Leuze

Original operating instructions

BPS 3048i
Bar code positioning system
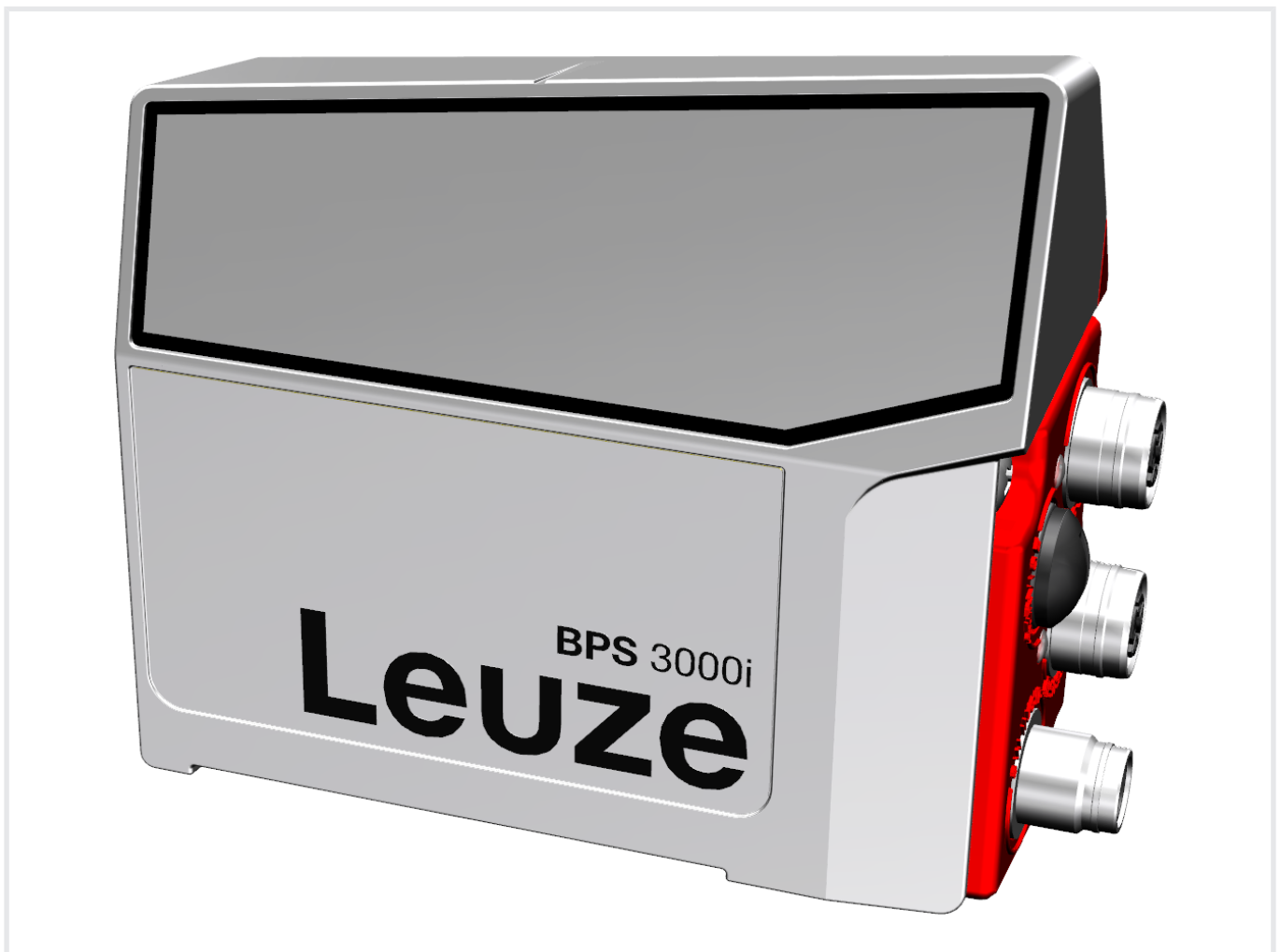
1 About this document

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

ℹ️	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

BCB	Bar code tape
BPS	Bar code positioning system
EMC	Electromagnetic compatibility
EN	European standard
FE	Functional earth
GSDML	Generic Station Description Markup Language
IO or I/O	Input/Output
LED	Light Emitting Diode
MAC	Media Access Control
NEC	National Electric Code
PELV	Protective Extra-Low Voltage
SNMP	Simple Network Management Protocol
PLC	Programmable Logic Control Programmable Logic Control
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
USB	Universal Serial Bus
UV	Ultraviolet

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 3000i 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 stacker cranes

• 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 60825-1:2014 / EN 60825-1:2014+A11:2021 safety regulations for a product of **laser class 1** as well as the U.S. 21 CFR 1040.10 regulations with deviations corresponding to Laser Notice No. 56 from May 8, 2019.
	↳ 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. **CAUTION!** Opening the device can lead to dangerous exposure to radiation! 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 3000i 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 connection hood must be ordered separately.

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

- MS 3048 connection hood with M12 connectors
- MK 3048 connection hood with spring-cage terminals
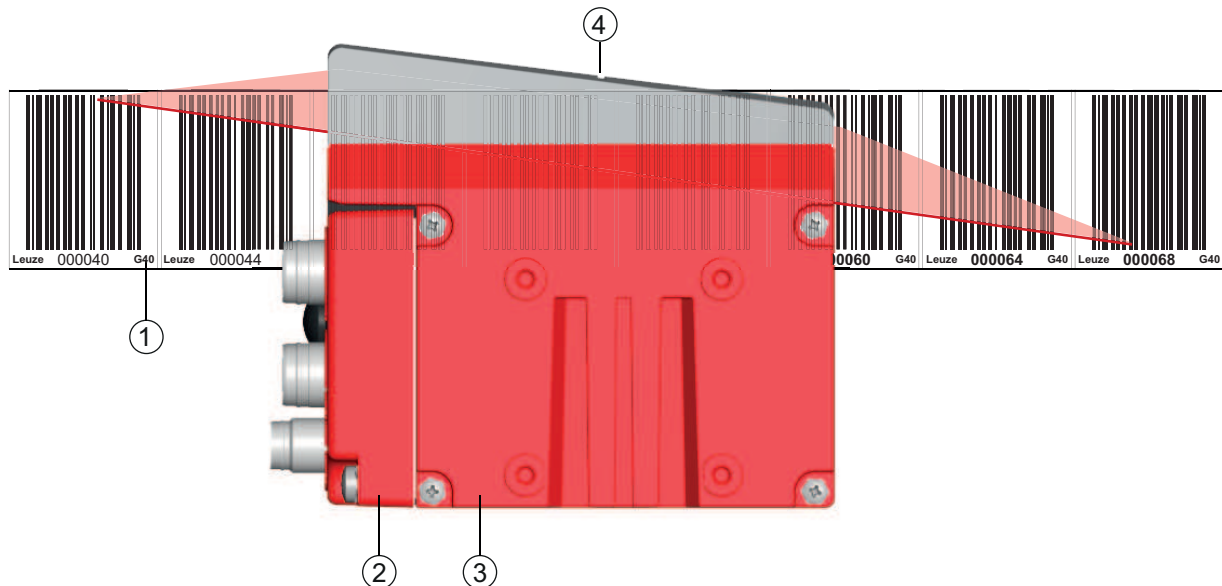
1   Bar code tape
2   Connection hood
3   Device housing
4   Middle of the scanning beam (device middle, output position value)

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
- Interface: PROFINET IO/RT

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 or spring-cage terminals

3.2 Connection technology

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

- MS 3048 connection hood with M12 connectors
- MK 3048 connection hood with spring-cage terminals

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 3048 connection hood with M12 connectors

The MS 3048 connection hood features three M12 connector plugs and a Mini-B type USB socket.

> ℹ️ **NOTICE**
>
> The integrated parameter memory for the simple replacement of the BPS is located in the MS 3048.
>
> In the integrated parameter memory, both the settings and the PROFINET name are saved. Upon device exchange, they are automatically transmitted to the new device.
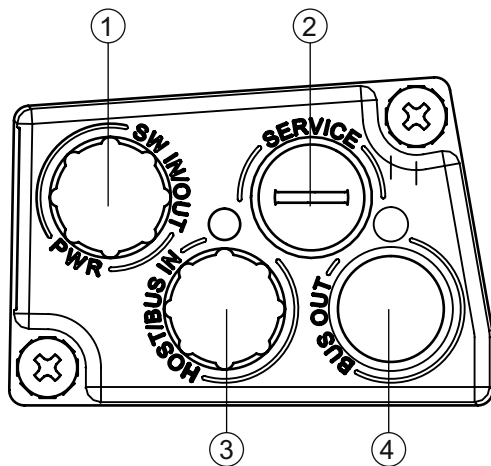
1   PWR / SW IN/OUT: M12 plug (A-coded)
2   Mini-B USB socket (behind protective cap)
3   HOST / BUS IN: M12 socket (D-coded), Ethernet 0
4   BUS OUT: M12 socket (D-coded), Ethernet 1

Fig. 3.2:   MS 3048 connection hood, connections

> ⓘ **NOTICE**
>
> **Shielding connection**
> ✎ The shielding connection is done via the M12 connector housing.

3.2.2 MK 3048 connection hood with spring-cage terminals

The MK 3048 connection hood makes it possible to connect the BPS directly and without additional connectors.

- The MK 3048 features three cable bushings in which the shielding connection for the interface cable is also located, and
- a Mini-B type USB socket.

	NOTICE
(i)	The integrated parameter memory for the simple replacement of the BPS is located in the MK 3048. In the integrated parameter memory, both the settings and the PROFINET name are saved. Upon device exchange, they are automatically transmitted to the new device.
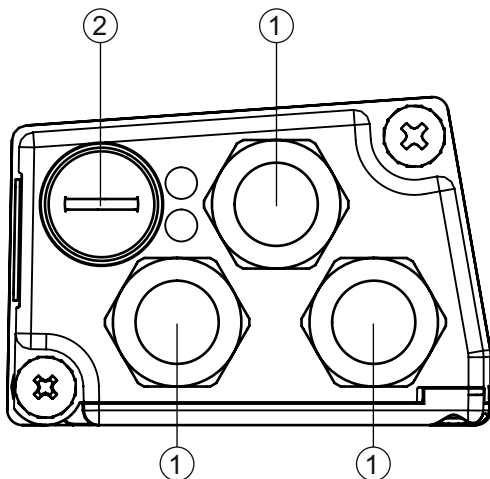
1 3x cable bushing, M16 x 1.5
2 Mini-B USB socket (behind protective cap)

Fig. 3.3: Connection hood MK 3048, 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
(i)	The shield is automatically contacted when the cable is lead into the metal screw fitting and fastened when the cord grip is closed.
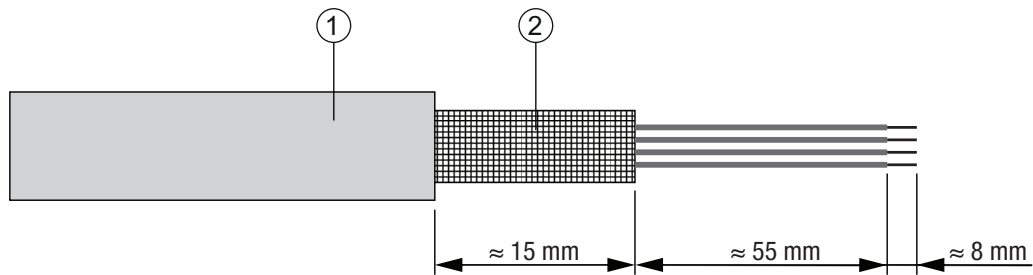
1   Diameter of contact area, cable: 6 … 9.5 mm
2   Diameter of contact area, shield: 5 … 9.5 mm

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

3.3   Display elements

The BPS is available with two LEDs as display elements on the device housing.

