Fig. 9.1: The start page of the webConfig tool

The user interface of the webConfig tool is largely self-explanatory.

NOTICE
The webConfig tool is completely contained in the firmware of the BPS. The pages and functions of the webConfig tool may appear and be displayed differently depending on the firmware version.

Clear browser history

The cache of the Internet browser is to be cleared if different device types or devices with different firmware were connected to the webConfig tool.

↳ Delete cookies and temporary Internet and website data from browser history before starting the web-Config tool.

Note limit of Firefox sessions for version 30.0 and higher

If the limited number of Firefox sessions is exceeded, it may no longer be possible to address the BPS via the webConfig tool.

↳ Do **not** use the Internet browser's refresh function:
[Shift] [F5] or [Shift] + mouse click

9.3 Short description of the webConfig tool

9.3.1 Overview

Operating modes

For configurations with the webConfig tool, you can switch between the following operating modes:

- **Process**

  The BPS is connected to the control.
  - The process communication to the control is activated.
  - The switching inputs/outputs are activated.
  - Configuration and diagnostics functions available, cannot be changed.
  - *PROCESS* function available.
  - Alignment and maintenance functions not available.
- **Service**
  - The process communication to the control is interrupted.
  - The switching inputs/outputs are deactivated.
  - The configuration can be changed.
  - *PROCESS* function not available.
  - Alignment, configuration, diagnostics and maintenance functions available.

Process operating mode

In the *Process* operating mode, the webConfig tool has the following main menus and functions:

- *PROCESS*

  Check and save the current read data in process mode (see chapter 9.3.2 "PROCESS function").
  - Tabular display of the following values:

    Scan number, position, speed, reading quality, distance from BCB, info on the control label
- *CONFIGURATION* (see chapter 9.3.4 "CONFIGURATION function")

Information on the current BPS configuration – no change to the configuration:

- Selection of the used bar code tape (30 mm grid or 40 mm grid)
- Display of the tape value correction (deviation of the BCB from scaling)
- Display of the device components (switching inputs/outputs, display)
- Data processing (position/speed detection or monitoring, data preparation)
- Display of the warning threshold and the error threshold for the reading quality

Service operating mode

In the *Service* operating mode, the webConfig tool also has the following main menus and functions:

- *ALIGNMENT* (see chapter 9.3.3 "ALIGNMENT function")
  - Display of the following values:
    Scan number, position, speed, quality, distance, number of labels in the scanning beam
  - Graphical displays of the following values:
    Position, speed, quality
- *CONFIGURATION* (see chapter 9.3.4 "CONFIGURATION function")
  - Configuration of device components (switching inputs/outputs, display)
  - Selection of the used bar code tape
  - Configuration of the data processing (position/speed detection or monitoring, data preparation)
  - Configuration of the warning threshold and the error threshold for the reading quality
- *DIAGNOSIS* (see chapter 9.3.5 "DIAGNOSIS function")
  - Event logging of warnings and errors.
- *MAINTENANCE* (see chapter 9.3.6 "MAINTENANCE function")
  - Firmware update
  - User management
  - Backup/Restore

9.3.2 PROCESS function

The *PROCESS* function serves to control the current measurement data in the *Process* operating mode.
The measurement results are output in tabular form – strictly as monitor output.
The **Pause/Start** icon can be used to interrupt and resume monitor recording.

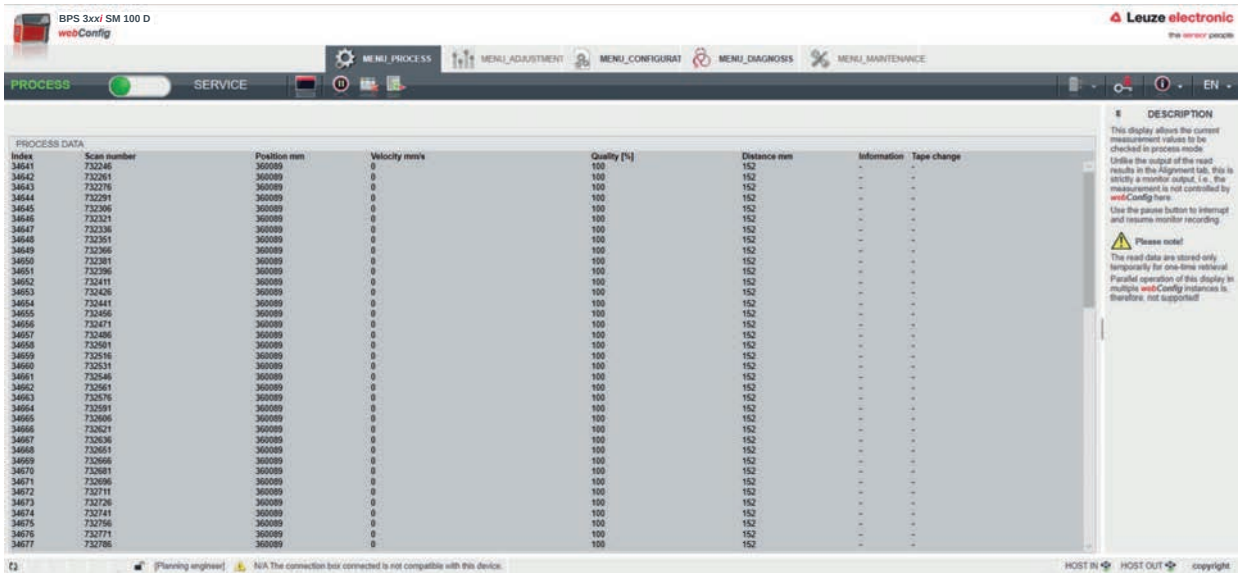


Fig. 9.2: *PROCESS* webConfig function

9.3.3 ALIGNMENT function

NOTICE
***ALIGNMENT* function only in the *Service* operating mode!** ↳ The BPS can only be aligned using the *ALIGNMENT* function in the *Service* operating mode.

The *ALIGNMENT* function serves to simplify mounting and alignment of the BPS. The laser is to be activated via the **Start** icon so that the function can monitor and directly display the measurement values for position and speed and determine the optimum installation location.

In addition, reading quality (in %), working distance and the number of labels in the scanning beam can be displayed. Using this information, it is possible to assess how well the BPS is aligned with the BCB.

NOTICE
During output of the measurement results, the BPS is controlled by the webConfig tool.

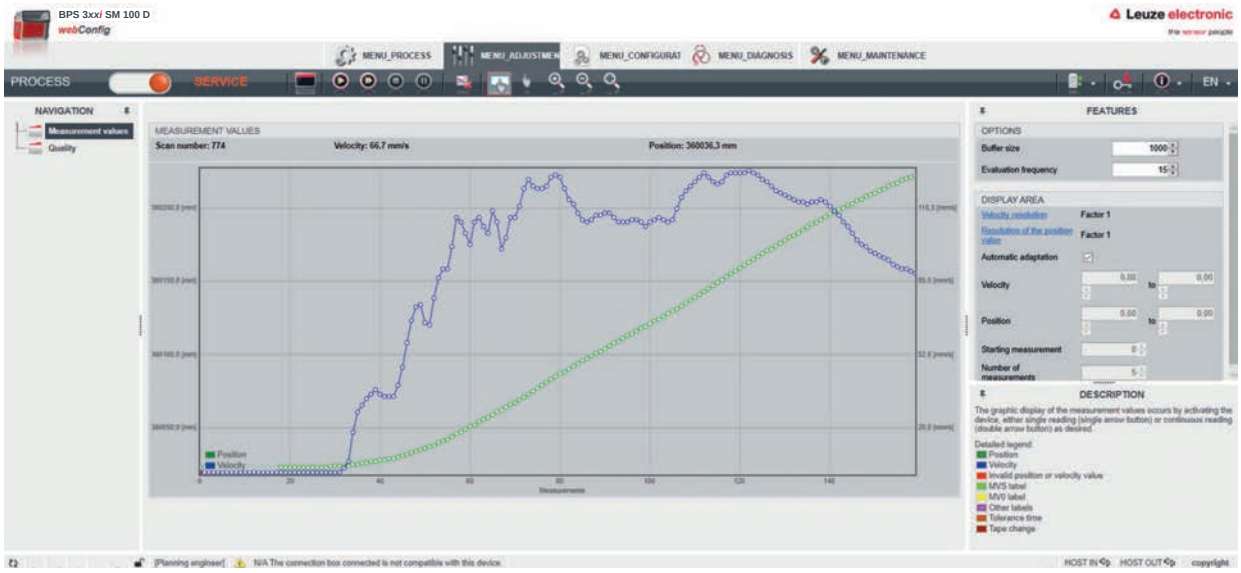


Fig. 9.3: *ALIGNMENT* webConfig function

9.3.4 CONFIGURATION function

NOTICE

Configuration changes only in the *Service* operating mode!

↳ Changes made using the *CONFIGURATION* function can only be performed in the *Service* operating mode.