Located in the connection hood (MS 3048 or MK 3048) are two split, two-colored LEDs as status indicators for PROFINET connections BUS IN and BUS OUT.

LED indicators on the device housing

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

• PWR
• NET
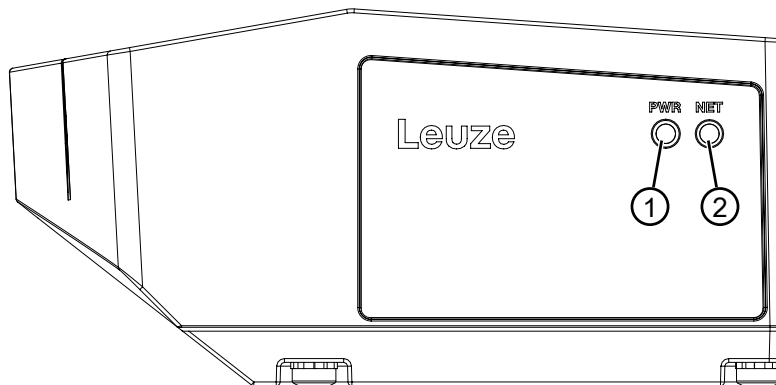
Fig. 3.5:   Indicators on the device housing

1   PWR LED
2   NET LED

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

LED	Color, state	Description
LED 1 PWR	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
	Orange, flashing	PROFINET wave function activated
	Orange, continuous light	Service active • No data on the host interface
LED 2 NET	Off	No supply voltage
	Green, flashing	• Device waiting for communication to be re-established • No data exchange
	Green, continuous light	• Communication with IO-Controller established • Data exchange active
	Orange, flashing	PROFINET wave function activated
	Red, flashing	• No data exchange

LED indicators on the connection hood (MS 3048 or MK 3048)
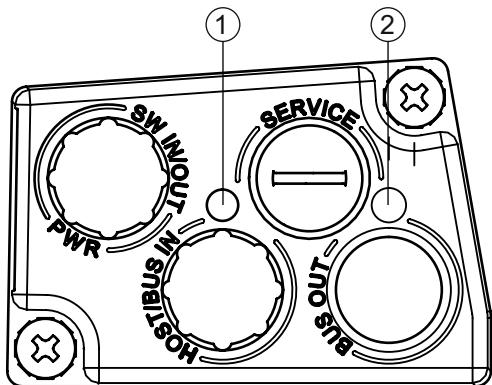
1   LED 0, ACT0/LINK0
2   LED 1, ACT1/LINK1

Fig. 3.5:   MS 3048, LED indicators
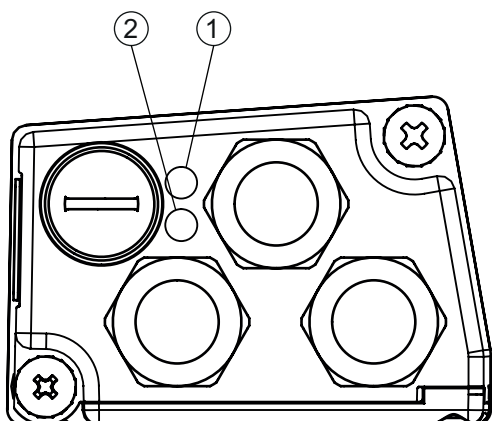
1   LED 0, ACT0/LINK0
2   LED 1, ACT1/LINK1

Fig. 3.6:   MK 3048, LED indicators

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)

3.4 Bar code tape

3.4.1 General information

A bar code tape with 40 mm grid is required for operation of a BPS 3000i bar code positioning system.

A bar code tape consists of a sequence of individual position labels. Defined cut marks are provided between the individual bar codes 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 3000i devices.

An entry wizard is available for special bar code tapes on the Leuze website under devices BPS 3000i - *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.

Bar code tape … G40 … 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. 3.7: Bar code tape … G40 … with 40 mm grid

> **NOTICE**
>
> Standard … G40 … bar code tapes are available in various length increments in the following heights: 47 mm and 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 3000i - *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 Twin tapes

Designation: BCB G40 … 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.
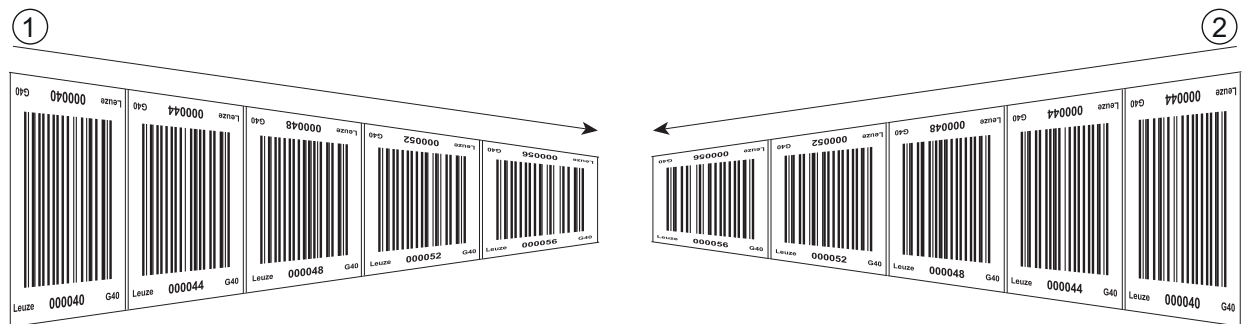
1   Twin bar code tape 1
2   Twin bar code tape 2

Fig. 3.8:   Twin bar code tape with double numbering

ℹ	**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 3000i - *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

4.1 Evaluation of the reading quality

	NOTICE
i	**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 output 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
i	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 two 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
i	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.

The parameters for the evaluation of the reading quality are set in the interface-specific configuration (see chapter 8.4.13 "Module 24 – Reading quality").

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 poor at certain position values: Soiling of the bar code tape

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 bar code positioning system convinces with a variety of advantages:

- The laser simultaneously scans multiple bar codes and, as a result, is able to determine the position with sub-millimeter precision. 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.

- 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:

- Stacker crane (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
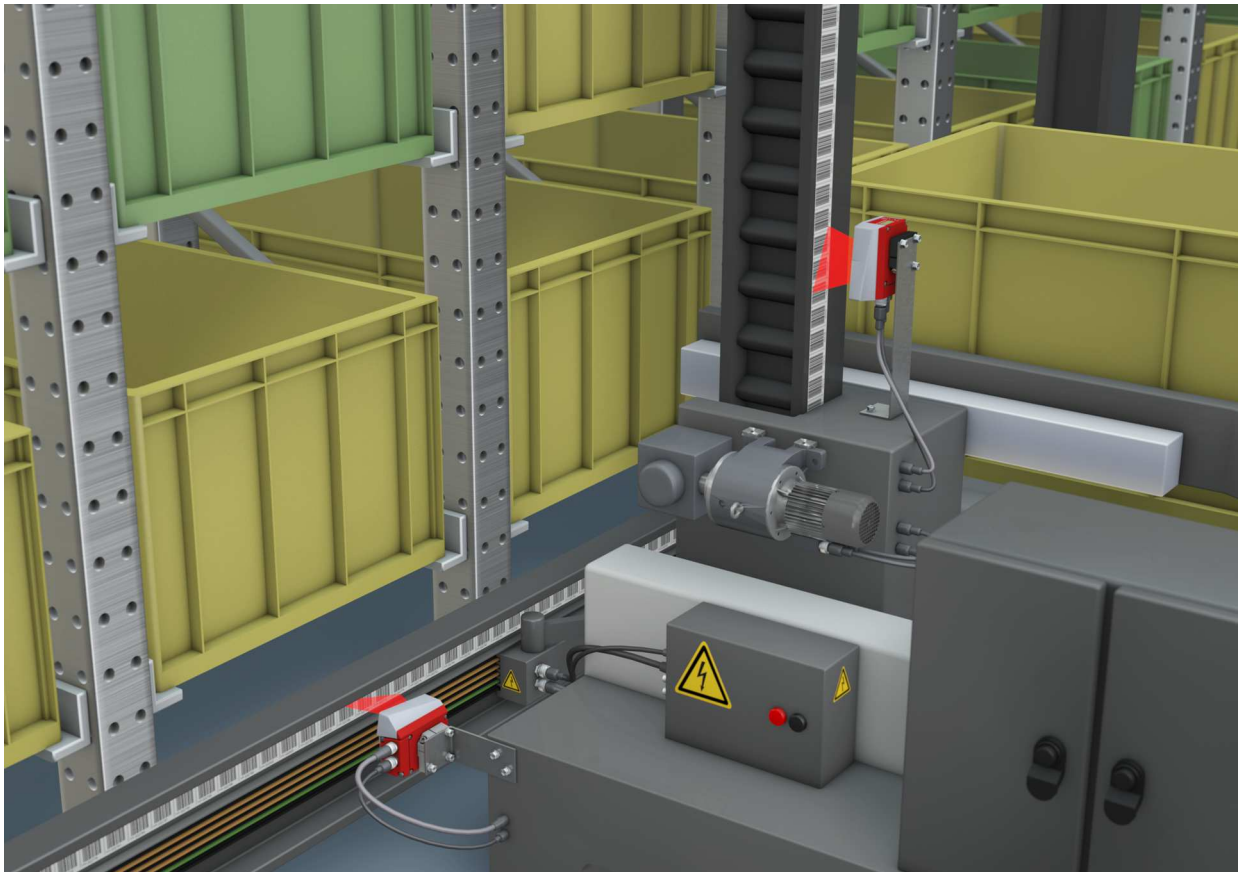
Fig. 5.1:   Stacker crane