Overview of the webConfig configuration functions

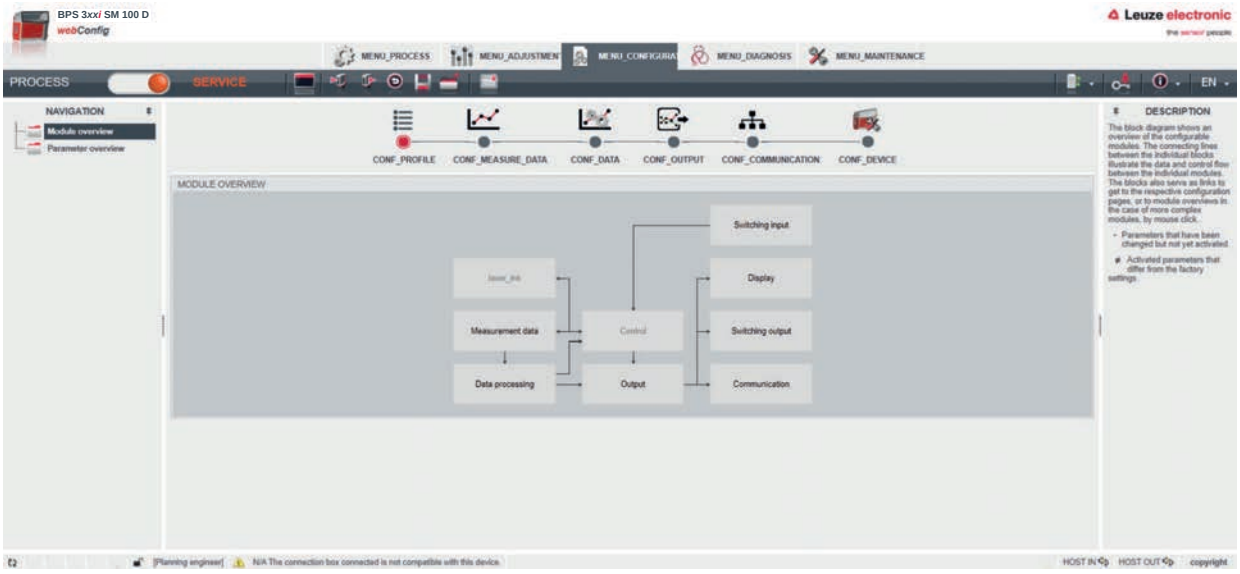


Fig. 9.4: *CONFIGURATION* webConfig function

Configuration of the switching inputs/outputs (*DEVICE* tab)

- I/O mode: switching input or switching output
- Output function
- Input function
- Time behavior functions
  - Signal delay
  - Pulse duration
  - Switch-on/switch-off delay
  - Debounce time
  - Inversion yes/no

Configuring switching outputs

- Select the function symbol for activation of the switching output in the *Functions* area.
- Use the left mouse button to drag the function symbol into the *Activation* window.
- Configure the timing; see "Time behavior functions of the switching inputs/outputs".
- Save the configuration of the switching outputs in the device.
  Click on the icon.

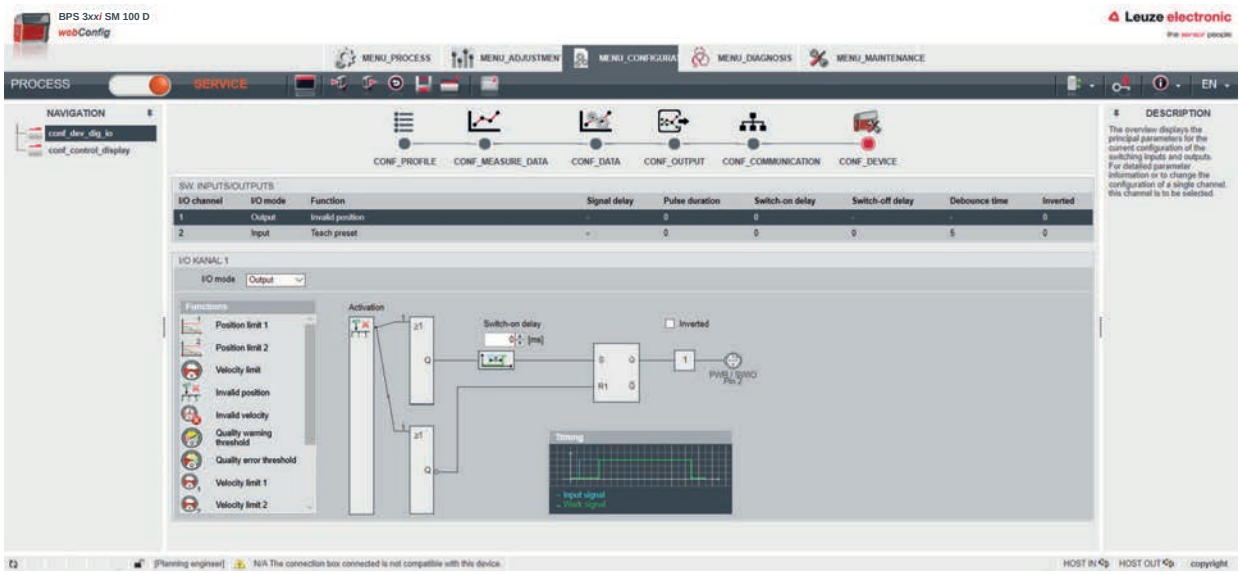


Fig. 9.5: Configuration of the switching outputs

Possible signals via the switching outputs:

- Position limit 1/2
  Signals a value above/below the position limit.
- Invalid position
  Signals that no valid position can be ascertained.
- Speed limit
  Signals a value above/below the speed limit.
- Speed limit value 1-4
  Signals that speed limit value 1-4 has been exceeded or has not been met.
- Invalid speed
  Signals that no valid speed can be ascertained.
- Quality warning threshold
  Signals that the reading quality is less than the warning threshold.
- Quality error threshold
  Signals that the reading quality is less than the error threshold.
- Device error
  Signals a device error.
- Marker bar code or control bar code label detected

Configuring switching inputs

↳ Select the function of the switching input from the *Function* list:

- No function
- Start/stop measurement
- Teach preset
- Reset preset

↳ Configure the timing; see "Time behavior functions of the switching inputs/outputs".

↳ Save the configuration of the switching inputs in the device.
Click the symbol.

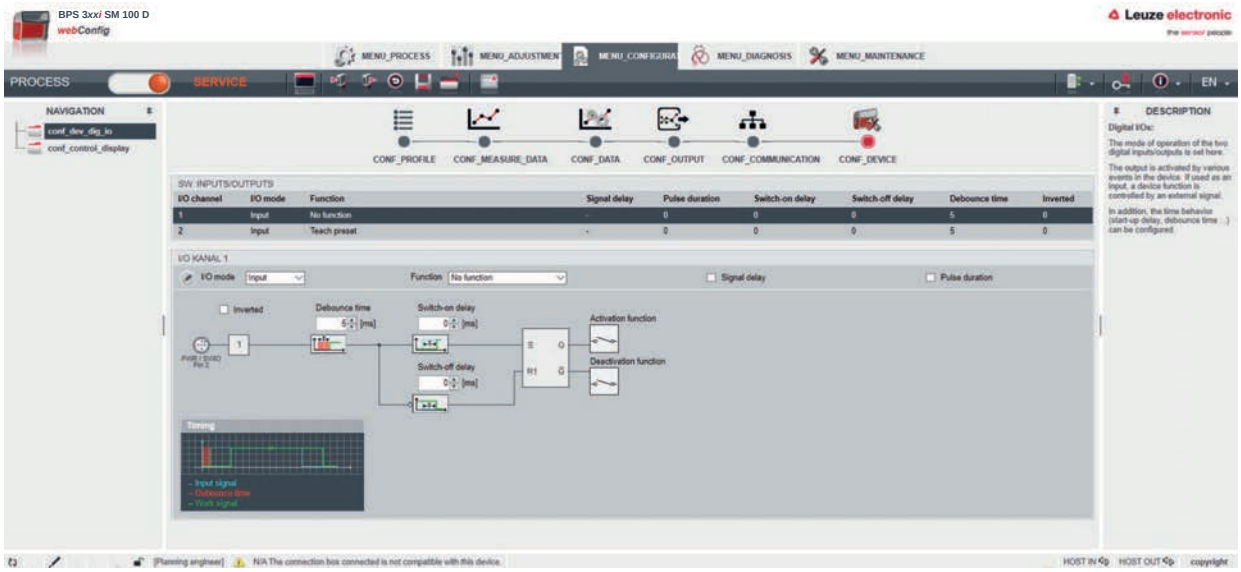


Fig. 9.6: Configuration of the switching inputs

Time behavior functions of the switching inputs/outputs

The time behavior functions (e.g., start-up delay) can **only** be configured with the webConfig tool.

- Start-up delay

  With this setting, the output pulse is delayed by the specified time (in ms).

- Switch-on time

  Defines the switch-on time period for the switching input. Any activated switch-off function then no longer has any function.

  If the output is deactivated via the switch-off signal before the start-up delay lapses, only a brief pulse appears at the output following the start-up delay.

- Debounce time

  Parameter for setting the software debounce time for the switching input. The definition of a debounce time extends the signal transition time accordingly.

  If this parameter has the value *0*, no debouncing takes place. Otherwise, the set value corresponds to the time (in ms) that the input signal must be present and stable.

- Switch-off delay

  This parameter specifies the duration of the switch-off delay (in ms).

Configuration of the bar code tape selection and tape value correction (*MEASUREMENT DATA* tab, Bar code tape)

- Bar code tape with 30 mm grid (BCB G30 …) or 40 mm grid (BCB G40 …)
- Tape value correction

  With this parameter, the deviation of the BCB from the correct millimeter scaling that arises from the production process can be corrected.

Configuration of position detection (*DATA PROCESSING* tab, Position > Detection)

- Integration depth

  Number of successive measurements that the BPS uses for position determination.
- Scaling free resolution

  Free scaling of the output of the position values.
- Preset

  A preset position value (preset value) is activated at an appropriate position.
- Offset

  Output value=measurement value+offset

  If a preset is active, this has priority over the offset.
- Error handling procedures

  Parameters for the position value in case of failure.

Configuration of position monitoring (*DATA PROCESSING* tab, Position > Monitoring)

- Position limit value 1/2

  Signals that the position value is outside of the configured limit value range.

Configuration of speed detection (*DATA PROCESSING* tab, Speed > Detection)

- Speed measurement averaging

  Measurement value preparation averages all speed values calculated during the selected period (averaging) to yield a speed output value.
- Scaling free resolution

  Free scaling of the output of the speed values.
- Error handling procedures

  Parameters for the speed value in case of failure.

Configuration of speed monitoring (*DATA PROCESSING* tab, Measurement data > Speed > Monitoring)

- Speed limit value 1-4

  Signals that the speed is outside of the configured limit value range.

Configuration of the measurement value display (*DATA PROCESSING* tab, General preparation)

- Unit of measurement: metric or inch
- Counting direction

  Count direction for position calculation or sign for speed calculation.
- Output mode sign

  Output mode of the sign. Affects position value and speed output.

Configuration of monitoring of the reading quality (*DATA PROCESSING* tab, Reading quality)

- Warning threshold for reading quality in %
- Error threshold for reading quality in %

Configuration of the communication data (*COMMUNICATION* tab)

- Configuration of the SERVICE USB interface
- Setting the process interface:
  - Transmission standard of the interface: Ethernet
  - Baud rate: 100 MBaud (100Base-TX)

9.3.5 DIAGNOSIS function

The *DIAGNOSIS* function is available in the *Process* and *Service* operating modes.

The device event log is displayed with the *DIAGNOSIS* function.

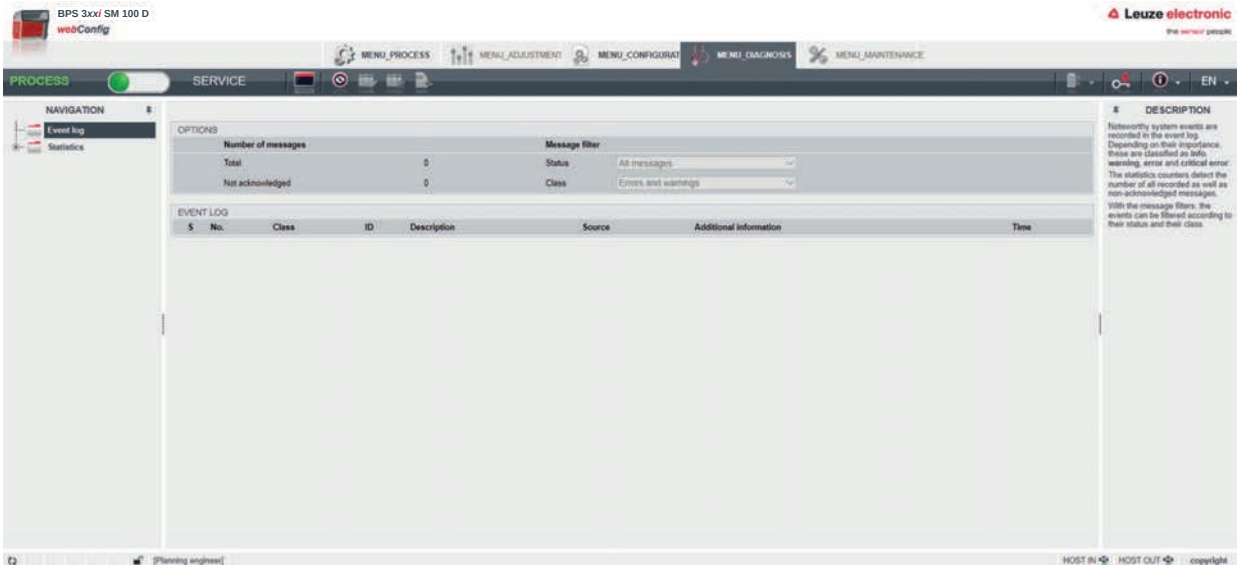


Fig. 9.7: *DIAGNOSIS* webConfig function

9.3.6 MAINTENANCE function

The *MAINTENANCE* function is only available in the *Service* operating mode.

Functionalities:

- User management
- Devices Backup/Restore
- Firmware update
- System clock
- Settings of the user interface

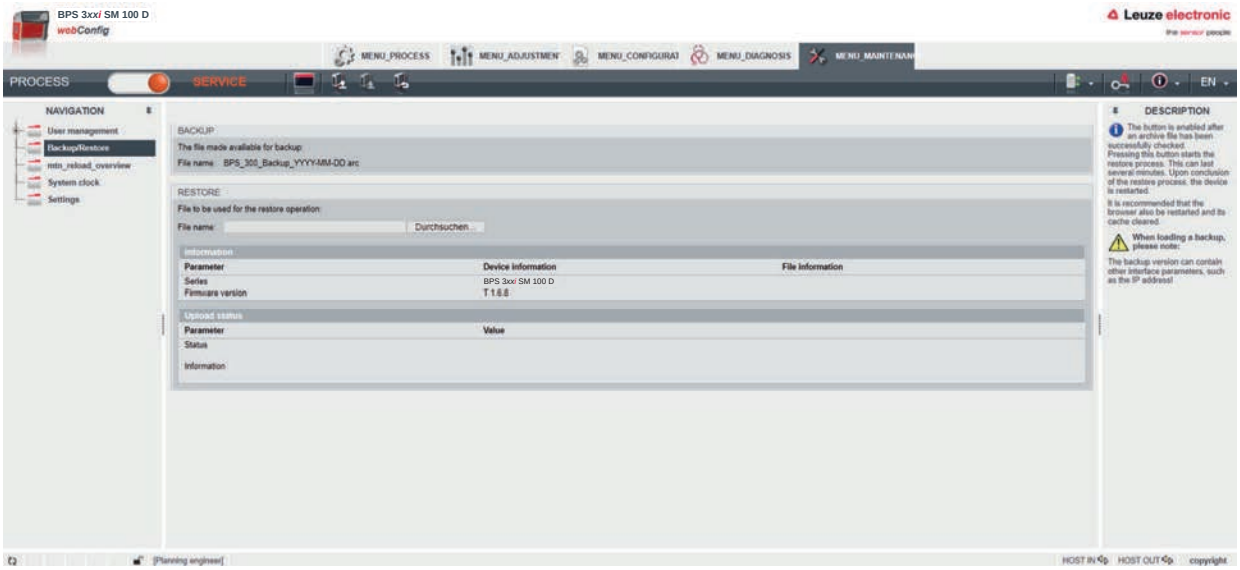


Fig. 9.8: *MAINTENANCE* webConfig function

10 Diagnosis and troubleshooting

10.1 What to do in case of failure?

After switching on the BPS, display elements (see chapter 3.3 "Display elements") assist in checking the proper function and troubleshooting.

In case of error, you can determine the error from the LED displays. With the error message you can determine the cause of the error and initiate measures to rectify it.

- Switch off the system and leave it switched off.
- Analyze the cause of the error using the operation indicators, the error messages and the diagnostic tools (also with the help of the webConfig tool, *DIAGNOSIS* tab) and rectify the error.

NOTICE	
	Contact Leuze subsidiary/customer service. If you are unable to rectify a fault, contact the Leuze branch responsible for you or call the Leuze customer service (see chapter 12 "Service and support").

10.1.1 Diagnosis with webConfig tool

System events are displayed in the webConfig tool via the *DIAGNOSIS* tab. Noteworthy system events are recorded in the event log. Depending on their importance, the events are classified as info, warning, error and critical error. The statistics counters detect the number of all recorded as well as non-acknowledged messages. With the message filters, the events can be filtered according to their status and their class.

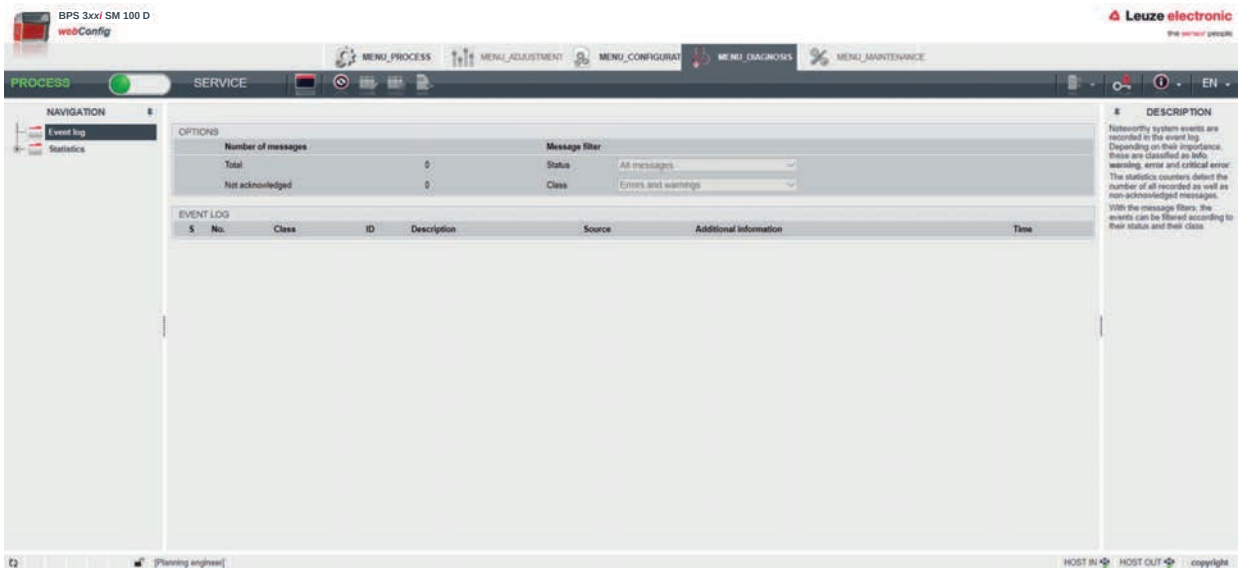


Fig. 10.1: *DIAGNOSIS* webConfig function

10.2 Operating indicators of the LEDs

You can ascertain general causes of errors via the PWR and BUS status LEDs (see chapter 3.3 "Display elements").