↳ 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
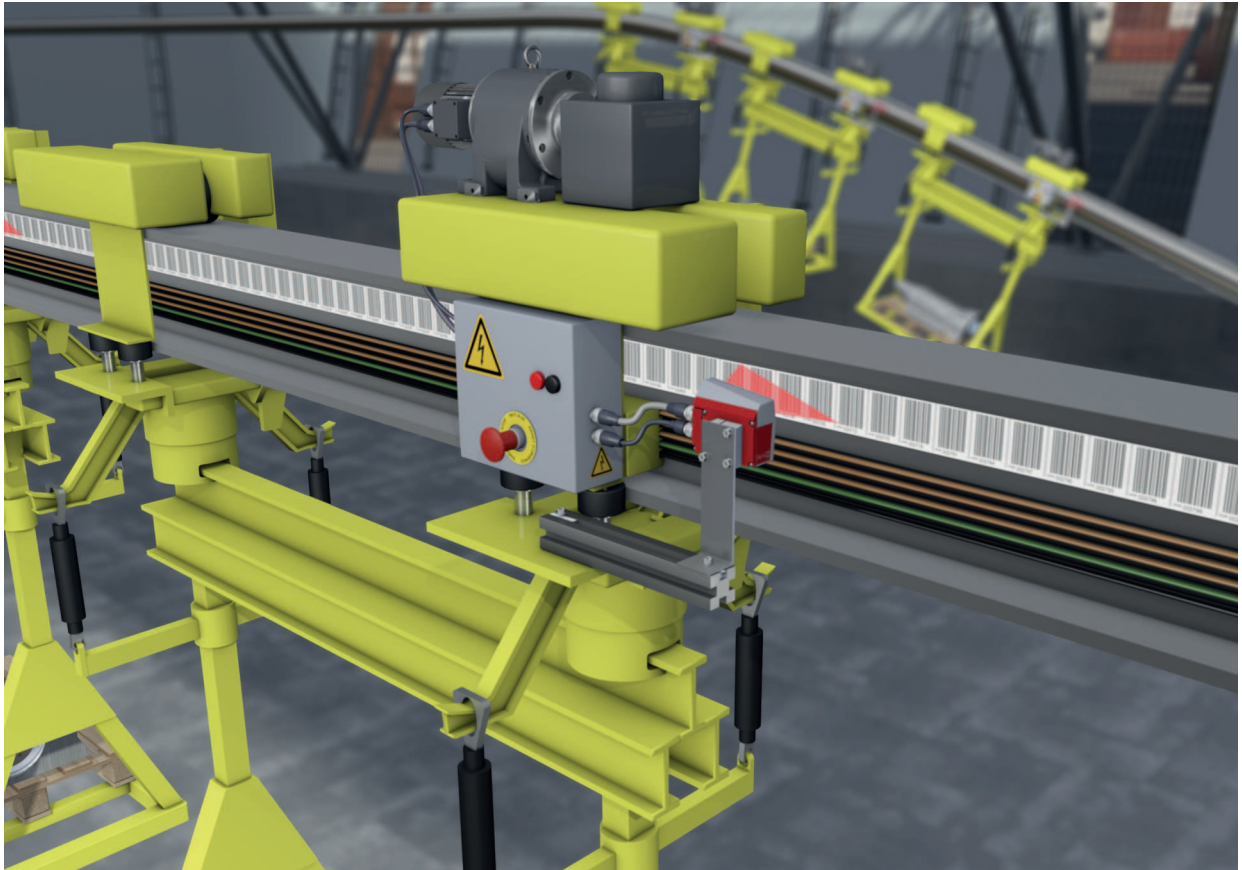
Fig. 5.2:   Electrical monorail system

✎ 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

5.3   Gantry cranes
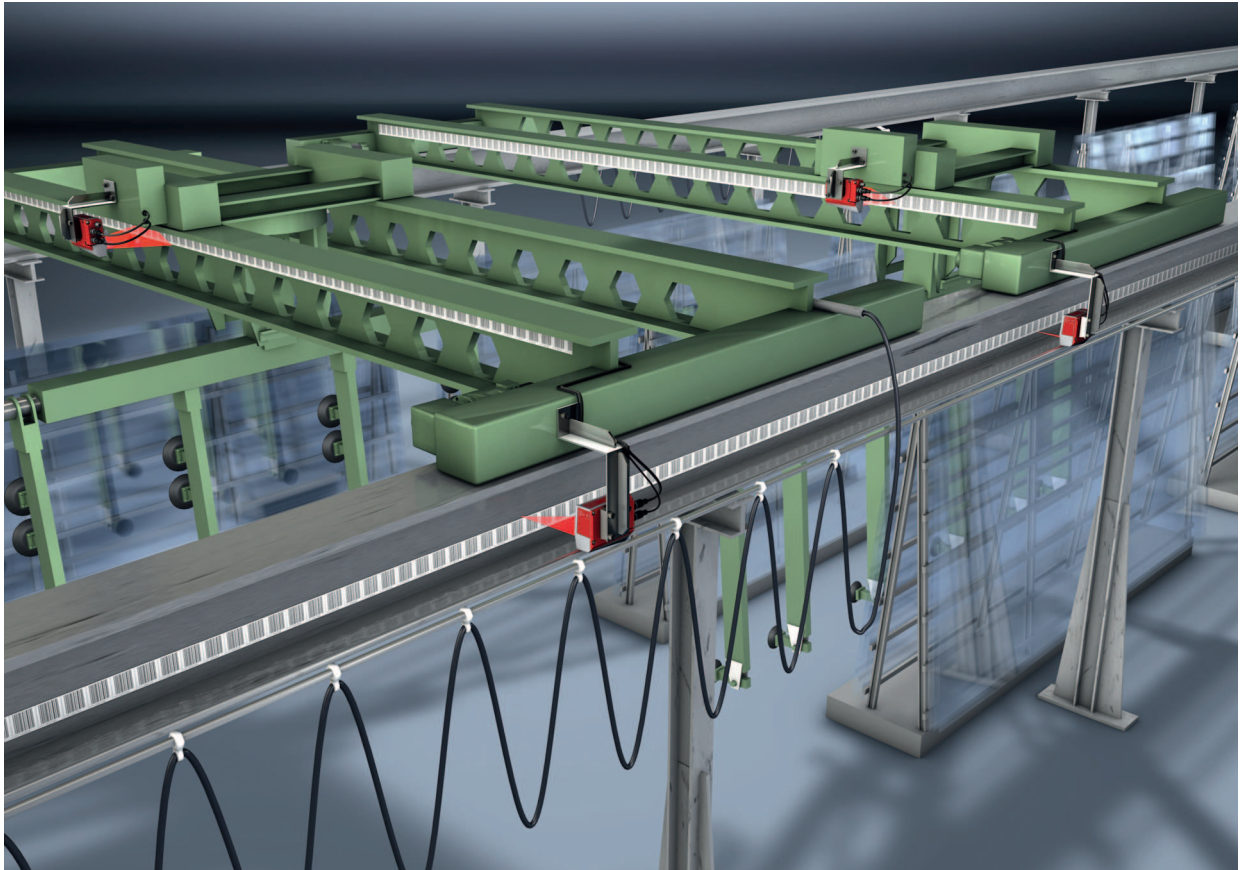
Fig. 5.3:   Gantry cranes

↳ 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 difference of at least 1 m must be maintained between the position value of the last position bar code of the preceding BCB and the position value of the first position bar code of the subsequent BCB.
	↳ 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:
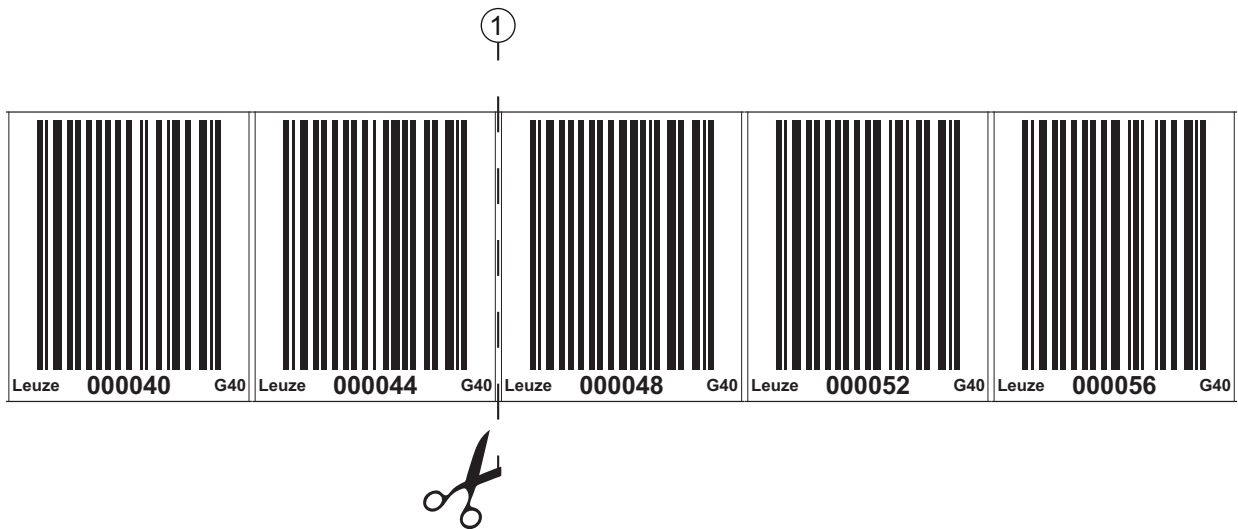
1   Cut mark

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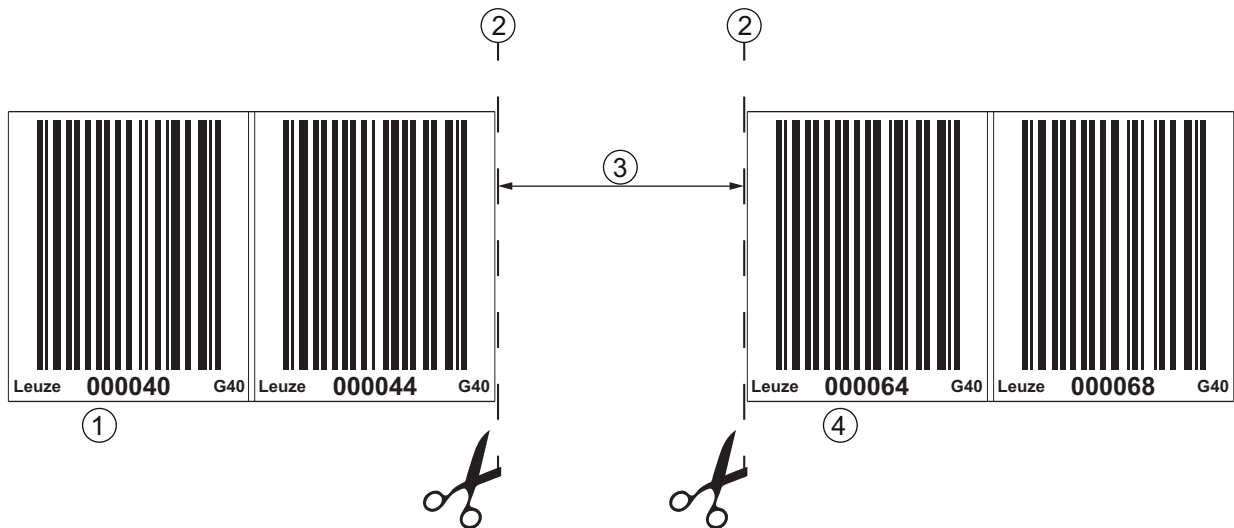
1 Preceding bar code tape
2 Cut mark
3 Gap, at least 300 mm
4 Subsequent bar code tape

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

	NOTICE
❶	**No glossy gaps in the cut bar code tape!** ⮩ Ensure that there are matt, bright surfaces behind the gaps in the BCB. 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
❶	**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 10.2.2 "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 due to optical distortions.