Tab. 10.1: PWR LED displays – causes and measures

Error	Possible cause	Measures
Off	No supply voltage connected to the device Hardware error	Check supply voltage Contact Leuze customer service (see chapter 12 "Service and support")
Green, flashing	Device is being initialized	
Red, flashing	No bar code in the scanning beam No valid measurement value	Query BCB diagnostic data and carry out the resulting measures (see chapter 10.4 "Checklist for causes of errors", "Position measurement errors – causes and measures" table)
Orange, continuous light	Device in *Service* mode	Reset the device to *Process* mode using the webConfig tool

10.3 Error messages on the display

Via the optional display of the BPS, the device outputs the following possible error status information while it has the *BPS Info* device status:

- *System OK*

  BPS operating error-free.
- *Warning*
- *Error*

  Device function is not ensured.

Fig. 10.2: Example: Device status/error status information on the display

10.4 Checklist for causes of errors

Tab. 10.2: Service interface errors – causes and measures

Error	Possible cause	Measures
webConfig does not start	Incorrectly connected interconnection cable Connected BPS is not recognized No communication via USB service interface Old webConfig configuration in the browser cache IP address not correct	Check interconnection cable Install USB driver Clear browser history

Tab. 10.3: Process interface errors – causes and measures

Error	Possible cause	Measures
No communication via USB service interface	Incorrect interconnection cable Connected device is not recognized	Check interconnection cable Install USB driver Enter correct IP address in browser. Default IP address: 192.168.61.100
Sporadic error at the EtherCAT interface	Incorrect wiring	Check wiring: • Check wire shielding • Check wires used
	EMC coupling	Observe contact quality of screwed or soldered contacts in the wiring Check grounding concept and connection to functional earth (FE) Avoid EMC coupling caused by power cables laid parallel to device lines
	Network expansion exceeded	Check max. network expansion as a function of the max. cable lengths

Tab. 10.4: LED indicators - interface errors – causes and measures

Error	Possible cause	Measures
BUS LED "Off"	No supply voltage connected to the device	Check supply voltage
	EtherCAT communication not initialized or inactive	Check EtherCAT connection/system, assign IP address
	Hardware error	Contact Leuze customer service (see chapter 12 "Service and support")
BUS LED "red, steady flashing"	Faulty configuration, device status: PRE-OPERATIONAL	Check configuration
BUS LED "red, flashing, single flash"	Local error (e.g., synchronization error)	Check configuration
BUS LED "red, flashing, double flash"	Watchdog timeout	Check configuration
BUS LED "red continuous light"	Bus error, no communication established to master	Check network configuration

Tab. 10.5: Position measurement errors – causes and measures

Error	Possible cause	Measures
Measurement value or reading quality is continuously instable	Soiling of the BPS optics	Clean the optics of the BPS
Measurement value or reading quality is poor • at certain position values • always at the same position values	Soiling of the bar code tape	Clean the bar code tape Replace the bar code tape
No measurement value can be determined	No code in scanning beam	Align the scanning beam with the bar code tape
	Code not in the working range of the BPS	Align the BPS with the bar code tape (working range 50 mm … 170 mm)
Faulty measurement value	Wrong bar code tape BCB grid different from BPS configuration Preset or offset active. Incorrect unit or resolution configured.	Change BPS configuration to the bar code tape that is being used

11 Care, maintenance and disposal

11.1 Cleaning

If there is dust on the device:

↳ Clean the device with a soft cloth; use a cleaning agent (commercially available glass cleaner) if necessary.

NOTICE
Do not use aggressive cleaning agents! ↳ Do not use aggressive cleaning agents such as thinner or acetone for cleaning the device.

11.2 Servicing

The device does not normally require any maintenance by the operator.

Repairs to the device must only be carried out by the manufacturer.

↳ For repairs, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 12 "Service and support").

11.2.1 Firmware update

A firmware update can only be performed by Leuze Service on-site or at the company headquarters.

↳ For firmware updates, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 12 "Service and support").

11.2.2 BCB repair with repair kit

If a bar code tape was damaged, e.g., by falling parts, you can download a repair kit for the BCB from the Internet.

www.leuze.com > Products > Measuring Sensors > Bar Code Positioning Systems > BPS 300i > (Name of the BPS) > Tab **Downloads > Repair kit**.

NOTICE
Do not use the BCB repair kit on a permanent basis! ↳ Use the bar code tape created with the repair kit only temporarily as an emergency solution. The optical and mechanical properties of the self-printed bar code tape do not correspond to those of the original bar code tape. Self-printed bar code tape should not remain in the system on a permanent basis. ↳ Original repair tapes (BCB G30 … RK or BCB G40 … RK) with custom tape start value, tape end value, custom length in standard heights of 25 mm and 47 mm can be found on the Leuze website in the accessories for the BPS 300 devices. An entry wizard is available for repair tapes on the Leuze website under devices BPS 300 - Accessories. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form for the desired repair tape. ↳ Repair tapes are available up to a maximum length of 5 m per repair tape. Repair tapes longer than 5 must be ordered as special tapes in the entry wizard.

NOTICE
In the repair kit files, you will find all position values with 30 mm grid (BCB G30 …) and 40 mm grid (BCB G40 …).

Layout:

- BCB G30: 0.9 m of bar code tape is provided on each A4 sheet.
  - Five lines of 18 cm with six code-information segments of 30 mm each
  - Tape lengths: from 0 to 9999.99 m in various files; each 500 m

- BCB G40: 1 m of bar code tape is provided on each A4 sheet.
  - Five lines of 20 cm with five code-information sections of 40 mm each
  - Tape lengths: from 0 to 9999.99 m in various files; each 500 m

Replacing a section of defective bar code tape

↳ Determine the coding of the defective area.

↳ Print out the coding for the given area.

↳ Affix the printed code over the defective section of bar code tape.

NOTICE

Printing coding

↳ Select only those pages that are actually required.

↳ Change the printer settings so that the bar code is not distorted.

↳ Check the print results and measure the distance between two bar codes: BCB G40 …: 40 mm and BCB G30 …: 30 mm. See graphics below.

↳ Cut the code strips and arrange them next to one another. The code content must always increase or decrease in increments of 30 mm or 40 mm. Check that the printed values increase by 3 (BCB G30 …) or 4 (BCB G40 …).

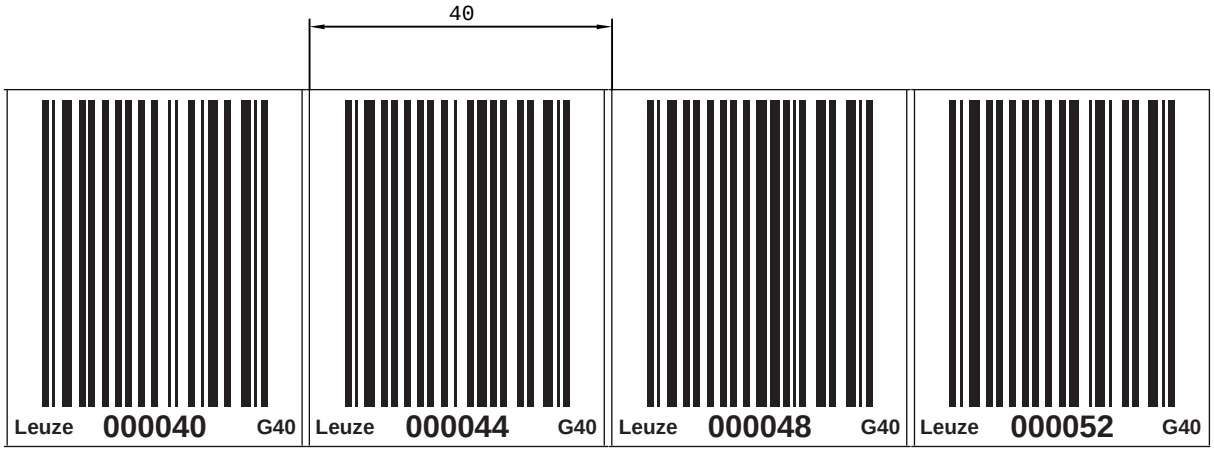


Fig. 11.1: Checking the print result – BCB G40 …-repair kit (40 mm gird)

Fig. 11.2: Checking the print result – BCB G30 …-repair kit (30 mm gird)

11.3 Disposing

↳ For disposal observe the applicable national regulations regarding electronic components.

12 Service and support

24-hour on-call service at:

+49 7021 573-0

Service hotline:

+49 7021 573-123

Monday to Friday 8.00 a.m. to 5.00 p.m. (UTC+1)

E-mail:

service.identify@leuze.de

Repair service and returns:

Procedure and Internet form can be found at

www.leuze.com/repair

Return address for repairs:

Service center

Leuze electronic GmbH + Co. KG

In der Braike 1

D-73277 Owen / Germany

What to do should servicing be required?

	NOTICE
	**Please use this chapter as a master copy should servicing be required!** ↳ Enter the contact information and fax this form together with your service order to the fax number given below.

Customer data (please complete)

Device type:	
Serial number:	
Firmware:	
Display messages	
Status of LEDs:	
Error description:	
Company:	
Contact person/department:	
Phone (direct dial):	
Fax:	
Street/No:	
ZIP code/City:	
Country:	

Leuze Service fax number:

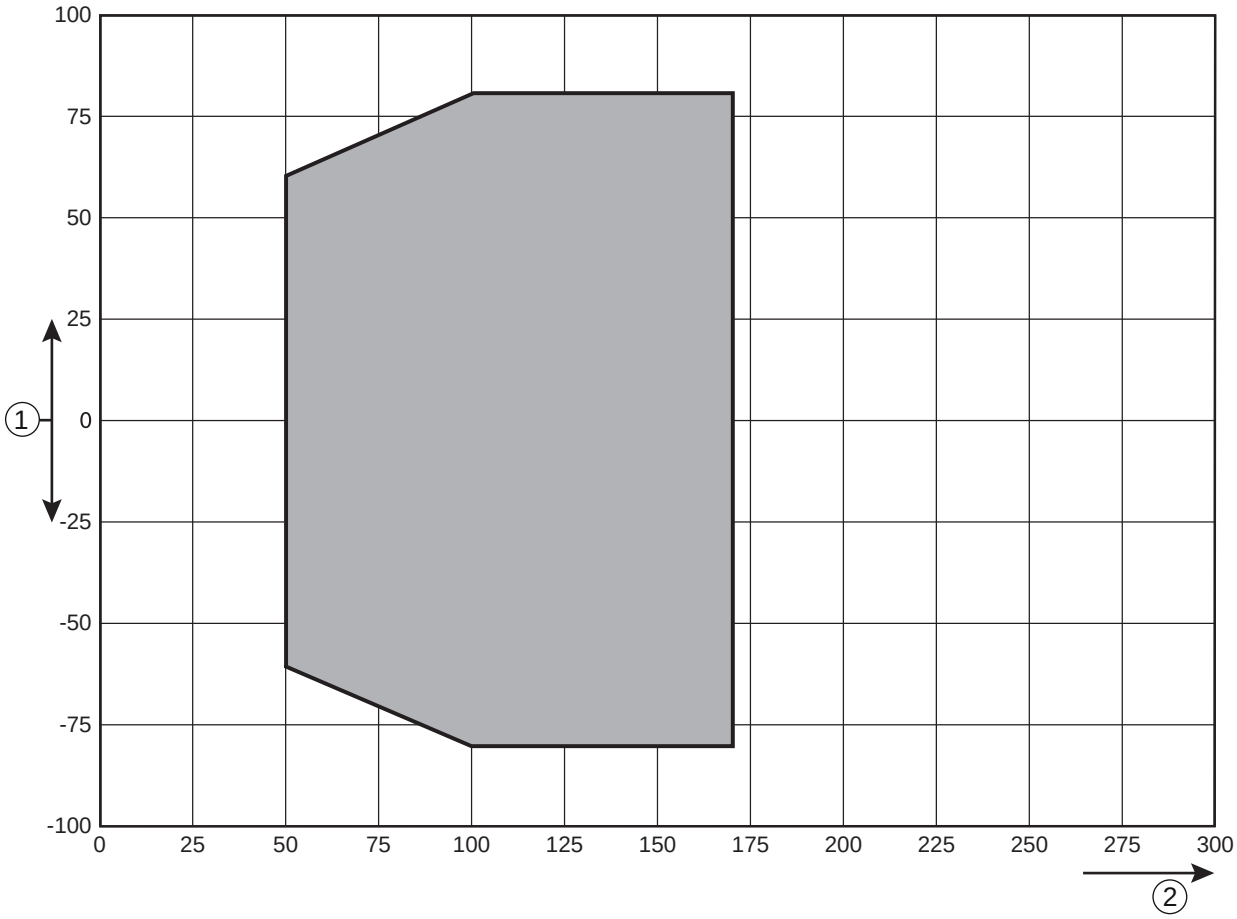
+49 7021 573-199

13 Technical data

13.1 General specifications

Tab. 13.1: Optics

Light source	Laser diode
Wavelength	655 nm
Impulse duration	< 150 µs
Max. output power	1.8 mW
Average life expectancy laser diode	100,000 h (typ. at +25 °C)
Beam deflection	Via rotating polygon wheel
Exit window	Glass
Laser class	1 acc. to IEC/EN 60825-1:2014
Working range	50 mm … 170 mm At a reading distance of 50 mm, the reading field width is 120 mm. At a reading distance beyond 100 mm, the reading field width is 160 mm (see BPS reading field curve).



1 Reading field width [mm]
2 Reading distance [mm]

Fig. 13.1: BPS reading field curve

Tab. 13.2: Measurement data

Reproducibility (1 sigma)	±0.05 mm
Output time	1 ms … 30 ms (configurable) Default: 1 ms
Response time	8 ms (adjustable, factory setting 8 ms)
Basis for contouring error calculation	4 ms
Measurement range	0 … 10,000,000 mm
Resolution	0.1 mm (adjustable, factory setting 0.1 mm)
Max. traverse rate	10 m/s

Tab. 13.3: Operating and display elements

Display (optional – only in device models with "D")	Monochromatic graphical display, 128 x 32 pixels, With background lighting
Keyboard (optional – only in device models with "D")	Two buttons
LEDs	Two LEDs for power (PWR) and bus state (BUS), two-colored (red/green)

Tab. 13.4: Mechanical data

Housing	Diecast aluminum
Connection technology	• BPS with MS 338: M12 connectors • BPS with MK 338: Terminal blocks with spring-cage terminals (5-pin) • BPS with ME 338 103: Cables with M12 connectors
Degree of protection	IP 65
Weight	Approx. 580 g (without connection hood)
Dimensions of the BPS 338i without connection hood	(H x W x D) 108.7 mm x 100.0 mm x 48.3 mm
Dimensions of the BPS 338i with MS 338 connection hood	(H x W x D) 128.0 mm x 111.5 mm x 43.4 mm
Dimensions of the BPS 338i with MK 338 connection hood	(H x W x D) 166.7 mm x 111.5 mm x 43.4 mm
Dimensions of the BPS 338i with ME 338 connection hood	(H x W x D) 128.0 mm x 111.5 mm x 43.4 mm
Dimensions of MS 338 connection hood	(H x W x D) 64.0 mm x 43.5 mm x 33.5 mm
Dimensions of MK 338 connection hood	(H x W x D) 64.0 mm x 43.5 mm x 83.5 mm
Dimensions of ME 338 103 connection hood	(H x W x D) 64.0 mm x 43.5 mm x 38.0 mm

Tab. 13.5: Environmental data

Air humidity	Max. 90% rel. humidity, non-condensing
Vibration	IEC 60068-2-6, test Fc
Shock Continuous shock	IEC 60068-2-27, test Ea
Electromagnetic compatibility	IEC 61000-6-3 IEC 61000-6-2 (contains IEC 61000-4-2, -3, -4, -5, -6)

Tab. 13.6: Certifications, conformity

Conformity	CE, CDRH
Certifications	UL 60950-1, CSA C 22.2 No. 60950-1

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

13.1.1 BPS without heating

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

Tab. 13.7: Electrical equipment

Data specification	Values/description
Interface type	2x Ethernet on 2x M 12 (D-coded) Protocol: EtherCAT, EoE, CoE Baud rate: 100 Mbaud (100 Base-TX)
Service USB interface	Mini-B type USB 2.0 socket
Switching input / switching output	Two switching inputs/outputs Functions are freely programmable via Ethernet interface Switching input: 18 … 30 VDC depending on supply voltage, I max. = 8 mA Switching output: 18 … 30 VDC, depending on supply voltage, I max. = 60 mA (short-circuit proof) Switching inputs/outputs protected against polarity reversal!
Operating voltage U_B	18 … 30 VDC (Class 2, protection class III)
Power consumption	Max. 4.5 W

Tab. 13.8: Ambient temperature

Ambient temperature (operation)	-5 °C … +50 °C
Ambient temperature (storage)	-35 °C … +70 °C

13.1.2 BPS with heating

CAUTION

UL applications!

For UL applications, use is only permitted in Class 2 circuits in accordance with the NEC (National Electric Code).

Tab. 13.9: Electrical equipment

Operating voltage U_B	18 … 30 VDC
Power consumption	Max. 17.7 W
Structure of the heating	Housing heating and separate heating of the optics glass
Warmup time	Minimum 30 min at +24 VDC and an ambient temperature of -35 °C
Minimum conductor cross section	Conductor cross section of at least 0.75 mm² for the supply voltage supply line. **Note:** Wiring through of the voltage supply to multiple heating devices is not permissible. Standard, M12 ready-made cable not usable (insufficient conductor cross section).

Tab. 13.10: Ambient temperature

Ambient temperature (operation)	-35 °C … +50 °C
Ambient temperature (storage)	-35 °C … +70 °C

13.2 Bar code tape

Tab. 13.11: BCB dimensions

	BCB G40 …	**BCB G30 …**
Grid	40 mm	30 mm
Standard height	47 mm, 25 mm	47 mm, 25 mm
Length	0 … 5 m, 0 … 10 m, 0 … 20 m, …, 0 … 150 m, 0 … 200 m; Special lengths and special encodings: see chapter 14 "Order guide and accessories"	0 … 5 m, 0 … 10 m, 0 … 20 m, …, 0 … 150 m; Special lengths and special encodings: see chapter 14 "Order guide and accessories"
Tape tolerance	±1 mm per meter	±1 mm per meter

NOTICE

Twin tapes on request

↳ An entry wizard for twin tapes with custom tape start value, tape end value, custom length and height is available on the Leuze website under devices BPS 300 – Accessories. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form for the desired twin tape.