ᗷ For horizontal curves, maintain a minimum bending radius of 300 mm.
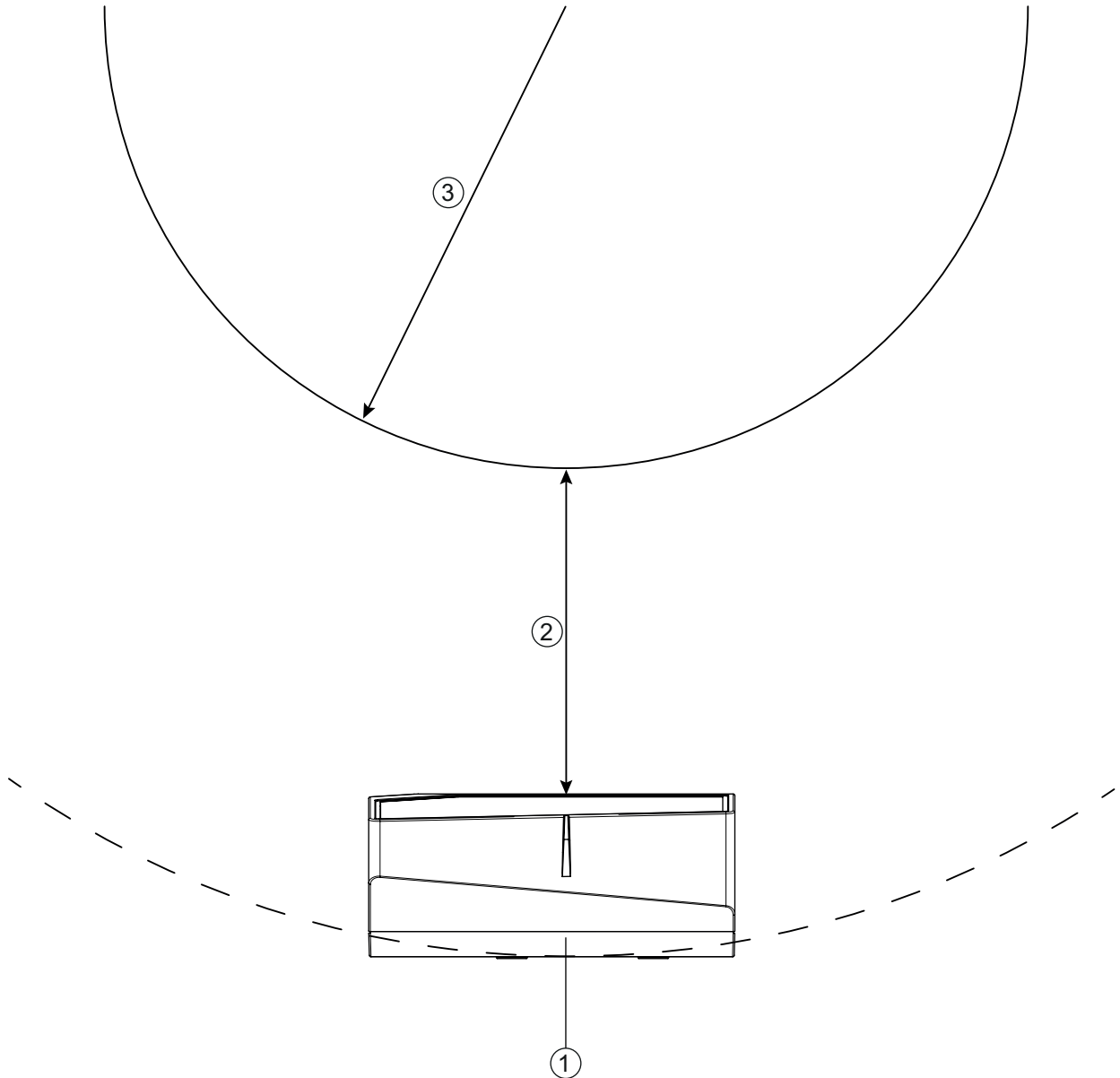
1	BPS
2	Reading distance
3	Radius of the bar code tape, R_{min} = 300 mm

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!** ᗷ 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. ᗷ In areas where the BCB is fanned out around curves, limitations of the reproducibility must be expected.

ᨏ Only partially cut the BCB at the cut mark.

ᨏ Affix the BCB along the curve like a fan.

ᨏ Ensure that the BCB is affixed without mechanical tension.

> **NOTICE**
>
> **No glossy gaps in the bar code tape!**
>
> ᨏ Ensure that there are matt, bright surfaces behind the fanning in the BCB curves. Reflective and high-gloss surfaces in the scanning beam may impair the measurement quality of the BPS.
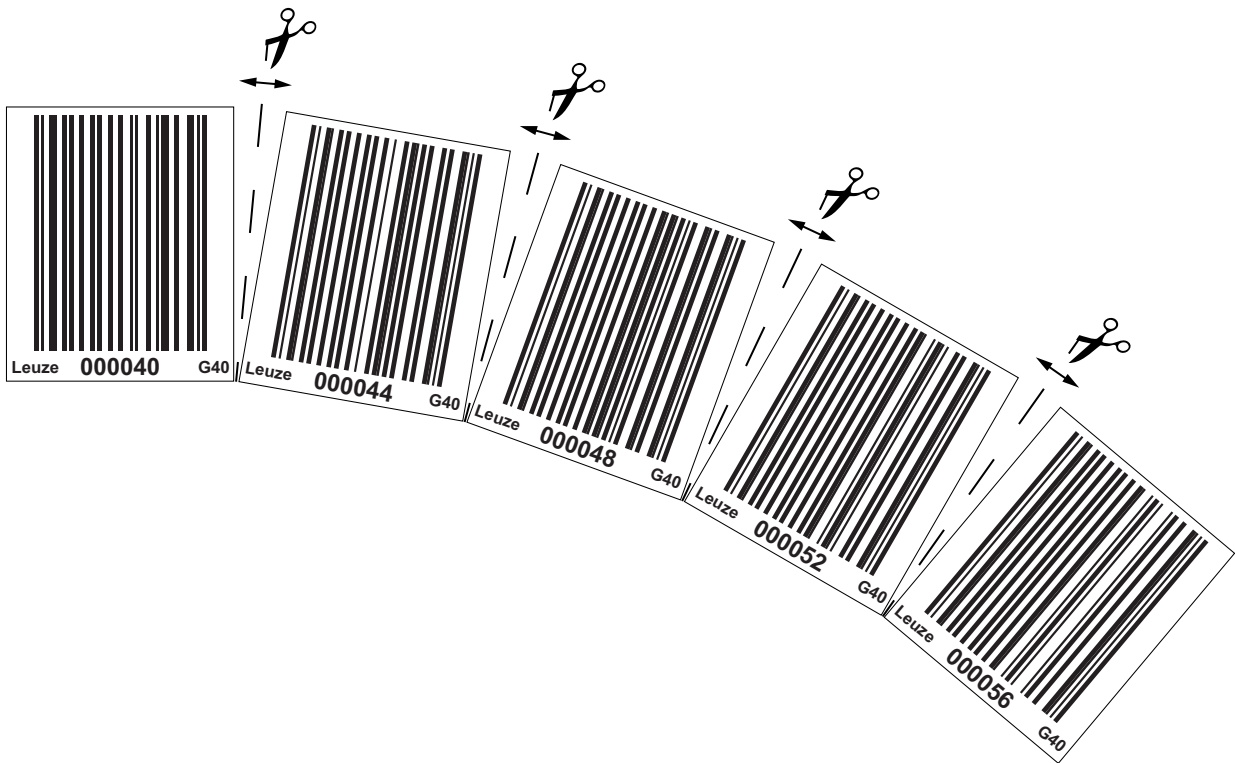
Fig. 6.5:   Preparing the bar code tape for use in vertical curves

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 3.4.2 "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.
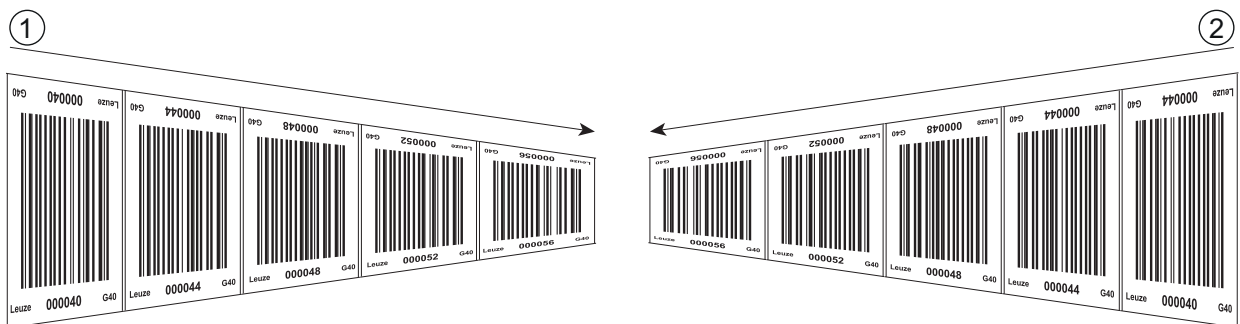
1   Twin bar code tape 1
2   Twin bar code tape 2

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.

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
- Mounting using a mounting bracket on the M4 threads on the rear side of the device
  - BT 300 W: Mounting on a mounting bracket
- Direct mounting using four M4 mounting threads on the rear side 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 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.

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.
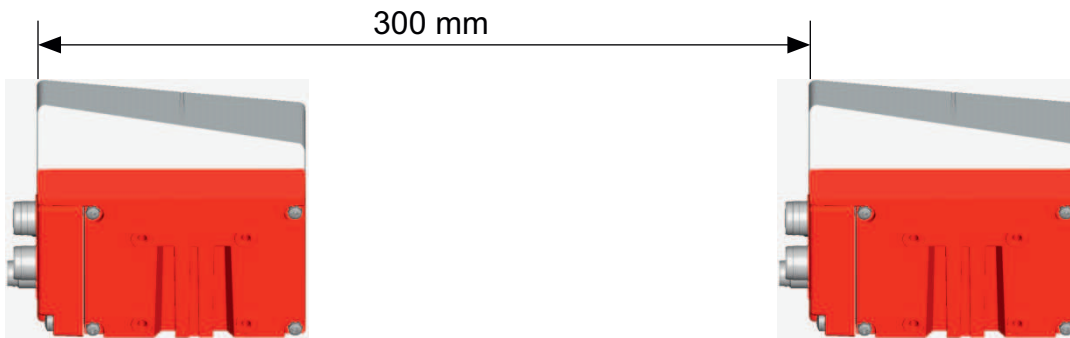
Fig. 6.7:   Minimum distance for parallel mounting