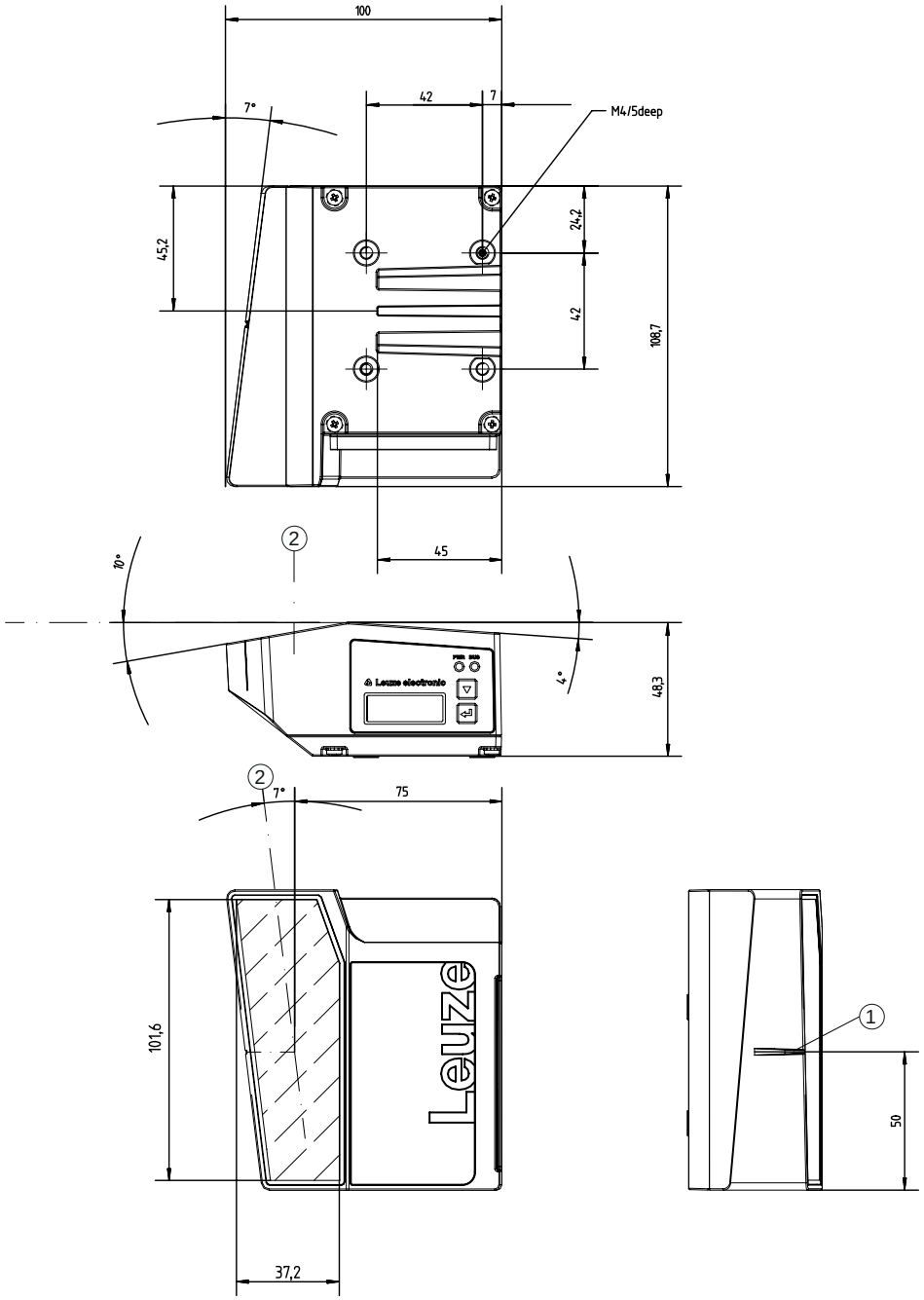
Tab. 13.12: BCB structure

Manufacturing process	Filmsetting
Surface protection	Polyester, matt
Base material	Polyester film, affixed without silicone
Adhesive	Acrylate adhesive
Strength of adhesive	0.1 mm
Adhesive strength (average values)	On aluminum: 25 N/25 mm On steel: 25 N/25 mm On polycarbonate: 22 N/25 mm On polypropylene: 20 N/25 mm

Tab. 13.13: BCB environmental data

Recommended processing temperature	0 °C … +45 °C
Ambient temperature	-40 °C … +120 °C
Dimensional stability	No shrinkage, tested according to DIN 30646
Curing	Final curing after 72 h; the BPS can detect the position immediately after the BCB is affixed.
Tear resistance	150 N
Elongation at tear	Min. 80%, tested in accordance with DIN 50014, DIN 51220
Weathering resistance	UV-light, humidity, salt spray (150 h/5 %)
Chemical resistance (checked at 23 °C over 24 h)	Transformer oil, diesel oil, white spirit, heptane, ethylene glycol (1:1)
Behavior in fire	Self-extinguishing after 15 s, does not drip
Surface	Grease-free, dry, clean, smooth
Mechanical properties	Scratch and wipe resistant, UV resistant, moisture resistant, partly chemical resistant

13.3 Dimensioned drawings

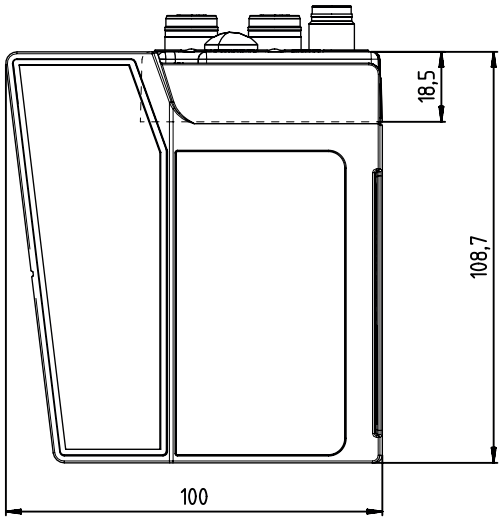


all dimensions in mm

1 Reference point for the bar code position

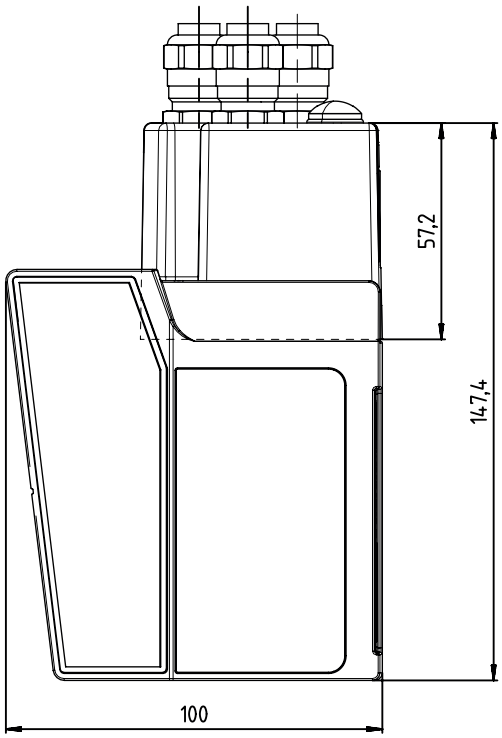
2 Optical axis

Fig. 13.2: Dimensioned drawing BPS without connection hood



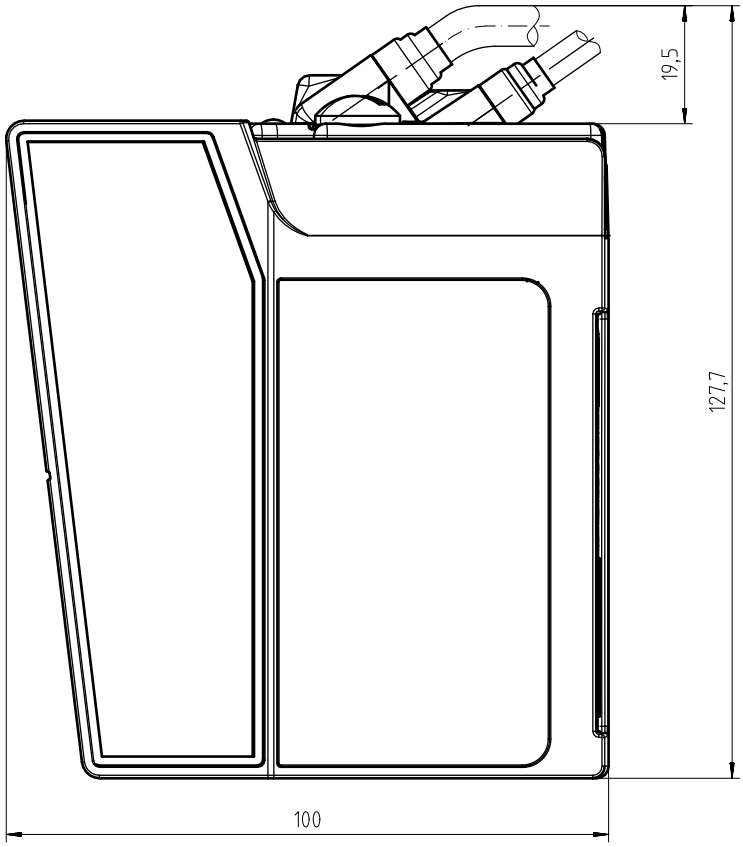
all dimensions in mm

Fig. 13.3: Dimensioned drawing BPS with MS 338 connection hood



all dimensions in mm

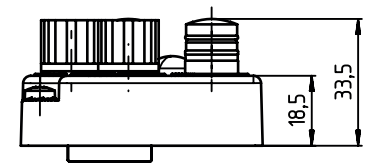
Fig. 13.4: Dimensioned drawing BPS with MK 338 connection hood