ⓘ	**NOTICE**
	Install the connection hood before mounting the BPS!
	↳ Screw the MS 3048 or MK 3048 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.
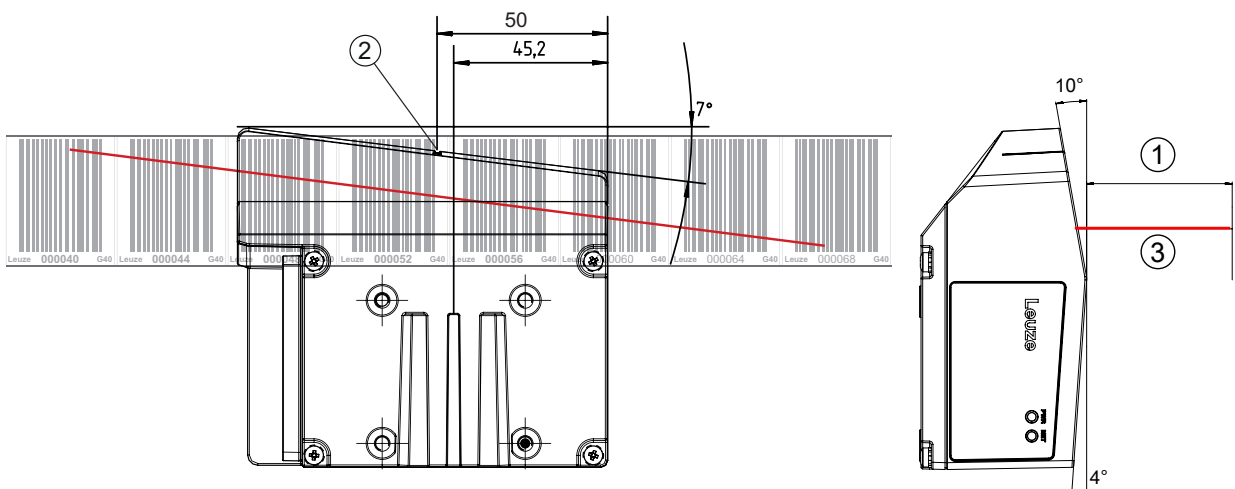
Fig. 6.20:   Beam exit

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

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 13 "Order guide and accessories"; for dimensioned drawing see chapter 12.4 "Dimensioned drawings: Accessories".
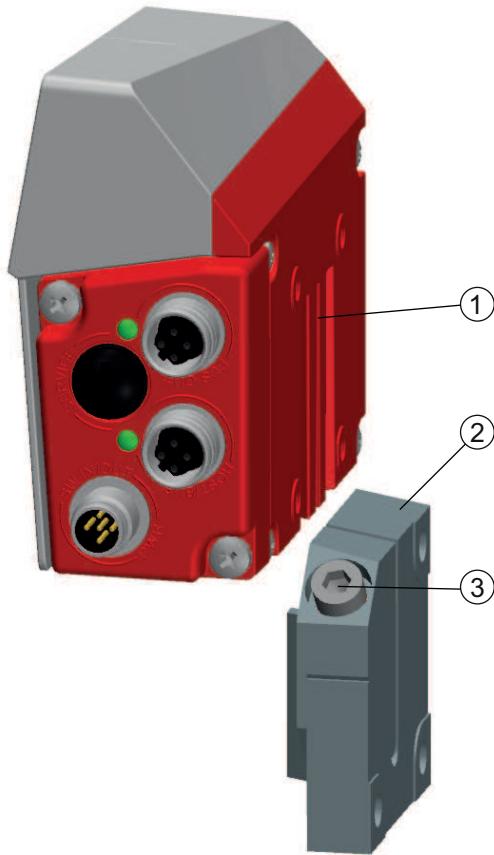
1 Clamp profile
2 Clamping jaws
3 Screw terminal

Fig. 6.8:   Mounting the BPS with the BTU 0300M-W mounting device

ᗷ Mount the BTU 0300M-W on the system side with M6 fastening screws (not included in delivery contents).

ᗷ Mount the BPS with the dovetail fastening grooves on the clamping jaws of the BTU 0300M-W with limit stop at end.

ᗷ 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 13 "Order guide and accessories"; for dimensioned drawing see chapter 12.4 "Dimensioned drawings: Accessories".

ᗷ Mount the BT 300 W mounting bracket on the system side with M6 fastening screws (included in delivery contents).

ᗷ 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 M4 fastening screws
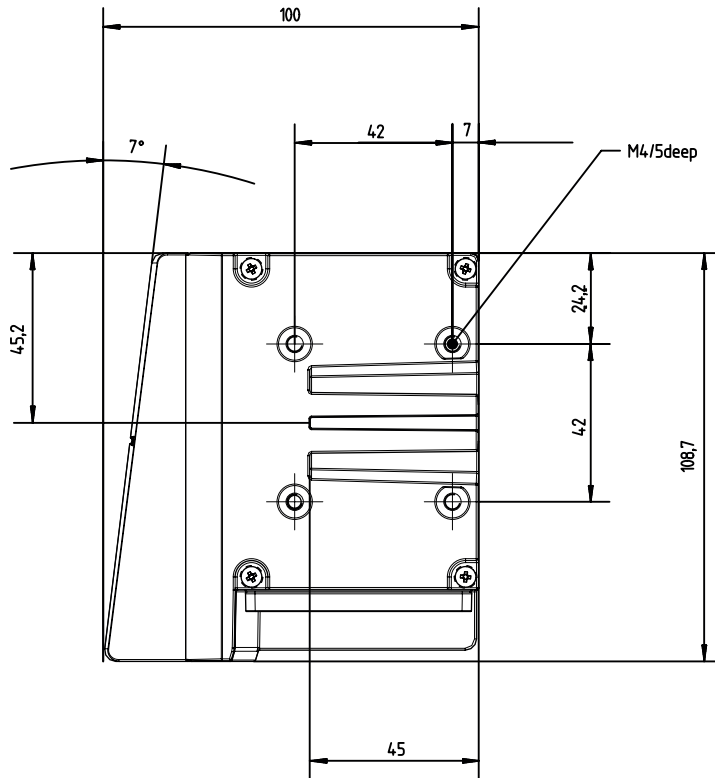
all dimensions in mm

Fig. 6.9:   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.

❗	*NOTICE*
❗	**Protective Extra Low Voltage (PELV)!** The device 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 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.

ℹ	*NOTICE*
ℹ	For all connections (connection cable, interconnection cable, etc.), use only the cables listed in the accessories (see chapter 13 "Order guide and accessories").

7.1 External parameter memory in the connection hood

The parameter memory in the MS 3048 or MK 3048 connection hood stores the device name and holds a copy of the current BPS parameter set.

• If a BPS device exchange is performed on-site, the device name for the new BPS is taken over automatically.

Manual configuration of the exchanged device and re-naming of the device name are not necessary.

• The control can immediately access the exchanged BPS.

7.2 MS 3048 connection hood with connectors

The MS 3048 connection hood features three M12 connector plugs and a Mini-B type USB socket.
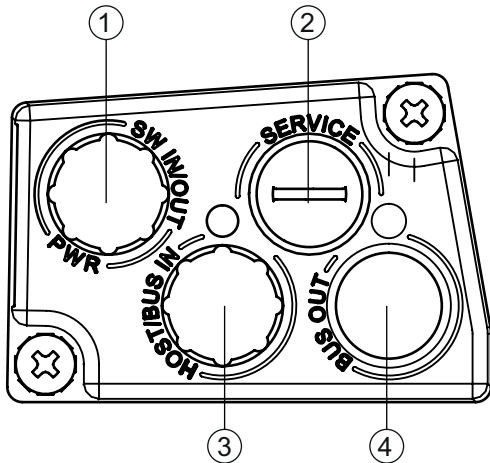
1   PWR / SW IN/OUT: M12 plug (A-coded)
2   Mini-B USB socket (behind protective cap)
3   HOST / BUS IN: M12 socket (D-coded), Ethernet 0
4   BUS OUT: M12 socket (D-coded), Ethernet 1

Fig. 7.1:   MS 3048 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 BPS in PROFINET linear topology!**
	↳ In the event of a device exchange, the PROFINET network is interrupted at this location.
	↳ The PROFINET network is interrupted if the BPS is unplugged from the connection hood.
	↳ If there is no voltage supply for the BPS, the PROFINET network is interrupted.

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

↳ PROFINET star topology: Connect the HOST / BUS IN connection to a switch with the interconnection cable.

↳ PROFINET linear topology: Connect the HOST / BUS IN connection to the BUS OUT connection of the upstream BPS with the interconnection cable.
Connect the BUS OUT connection to the HOST / BUS IN connection of the downstream BPS with the interconnection cable.

7.3 MK 3048 connection hood with spring-cage terminals

With the MK 3048 connection hood, the BPS is connected directly and with no additional plug.

- The MK 3048 features three cable bushings in which the shielding connection for the interface cable is also located, and
- a Mini-B type USB socket.
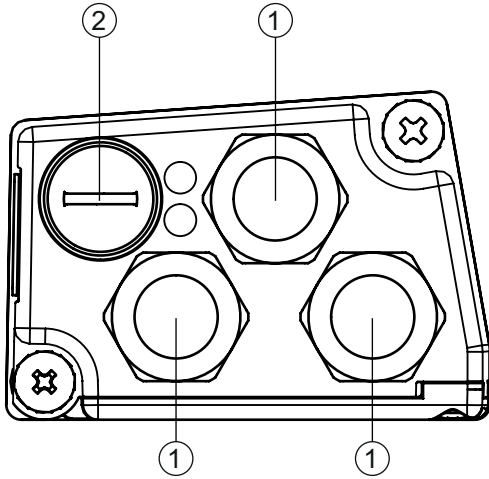
1 3x cable bushing, M16 x 1.5
2 Mini-B USB socket (behind protective cap)

Fig. 7.2:   Connection hood MK 3048, 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.

⮑ PROFINET star topology: Connect the HOST / BUS IN connection to a switch with the interconnection cable.

⮑ PROFINET linear topology: Connect the HOST / BUS IN connection to the BUS OUT connection of the upstream BPS with the interconnection cable. Connect the BUS OUT connection to the HOST / BUS IN connection of the downstream BPS with the interconnection cable.

7.4 Pin assignment

7.4.1 PWR / SW IN/OUT (Power and switching input/output)

5-pin, M12 plug (A-coded) or terminal block for connecting to PWR / SW IN/OUT.
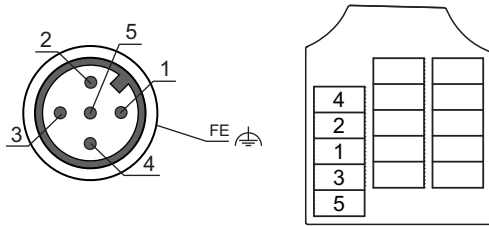
Fig. 7.3: PWR / SW IN/OUT connection

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

Pin/terminal	Designation	Assignment
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 (M12 connector) Cable gland	Functional earth	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 13 "Order guide and accessories"

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 control can use switching inputs/outputs as digital I/Os.

  If no internal BPS function is connected to the switching inputs/outputs, the ports can be addressed as two inputs, two outputs or as one input and one output of a digital I/O component.

NOTICE
If SWIO1 or SWIO2 is to be used as digital input or output, the configuration must be performed in module 4 (see chapter 8.4.6 "Module 4 – Input/output IO 1") or module 5 (see chapter 8.4.7 "Module 5 – Input/output IO 2").

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
The two switching inputs/outputs, SWIO1 and SWIO2, are configured as follows by default:
Switching output SWIO1: Position value invalid
Switching input SWIO2: Teach Preset

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.

7.4.2 HOST / BUS IN (Host/Bus input, Ethernet)

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

4-pin, M12-socket (D-coded) or terminal block for connecting to HOST / BUS IN.
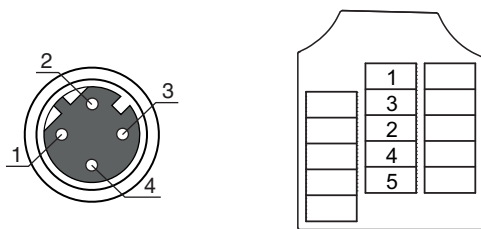
Fig. 7.4: HOST / BUS IN connection

Tab. 7.2: HOST / BUS IN pin assignment

Pin/terminal	Designation	Assignment
1	TD+	Transmit Data +
2	RD+	Receive Data +
3	TD-	Transmit Data -
4	RD-	Receive Data -
5	-	Not connected

NOTICE
Use preassembled cables!
↳ If possible, use the preassembled cables from Leuze (see chapter 13.3 "Cables accessories").

PROFINET - cable assignments
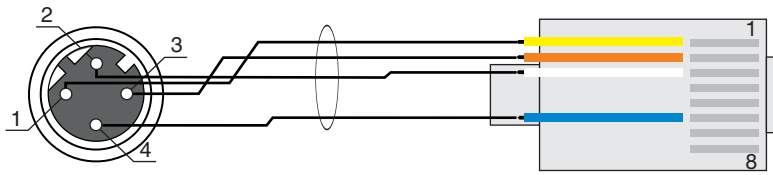
Fig. 7.5:   HOST / BUS IN cable assignments on RJ-45

Designed as shielded cable, max. 100 m.

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

	NOTICE
!	**Self-configured cables with PROFINET interface!** ↳ 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.

7.4.3   BUS OUT (host/bus output, Ethernet)

For the creation of a PROFINET network with multiple participants, the BPS is equipped with the outgoing BUS OUT PROFINET 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 7.5 "PROFINET topologies").

4-pin, M12-socket (D-coded) or terminal block for connection to BUS OUT.
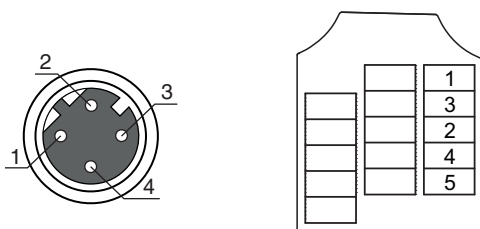
Fig. 7.6:   BUS OUT connection

Tab. 7.3:   BUS OUT pin assignment

Pin/terminal	Designation	Assignment
1	TD+	Transmit Data +
2	RD+	Receive Data +
3	TD-	Transmit Data -
4	RD-	Receive Data -
5	-	Not connected

	NOTICE
ⓘ	**Use preassembled cables!** ↳ If possible, use the preassembled cables from Leuze (see chapter 13.3 "Cables accessories").

	NOTICE
ⓘ	**Self-configured cables with PROFINET interface!** ↳ Ensure adequate shielding. The entire interconnection cable must be shielded and earthed. ↳ The signal lines must be stranded in pairs.

	NOTICE
ⓘ	**No BUS OUT termination necessary!** ↳ For the BPS as standalone device or as the last participant in a linear PROFINET topology, termination on the BUS OUT socket is **not** mandatory.

7.5 PROFINET topologies

7.5.1 Star topology

The BPS can be operated as a single device (standalone) with individual device name in a PROFINET - star topology. The control must communicate this device name to the participant during the "device naming" (see chapter 8.3 "Configuring for the Siemens control").
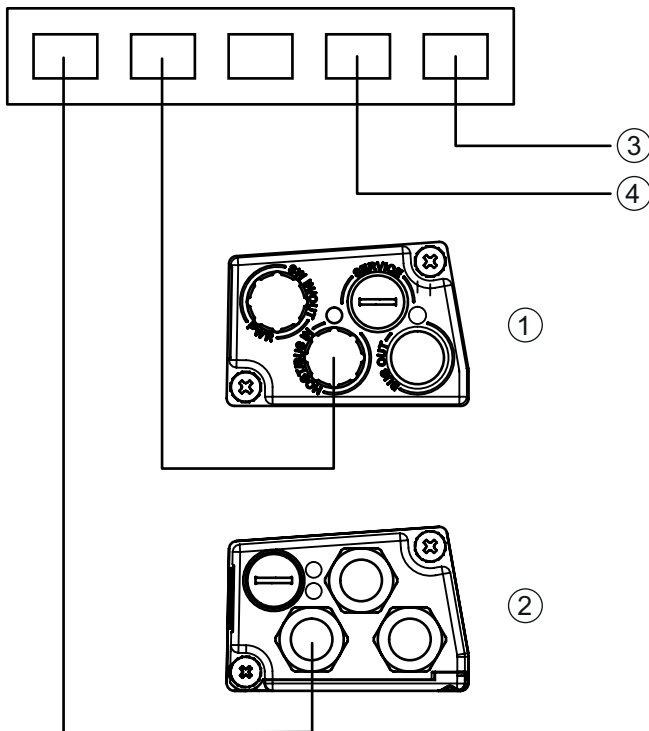
1   With MS 3048 connection hood with M12 connectors
2   With MK 3048 connection hood with spring-cage terminals
3   Host interface - PC/control
4   other network participants

Fig. 7.7:   PROFINET in a star topology

7.5.2 Linear topology

The integrated switch functionality of the BPS offers the possibility to network multiple BPS devices. In addition to the classic "star topology", a "linear topology" is thus also possible. The wiring of the network in a linear topology is simple and economical since 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.
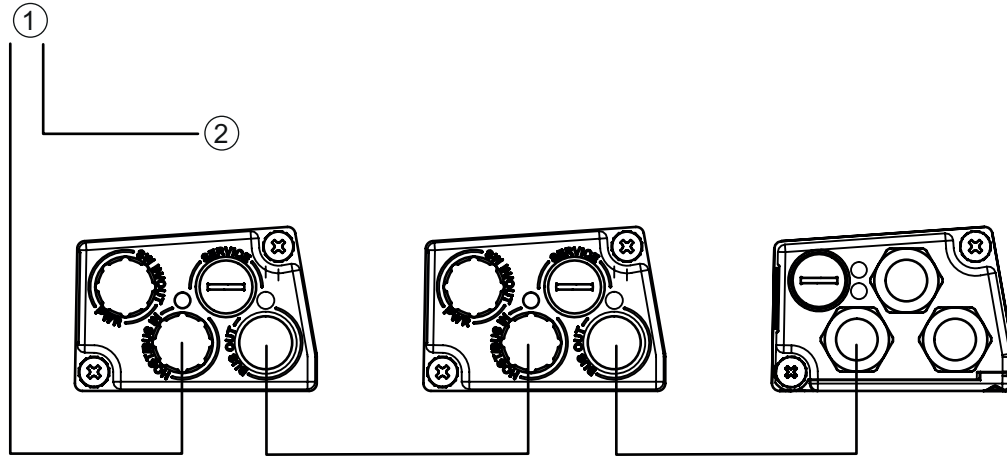
1   Host interface - PC/control
2   other network participants

Fig. 7.8:   PROFINET in a linear topology

Up to 254 BPS can be networked. They must all be located in the same subnet.

To do this, the individual "device name" is assigned to each participating BPS through "device naming", using the control's configuration tool (see chapter 8.3 "Configuring for the Siemens control").

7.5.3 PROFINET - wiring

ⓘ	**NOTICE**
	Strictly observe during PROFINET wiring!
	↳ Use the preassembled cables from Leuze (see chapter 13.3 "Cables accessories") or the recommended connectors/sockets.
	↳ Always use a CAT 5 Ethernet cable for the wiring.
	↳ For the conversion of the connection technology from M12 to RJ45, use the KDS ET M12 / RJ 45 W - 4P adapter (see chapter 13.4 "Other accessories"). Standard network cables can be plugged into the adapter.
	↳ If no standard network cables are used (e.g. due to lacking IP… degree of protection), you can use the KB ET - … - SA user-configurable cable on the BPS (see chapter 13.3 "Cables accessories").
	↳ The individual BPS devices in a linear topology are connected with the KB ET - … - SSA cable (see chapter 13.3 "Cables accessories").

ⓘ	**NOTICE**
	Observe for self-configured or preassembled cables!
	↳ If the desired cable lengths are unavailable, you can assemble the cables yourself.
	↳ Use the recommended connectors or sockets or the preassembled cables (see chapter 13 "Order guide and accessories").
	↳ Connect TD+ on the M12 plug to RD+ on the RJ-45 plug.
	↳ Connect TD- on the M12 plug to RD- on the RJ-45 plug, etc.

7.6 Cable lengths and shielding

Observe the maximum cable lengths and the shielding types:

Connection	Interface	Max. cable length	Shielding
BPS host	PROFINET	100 m	Shielding absolutely necessary
Network from the first BPS to the last BPS	PROFINET	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 – Basic configuration

As a rule, the BPS is configured via the PROFINET interface.

	NOTICE
!	**Observe for the configuration of PROFINET devices!**
	⟳ **Always** perform the basic configuration using the Generic Station Description Markup Language (GSDML) file. Download the appropriate file from the Internet. In process operation, only the parameters in the PROFINET modules set via the GSDML file or the PROFINET default presets are in effect.
	⟳ Configuration data is saved in the device **and** in the connection hood.

8.1 Configuring the PROFINET interface

The BPS is designed as a PROFINET-RT device (Real Time; acc. to IEEE 802.3). It supports a transmission rate of up to 100 Mbit/s (100 Base TX/FX), full duplex, as well as auto-negotiation and auto-crossover.

- The functionality of the BPS is defined via parameters which are organized in modules. The modules are part of the Generic Station Description Markup Language (GSDML) file.
- Each BPS has a unique MAC address (Media Access Control) that is specified on the name plate. The MAC address (MAC-ID) is linked to an IP address during the course of configuration.
- The configuration tool for creation of PROFINET networks links the IP address to a freely selectable device name which may only exist once in the network.

Address Link Label

The "Address Link Label" is an additional stick-on label that is affixed to the device.

BPS 348i MAC 00:15:7B:20:00:15

IP
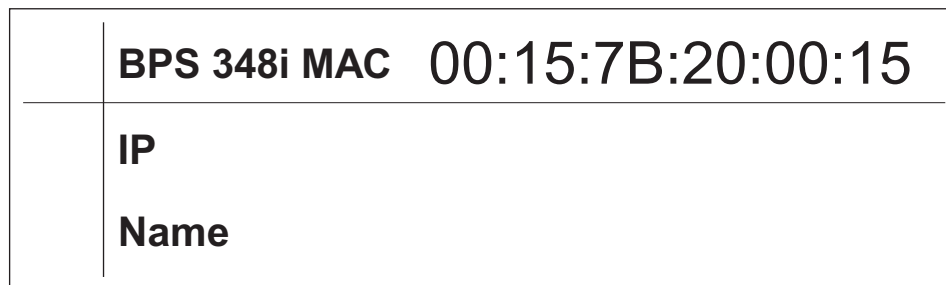
Name

Fig. 8.1: Example of an "Address Link Label"; the device type varies depending on the series

- The "Address Link Label" contains the MAC address (Media Access Control address) of the device and makes it possible to enter the IP address and the device name manually.

  The area of the "Address Link Label" on which the MAC address is printed can be separated from the remainder of the stick-on label if necessary using the perforation.

- The "Address Link Label" can be removed from the device and affixed in the installation and layout diagrams to designate the device.