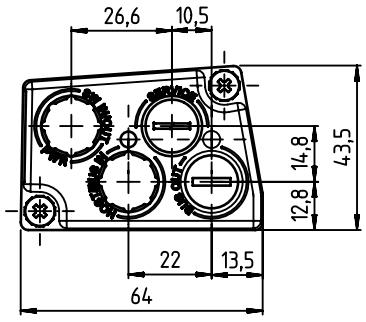


all dimensions in mm

Fig. 13.5: Dimensioned drawing BPS with ME 338 103 connection hood

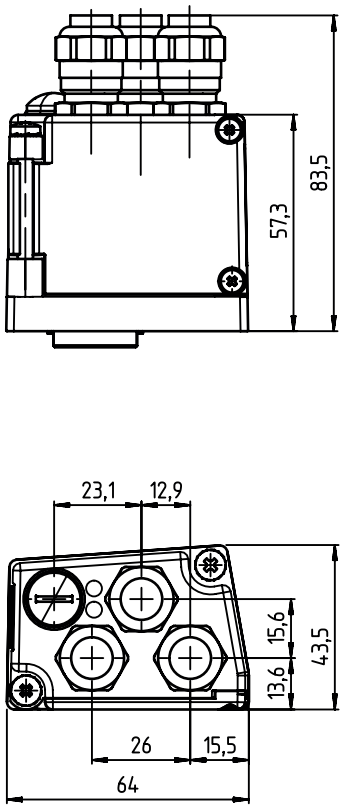
13.4 Dimensioned drawings: Accessories





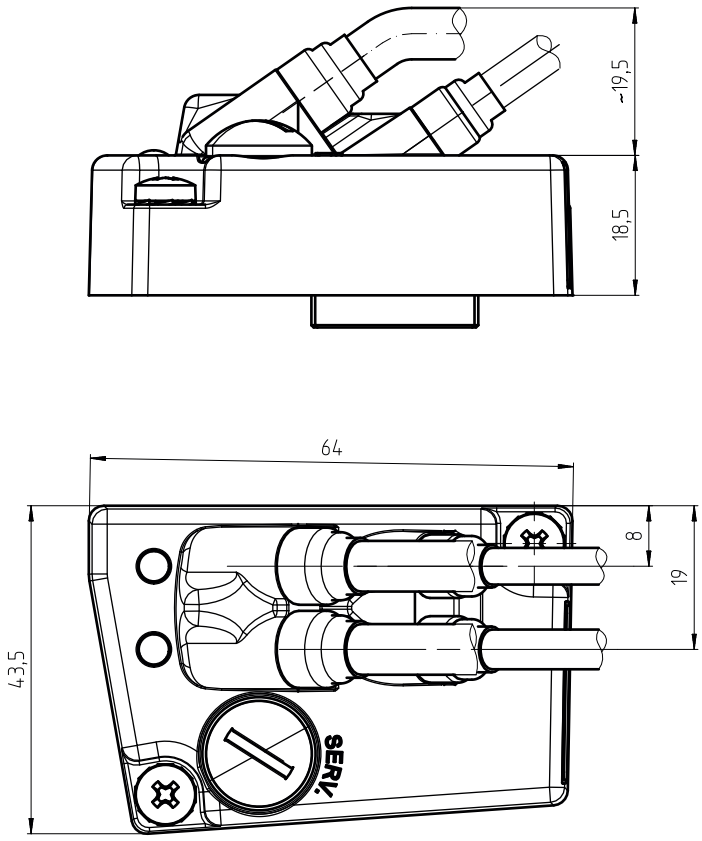
all dimensions in mm

Fig. 13.6: Dimensioned drawing MS 338 connection hood



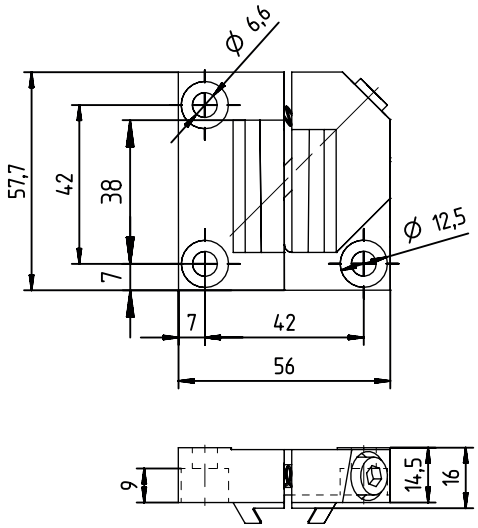
all dimensions in mm

Fig. 13.7: Dimensioned drawing MK 338 connection hood



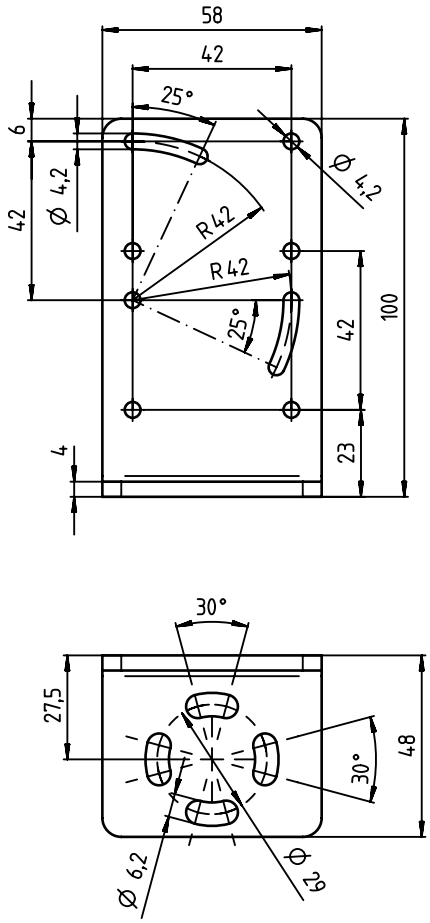
all dimensions in mm

Fig. 13.8: Dimensioned drawing ME 338 103 connection hood



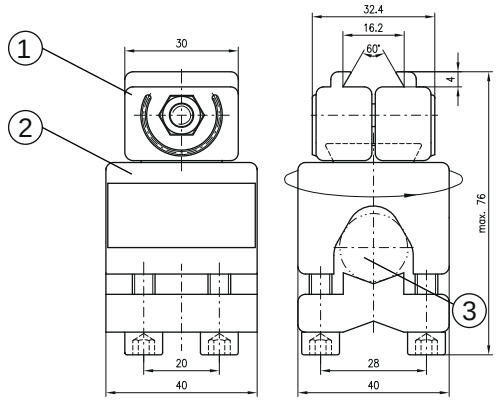
all dimensions in mm

Fig. 13.9: Dimensioned drawing BTU 0300M-W mounting device



all dimensions in mm

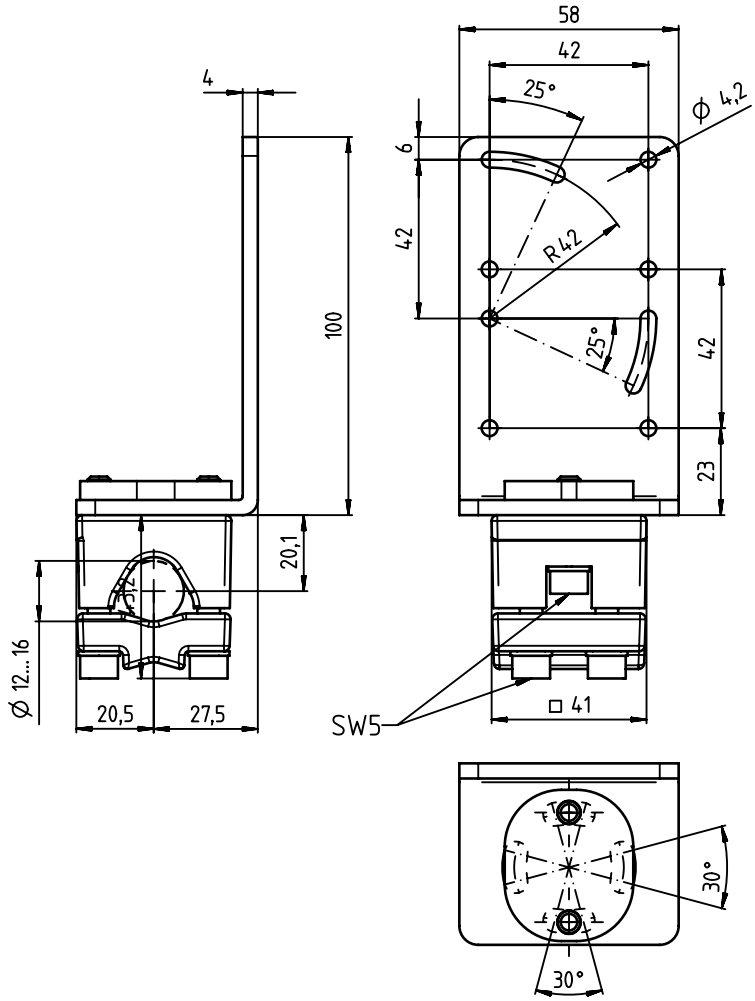
Fig. 13.10: Dimensioned drawing BT 300-W mounting bracket



all dimensions in mm

1 Clamping jaws for mounting on the BPS
2 Clamp profile for mounting to round or oval pipes (Ø 16 … 20 mm)
3 Rod holder, turnable 360 °

Fig. 13.11: Dimensioned drawing BT 56 mounting device



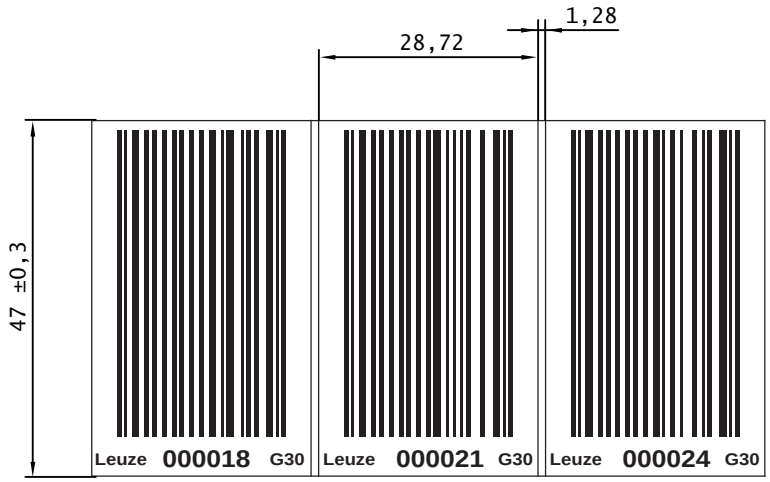
all dimensions in mm

Fig. 13.12: Dimensioned drawing BT 300-1 mounting device

13.5 Dimensioned drawing bar code tape

all dimensions in mm

Fig. 13.13: Dimensioned drawing BCB G40 … bar code tape with 40 mm grid



all dimensions in mm

Fig. 13.14: Dimensioned drawing BCB G30 … bar code tape with 30 mm grid

14 Order guide and accessories

14.1 BPS 338i type overview

Tab. 14.1: BPS 338i type overview

Part no.	Part designation	Description
50139943	BPS 338i SM 100	BPS with Ethernet interface
50139944	BPS 338i SM 100 D	BPS with Ethernet interface and display
50139945	BPS 338i SM 100 H	BPS with Ethernet interface and heating