- Once it is affixed in the documents, the "Address Link Label" establishes a unique reference between the mounting location, the MAC address or the device, and the associated control program.

  There is no need for time-consuming searching, reading, and manually writing down of the MAC addresses of every device that is installed in the system.

	NOTICE
i	Each device with Ethernet interface is uniquely identified via the MAC address assigned during production. The MAC address is also listed on the name plate of the device.
	If multiple devices are commissioned in a system, the MAC address of each installed device must be correctly assigned, e.g., during programming of the control.

⟳ Remove the "Address Link Label" from the device.

⟳ If necessary, add the IP address and the device name to the "Address Link Label".

⟳ Affix the "Address Link Label" in the documents, e.g., in the installation diagram, according to the position of the device.

8.2 Starting the device

To start the BPS:

✧ Connect the supply voltage. The BPS starts up and, for devices with a display, the device status is displayed.

✧ Configure the BPS, e.g., with a Siemens configuration tool.

✧ Assign the BPS its individual device name and name the device.

Starting up the device

	NOTICE
i	The default value of the input data bits after switching on the device corresponds to the specified initial value (generally ZERO).

	NOTICE
i	For output data with status IOPS = Bad, the downstream functions are switched to a safe state. For example, an activated device or an output is deactivated. This is the case, for example, if the control is switched to the STOP mode.
	In the event of a connection interruption, the device behaves in the same way.
	The outputs are deactivated during device start-up.

8.3 Configuring for the Siemens control

The functionality of the BPS is defined via parameter sets which are organized in modules. The modules are part of the GSDML file (Generic Station Description Markup Language), which is supplied as an integral part of the device.

By using a user-specific configuration tool for the Siemens PLC, the required modules are integrated into a project during commissioning and its settings and parameters are adjusted accordingly. These modules are provided by the GSDML file.

	NOTICE
!	**Observe SIMATIC Manager version!**
	✧ For the Siemens S7-300- and S7400 control, you need at least SIMATIC Manager version 5.4 + service pack 5 (V5.4+SP5).

The following steps are necessary for commissioning:

- Preparation of the control
- Installation of the GSDML file
- Hardware configuration
- Transmission of the PROFINET configuration to the IO Controller
- Device naming
- Check device name

Proceed as follows:

✧ To prepare the control:
Assign an IP address to the IO controller
Prepare the control system for consistent data transmission.

✧ Install the GSDML file for the subsequent configuration of the BPS.

General information on the GSDML file

The term GSD (Generic Station Description) stands for the textual description of a PROFINET device model. For the description of the complex PROFINET device model, the XML-based GSDML (Generic Station Description Markup Language) was introduced. In the following, the terms "GSD" or "GSD file" always refer to the GSDML-based format.

- The GSDML file can support an arbitrary number of languages in one file.
- Every GSDML file contains a version of the BPS device model. This is also reflected in the file name.

> **! NOTICE**
>
> The GSDML file is a certified and integral part of the device and must not be changed manually.
>
> The GSDML file is not changed by the system either.

- In the GSDML file, all data necessary for operating the BPS is described in modules:
  - Input and output data
  - Device parameters
  - Definition of control bits or status bits.
- If parameters are changed in the project tool, for example, these changes are stored by the control in the project, not in the GSDML file.

The functionality of the BPS is defined via parameter sets. The parameters and their functions are structured in the GSDML file using modules. A user-specific configuration tool is used during PLC program creation to integrate the required modules and configure them appropriately for their respective use.

During operation of the BPS on the PROFINET all parameters are set to default values. If these parameters are not changed by the user, the device functions with the default settings delivered by Leuze. The default settings of the BPS can be found in the module descriptions.

GSDML file name structure

The file name of the GSDML file is constructed according to the following rule:
GSDML-[GSDML schema version]-Leuze-[item description]-[date].xml

- **[GSDML schema version]** = Version identifier of the GSDML schema version used, e.g., V2.2
- **[Date]** = Release date of the GSDML file in the format yyyymmdd.
  This date also stands for the release date of the file.
  Example: GSDML-V2.42-LEUZE-BPS3048i-20220718.xml

- ↳ Configure the hardware of the PLC:
  Add the BPS to your project. The PROFINET system is configured with the help of the hardware configuration (*HW-Config*) of the configuration tool.
  Assign an IP address a unique device name.
- ↳ Transfer the PROFINET configuration to the IO Controller.

Following successful transfer, the following activities take place automatically:

- Check of device names
- Assignment of the IP addresses that were configured in the *HW Config* to the IO devices
- Establishment of a connection between the IO Controller and configured IO devices
- Cyclical data exchange

> **i NOTICE**
>
> Participants that have not been "named" cannot be contacted yet at this point in time!

Device naming

PROFINET defines the "naming of the device" as the creation of a name-based relationship for a PROFINET device.

↳ Set the device name.
  The PROFINET device has a unique MAC address that is part of the factory settings. The MAC address may be found on the name plate of the BPS. Multiple BPS devices can be distinguished by the MAC addresses displayed.
  This information is used to assign a unique, plant-specific device name ("NameOfStation") to the device via the "Discovery and Configuration Protocol (DCP)". Every time the system is started up, PROFINET uses the DCP protocol for the IP address assignment, provided the IO-device is located in the same subnet.

↳ Assign the device names to the configured IO devices.
  Select the BPS using its MAC address. The unique device name (which must match the name in the *HW Config*) is then assigned to the BPS.

↳ Assign the IP address to the MAC address (individual device name).
  At this point, assign another IP address (suggested by the control), a subnet mask and, if required, a router address, and assign this data to the named participant (device name).
  From now on, and when programming, only the unique device name (max. 255 characters) is used.

↳ Check device name
  After completing the configuration phase, check the device names that have been assigned.

!	*NOTICE*
	Assign unique device names!
	↳ Ensure that the device names are unique and that all participants are located in the same subnet.

8.4 PROFINET project modules

!	*NOTICE*
	Overwriting of data by PLC!
	↳ During the configuration phase, the BPS receives parameter telegrams from the Controller (master). Before the parameter telegrams are evaluated and the respective parameter values are set, all interface-specific parameters are reset to default values. This ensures that the parameters of modules that are not selected are set to the default values.

!	*NOTICE*
	Do not activate any universal modules!
	↳ If the control makes a so-called "universal module" available, the universal module may not be activated for the BPS.

i	*NOTICE*
	You can find the default values of the BPS in the module descriptions.

8.4.1 Overview of the modules

Module	Module name	Module contents (P) = Parameter, (O) = Output, (I) = Input
DAP_001 see chapter 8.4.2 "DAP module – permanently defined parameters"	Position value	Profile (P), Integration depth (P), Tape selection (P)

Module	Module name	Module contents (P) = Parameter, (O) = Output, (I) = Input
M1 see chapter 8.4.3 "Module 1 – Position value"	Position value	Sign (P), Unit (P), Position resolution (P), Counting direction (P), Offset (P), Position (I)
M2 see chapter 8.4.4 "Module 2 – Static preset"	Static preset	Preset value (P), Teach Preset (O), Reset Preset (O)
M3 see chapter 8.4.5 "Module 3 – Dynamic preset"	Dynamic preset	Preset value (P), Teach Preset (O), Reset Preset (O)
M4 see chapter 8.4.6 "Module 4 – Input/output IO 1"	Input/output IO 1	Function (P), Activation (P), Output (P), Input (P), State (I), Control output (O)
M5 see chapter 8.4.7 "Module 5 – Input/output IO 2"	Input/output IO 2	Function (P), Activation (P), Output (P), Input (P), State (I), Control output (O)
M6 see chapter 8.4.8 "Module 6 – Status and control"	Status and control	Measurement value invalid/not active (I), Preset active (I), Teach Preset toggle (I), Temperature warning/error (I), Hardware defect (I), Reading quality warning/Error threshold (I), Standby active (I), Start/stop measurement (O), Activate/deactivate Standby (O), Acknowledge control/marker bar code (O)
M9 see chapter 8.4.9 "Module 9 – Error handling procedures"	Error handling procedures	Position value in the case of error (P), Suppress position state (P), Error delay/error delay time (position) (P), Speed in the case of error (P), Suppress speed state (P), Error delay/error delay time (speed) (P)
M10 see chapter 8.4.10 "Module 10 – Speed"	Speed	Speed resolution (P), Averaging (P), Speed (I)
M16 see chapter 8.4.11 "Module 16 – Speed status"	Speed state	Speed measurement error (I), movement status/direction (I)
M23 see chapter 8.4.12 "Module 23 – Tape value correction"	Tape value correction	Real length (P), Range start/end(P)
M24 see chapter 8.4.13 "Module 24 – Reading quality"	Reading quality	Warning threshold/error threshold /reading quality smoothing (P), Reading quality (I)
M25 see chapter 8.4.14 "Module 25 – Device status"	Device status	Device status (I)
M26 see chapter 8.4.15 "Module 26 – Extended status"	Extended status	Tape direction (I)

8.4.2 DAP module – permanently defined parameters

On the PROFINET, parameters may be stored in modules or may be defined permanently in a PROFINET participant. Depending on the configuration tool, the permanently defined but adjustable parameters are called "common" parameters or device-specific parameters.

- The common parameters must always be present. They are defined outside configuration modules and are thus connected to the base module (DAP: Device Access Point) that is addressed via Slot 0/Subslot 0.
- Each PROFINET device must have a DAP module. The DAP module represents the communication access point to the BPS.
- The following list contains the device parameters that are permanently defined in the BPS (DAP Slot 0/Subslot 0) but are configurable. These parameters always exist and are available independent of the modules.

Module ID: Profinet_DAP_001

- Common parameters/device-specific parameters (DAP: Device Access Point):
- The module contains device-specific parameters, but no input data and no output data.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Profile	0	Byte	1	1	--------------		Defines the used device profile. **Note:** Currently, only the BPS profile is stored. Thus, no selection is possible. Number of the activated profile. 1: BPS profile
Integration depth	1.0 … 1.4	Bit field	2 … 16	8	Measurements		Number of successive measurements that the BPS uses for position determination.

8.4.3 Module 1 – Position value

Module ID: 1001 with submodule ID: 1

- Module for the output of the current position value. The module also includes the most important parameters for formatting the output value.
- The module contains parameters (with parameter data length of 6 bytes) and input data (with consistent input data length of 4 bytes), but no output data.

Parameter	Rel. addr.	Data type	Value range	De-fault	Unit		Explanation
					Metr.	Inch	
Sign	0.0	Bit	0 … 1	0	-------------		Output mode of the sign. Affects position value and speed output: 0: Two's complement 1: Sign + quantity
Unit	0.1	Bit	0 … 1	0	-------------		The selection of the measurement unit affects all values with measurement units. The parameter applies to all interfaces: 0: Metric (mm) 1: Inch (in)
Position resolution	0.2 … 0.4	Bit	1 … 6	4	mm	in/100	Resolution of the position value. Affects only the interface-specific output. The resolution has no effect on the set parameter values such as offset or preset: 001 = 1: 0.001 010 = 2: 0.01 011 = 3: 0.1 100 = 4: 1 101 = 5: 10
Counting direction	0.5	Bit	0 … 1	0	-------------		Count direction for position calculation or sign for speed calculation. The parameter affects all interfaces: 0: Positive 1: Negative
Offset	1 … 4	sign 32 bit	-10,000,000 … +10,000,000	0	mm	in/100	Output value = measurement value + offset. The parameter affects all interfaces. **Note:** If a preset is active, this has priority over the offset.