14.2 Connection hoods

Tab. 14.2: BPS connection hoods

Part no.	Part designation	Description
50134930	MS 338	Connection hood with M12 connectors
50134931	MK 338	Connection hood with spring-cage terminals
50134929	ME 338 103	Connection hood with cables with M12 connectors

14.3 Cables accessories

Tab. 14.3: Accessories – PWR connection cable (voltage supply)

Part no.	Part designation	Description
50132079	KD U-M12-5A-V1-050	PWR connection cable, M12 socket for PWR, axial plug outlet, open cable end, cable length 5 m, not shielded
50132080	KD U-M12-5A-V1-100	PWR connection cable, M12 socket for PWR, axial plug outlet, open cable end, cable length 10 m, not shielded

Tab. 14.4: Accessories – BUS IN connection cable (open cable end)

Part no.	Part designation	Description
M12 plug for BUS IN, axial connector, open line end		
50135073	KS ET-M12-4A-P7-020	BUS IN connection cable, length 2 m
50135074	KS ET-M12-4A-P7-050	BUS IN connection cable, length 5 m
50135075	KS ET-M12-4A-P7-100	BUS IN connection cable, length 10 m
50135076	KS ET-M12-4A-P7-150	BUS IN connection cable, length 15 m
50135077	KS ET-M12-4A-P7-300	BUS IN connection cable, length 30 m

Tab. 14.5: Accessories – BUS IN interconnection cable (on RJ-45)

Part no.	Part designation	Description
M12 connector for BUS IN to RJ-45 connector		
50135080	KSS ET-M12-4A-RJ45-A-P7-020	BUS IN interconnection cable (on RJ-45), length 2 m
50135081	KSS ET-M12-4A-RJ45-A-P7-050	BUS IN interconnection cable (on RJ-45), length 5 m
50135082	KSS ET-M12-4A-RJ45-A-P7-100	BUS IN interconnection cable (on RJ-45), length 10 m
50135083	KSS ET-M12-4A-RJ45-A-P7-150	BUS IN interconnection cable (on RJ-45), length 15 m
50135084	KSS ET-M12-4A-RJ45-A-P7-300	BUS IN interconnection cable (on RJ-45), length 30 m

Tab. 14.6: Accessories – BUS OUT interconnection cable (on M12)

Part no.	Part designation	Description
M12 connector + M12 connector for BUS OUT to BUS IN		
50137077	KSS ET-M12-4A-M12-4A-P7-020	BUS OUT interconnection cable, length 2 m
50137078	KSS ET-M12-4A-M12-4A-P7-050	BUS OUT interconnection cable, length 5 m
50137079	KSS ET-M12-4A-M12-4A-P7-100	BUS OUT interconnection cable, length 10 m
50137080	KSS ET-M12-4A-M12-4A-P7-150	BUS OUT interconnection cable, length 15 m
50137081	KSS ET-M12-4A-M12-4A-P7-300	BUS OUT interconnection cable, length 30 m

Tab. 14.7: Accessory USB cable

Part no.	Part designation	Description
50117011	KB USB A – USB miniB	USB service cable, 1 Type A and Mini-B type connector, length 1 m

14.4 Other accessories

Tab. 14.8: Accessories – BPS connectors

Part no.	Part designation	Description
50020501	KD 095-5A	M12 axial socket for voltage supply, shielded
50108991	D-ET1	RJ45 connector for user-configuration
50112155	S-M12A-ET	Axial M12 connector, D-coded, for self-assembly
50109832	KDS ET M12 / RJ45 W-4P	Converter from M12, D-coded, to RJ-45 socket

Tab. 14.9: Mounting device accessories

Part no.	Part designation	Description
50124941	BTU 0300M-W	Mounting device for wall mounting – precise alignment of the BPS without adjustment (easy-mount).
50121433	BT 300 W	Mounting bracket for wall mounting
50027375	BT 56	Mounting device for rod
50121434	BT 300-1	Mounting device for rod

14.5 Bar code tapes

14.5.1 Standard bar code tapes

Leuze offers a wide selection of standardized bar code tapes.

Tab. 14.10: Data for standard bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …) 40 mm (BCB G40 …)
Height	47 mm 25 mm
Length	5 m 10 m, 20 m … in 10 m increments up to 150 m 200 m
Length graduation	10 m
Tape start value	0

- Standard bar code tapes are printed below the bar code with the corresponding position value.
- The bar code tapes are wound and delivered on a core.

All available standard tapes are listed on the Leuze website under the currently selected BPS device in the *Accessories* tab.

14.5.2 Special bar code tapes

Special tapes are produced according to customer specifications.

Tab. 14.11: Data for special bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …) 40 mm (BCB G40 …)
Height	20 mm – 140 mm in millimeter increments
Length	According to customer specifications, maximum 10,000 m
Tape start value	According to customer specifications, dependent on grid dimension
Tape end value	According to customer specifications, dependent on grid dimension, maximum tape end value at 10,000 m

- Special bar code tapes are printed below the bar code with the corresponding position value.
- Special bar code tapes over 300 m in length are wound and delivered on multiple rolls.

An entry wizard is available for special bar code tapes on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

14.5.3 Twin tapes

Twin tapes are special bar code tapes and are produced according to customer specifications.

Tab. 14.12: Data for Twin tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …) 40 mm (BCB G40 …)
Height	20 mm – 140 mm in millimeter increments
Length	According to customer specifications, maximum 10,000 m
Tape start value	According to customer specifications, dependent on grid dimension
Tape end value	According to customer specifications, dependent on grid dimension, maximum tape end value at 10,000 m

- Two identical tapes are delivered in one package. The tape values as well as the tape tolerances are identical on both tapes. The tapes are printed with the position value in plain text below and above the bar code.
- Twin tapes over 300 m in length are wound and delivered on multiple rolls.

An entry wizard for twin tapes with custom tape start value, tape end value, custom length and height is available on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

14.5.4 Repair tapes

Repair tapes are produced according to customer specifications.

Tab. 14.13: Data for repair tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …) 40 mm (BCB G40 …)
Height	47 mm 25 mm
Length	According to customer specifications, maximum 5 m
Tape start value	According to customer specifications, dependent on grid dimension
Tape end value	According to customer specifications, dependent on grid dimension

- Repair tapes longer than 5 m must be ordered as special tapes.
- Repair tapes are printed below the bar code with the corresponding position value.
- Repair tapes are usually delivered wound on a roll.

An entry wizard is available for repair tapes on the Leuze website under devices BPS 300 - *Accessories* tab. The entry wizard provides support when entering the individual pieces of tape data and creates a query or order form with the correct part number and type designation.

14.5.5 Marker labels and control labels

Leuze offers a selection of standardized marker and control labels.

Tab. 14.14: Data for marker labels and control labels

Feature	Value
Grid dimensions	30 mm (BCB G30 …) 40 mm (BCB G40 …)
Height	47 mm
Base color of control label BCB … MVS	Red
Base color of control label BCB … MV0	Yellow
Base color of marker label BCB … ML	Red

- Marker labels and control labels are individual labels that are delivered in a packaging unit containing 10 pieces.

All available marker and control labels are listed on the Leuze website for the currently selected BPS device in the *Accessories* tab.

15 EC Declaration of Conformity

The bar code positioning systems of the BPS 300 series have been developed and manufactured in accordance with the applicable European standards and directives.

16 Appendix

16.1 Bar code sample

BCB G40 … bar code tape with 40 mm grid

Fig. 16.1: Continuous, 40 mm grid

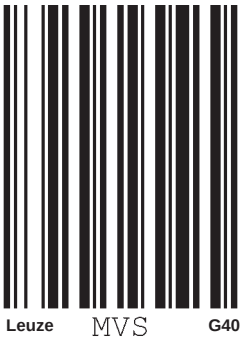


Fig. 16.2: Single label MVS, 40 mm grid

Fig. 16.3: Single label MV0, 40 mm grid

Fig. 16.4: Single marker label, 40 mm grid

BCB G30 … bar code tape with 30 mm grid

Fig. 16.5: Continuous, 30 mm grid

Fig. 16.6: Single label MVS, 30 mm grid

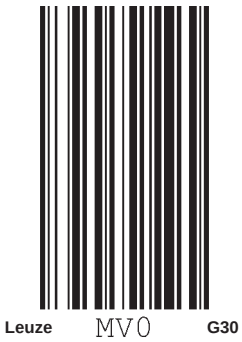


Fig. 16.7: Single label MV0, 30 mm grid

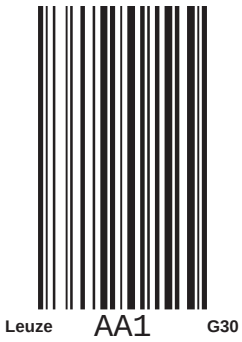


Fig. 16.8: Single marker label, 30 mm grid