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Position	0.0	sign 32 bit	-2.000.000.000 … +2,000,000,000	0	Scaled		Current position

	NOTICE
!	**Convert numerical values when changing the unit of measurement!**
	↻ If the unit of measurement is changed from metric to inch (or vice versa), previously entered numerical values (e.g. for offset, preset, limit values etc.) are not automatically converted. Example: Offset = 10000 mm after changing from metric to inch: Offset = 10000 in/100
	↻ Manually convert the numerical values when changing the unit of measurement.

8.4.4 Module 2 – Static preset

Module ID: 1002 with submodule ID: 1

- With the module, it is possible to specify a static preset as a parameter and to activate this preset value at a suitable position (Teach Preset). The preset value is deactivated using the *Reset Preset* function. If the preset is activated, a set offset (module 1) is not used for the calculation of the position value (module 1).

- An activated preset is stored in the BPS and in the connection hood. In the event of a device exchange, the values in the connection hood are retained. In the event of a device exchange including the connection hood, the preset value must be reactivated at the intended position (Teach Preset).

- The module contains parameters (with parameter data length of 4 bytes) and output data (with output data length of 1 byte), but no input data.

Parameter	**Rel. addr.**	**Data type**	**Value range**	**Default**	**Unit**		**Explanation**
					Metr.	**Inch**	
Preset value	0	sign 32 bit	-10,000,000 … +10,000,000	0	mm	in/100	New position value for a teach event via the output data.

Output data	**Rel. addr.**	**Data type**	**Value range**	**Init value**	**Unit**		**Explanation**
					Metr.	**Inch**	
Preset teach	0.0	Bit	0 … 1	---	-------------		Reading of the preset value (output value = preset value): Transition 0 → 1: Teach Preset
Preset reset	0.1	Bit	0 … 1	---	-------------		Preset value is deactivated (output value = measurement value + offset): Transition 0 → 1: Reset Preset

8.4.5 Module 3 – Dynamic preset

Module ID: 1003 with submodule ID: 1

- With the module, it is possible to specify a dynamic preset as part of the output data and to activate this preset value at a suitable position (Teach Preset). The preset value is deactivated using the *Reset Preset* function. If the preset is activated, a set offset (module 1) is not used for the calculation of the position value (module 1).

- A dynamic preset value can be ascertained at runtime in the PLC program and transmitted to the BPS. A static preset value (module 2) can only be stored in the configuration.

- An activated preset is stored in the BPS and in the connection hood. In the event of a device exchange, the values in the connection hood are retained. In the event of a device exchange including the connection hood, the preset value must be reactivated at the intended position (Teach Preset).

- The module contains output data (with output data length of 5 bytes), but no parameters and no input data.

Output data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	**Inch**	
Preset teach	0.0	Bit	0 … 1	---	-------------		Read in the preset value: Transition 0 → 1: Teach Preset
Preset reset	0.1	Bit	0 … 1	---	-------------		Preset value is deactivated: Transition 0 → 1: Reset Preset
Preset value	1	sign 32 bit	-10,000,000 … +10,000,000	---	-------------		New position value for a teach event via bit 0.0.

8.4.6 Module 4 – Input/output IO 1

Module ID: 1004 with submodule ID: 1

- This module is used to set the mode of operation of digital input/output IO 1. The connection can be used as either an input or an output.
- The output is activated by various events in the device.
- If used as an input, a device function is controlled by an external signal.
- Alternatively, the connection can also be used decoupled from the device:
  - If used as an input, the state of an external signal is transmitted to the control in the input data.
  - If used as an output, the connection is operated via the output data.
- The module contains parameters (with parameter data length of 4 bytes), input data (with input data length of 1 byte) and output data (with output data length of 1 byte).

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	**Inch**	
Function	0.0	Bit	0 … 1	1	-------------		Mode: 0: Input 1: Output
Activation	0.1	Bit	0 … 1	1	-------------		The parameter defines the level of the output at which the *Output* event occurs. 0: LOW (output), transition 1 → 0 1: HIGH (output), transition 0 → 1 If the I/O is configured as an input, it responds edge-triggered.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	**Inch**	
Output							Event for activating the output. The individual functions are OR-linked to one another.
	1.3	Bit	0 … 1	0	-------------		**Position value invalid:** If no valid position value can be ascertained because, e.g., no bar code tape is read or the bar codes are destroyed or soiled, the output is set. 0: OFF 1: ON
	1.4	Bit	0 … 1	0	-------------		**Speed value invalid:** The output is set if no valid speed can be calculated. 0: OFF 1: ON
	1.5	Bit	0 … 1	0	-------------		**Warning threshold reading quality:** If the ascertained reading quality is below the configured warning threshold, the output is set. 0: OFF 1: ON
	1.6	Bit	0 … 1	0	-------------		**Error threshold reading quality:** If the ascertained reading quality is below the configured error threshold, the output is set. 0: OFF 1: ON
	2.0	Bit	0 … 1	0	-------------		**Pseudodynamic output:** The control can set and reset the output on the BPS via bit 0.0 in the output data 0: OFF 1: ON
	2.1	Bit	0 … 1	0	-------------		**Device error:** If the BPS detects a device error, the output is set. 0: OFF 1: ON

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	**Inch**	
Input	3	Bit field	0 … 3	0			**Internal functionality** that is triggered in the device.
							If *no internal function* is selected, the control can read the state of an arbitrary external signal via bit 0.0 of the input data.
							0: No internal function
							1: Stop/start measurement
							2: Teach Preset
							3: Reset Preset

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	**Inch**	
State	0.0	Bit	0 … 1	---	-------------		Signal state of the input or output:
							0: Input/output not active at signal level
							1: Input/output active at signal level

Output data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	**Inch**	
Control output	0.0	Bit	0 … 1	---	-------------		Control of the output. The function must be activated/deactivated via the parameters:
							0: Output not active at signal level
							1: Output active at signal level

NOTICE
Behavior of the BPS during measurement stop/start
If the scanning beam is incident on the BCB at the moment the laser diode is switched on, the BPS returns valid measurement values after approx. 10 ms.
If the BPS is reactivated from standby, the motor must first reach its nominal rotational speed. It takes a few seconds before the BPS returns any valid measurement values.

8.4.7 Module 5 – Input/output IO 2

Module ID: 1005 with submodule ID: 1

This module is used to set the mode of operation of digital input/output IO 2. The connection can be used as either an input or an output.

- The output is activated by various events in the device.
- If used as an input, a device function is controlled by an external signal.
- Alternatively, the connection can also be used decoupled from the device:
    - If used as an input, the state of an external signal is transmitted to the control in the input data.
    - If used as an output, the connection is operated via the output data.
- The module contains parameters (with parameter data length of 4 bytes), input data (with input data length of 1 byte) and output data (with output data length of 1 byte).

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Function	0.0	Bit	0 … 1	0	-------------		Mode: 0: Input 1: Output
Activation	0.1	Bit	0 … 1	1	-------------		The parameter defines the level of the output at which the *Output* event occurs. 0: LOW (output), transition $1 \rightarrow 0$ 1: HIGH (output), transition $0 \rightarrow 1$ If IO 2 is configured as an input, it responds edge-triggered.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	**Inch**	
Output							Event for activating the output. The individual functions are OR-linked to one another.
	1.3	Bit	0 … 1	0	-------------		**Position value invalid:** If no valid position value can be ascertained because, e.g., no bar code tape is read or the bar codes are destroyed or soiled, the output is set. 0: OFF 1: ON
	1.4	Bit	0 … 1	0	-------------		**Speed value invalid:** The output is set if no valid speed can be calculated. 0: OFF 1: ON
	1.5	Bit	0 … 1	0	-------------		**Warning threshold reading quality:** If the ascertained reading quality is below the configured warning threshold, the output is set. 0: OFF 1: ON
	1.6	Bit	0 … 1	0	-------------		**Error threshold reading quality:** If the ascertained reading quality is below the configured error threshold, the output is set. 0: OFF 1: ON
	2.0	Bit	0 … 1	0	-------------		**Pseudodynamic output:** The control can set and reset the output on the BPS via bit 0.0 in the output data 0: OFF 1: ON
	2.1	Bit	0 … 1	0	-------------		**Device error:** If the BPS detects a device error, the output is set. 0: OFF 1: ON

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Input	3	unsign 8 bit	0 … 3	2	-------------		**Internal functionality** that is triggered in the device. If *no internal function* is selected, the control can read the state of an arbitrary external signal via bit 0.0 of the input data. 0: No internal function 1: Stop/start measurement 2: Teach Preset 3: Reset Preset

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
State	0.0	Bit	0 … 1	---	-------------		Signal state of the input or output: 0: Input/output not active at signal level 1: Input/output active at signal level

Output data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Control output	0.0	Bit	0 … 1	---	-------------		Control of the output. The function must be activated via the parameters: 0: Output not active at signal level 1: Output active at signal level

> ### *NOTICE*
> **Behavior of the BPS during measurement stop/start**
>
> If the scanning beam is incident on the BCB at the moment the laser diode is switched on, the BPS returns valid measurement values after approx. 10 ms.
>
> If the BPS is reactivated from standby, the motor must first reach its nominal rotational speed. It takes a few seconds before the BPS returns any valid measurement values.

8.4.8 Module 6 – Status and control

Module ID: 1006 with submodule ID: 1

The module signals various status information of the BPS.

- Various device functions are controlled via the output data.
- The module contains input data (with input data length of 2 bytes) and output data (with output data length of 2 bytes), but no parameters.

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Measurement value invalid	0.0	Bit	0 … 1	0	------------		Signals that no valid measurement value can be ascertained. 0: Measurement value valid 1: Measurement value invalid
Measurement not active	0.1	Bit	0 … 1		------------		Signals an inactive measurement. 0: Measurement active 1: Measurement not active
Preset active	0.2	Bit	0 … 1	0	------------		Signals a position value output with active preset. 0: No preset active 1: Preset active
Teach Preset toggle	0.3	Bit	0 … 1	0	------------		This toggle bit changes its state on each Teach Preset event.
Temperature warning	1.2	Bit	1 … 5	0	------------		Signals that temperature is no longer within the specified temperature range. 0: OK 1: Temperature warning
Temperature error	1.3	Bit	0 … 1	0	------------		Signals that the maximum permissible temperature has been exceeded. 0: OK 1: Temperature error
Hardware defect	1.4	Bit	0 … 1	0	------------		Signals a hardware defect. 0: OK 1: Hardware defect
Warning threshold reading quality	1.5	Bit	0 … 1	0	------------		Signals that the ascertained reading quality has dropped below the configured warning threshold. 0: OK 1: Value less than limit
Error threshold reading quality	1.6	Bit	0 … 1	0	------------		Signals that the ascertained reading quality has dropped below the configured error threshold. 0: OK 1: Value less than limit
Standby active	1.7	Bit	0 … 1	0	------------		Signals an active standby. 0: No standby 1: Standby active

Output data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	**Inch**	
Stopping/starting the measurement	0.0	Bit	0 … 1	0	-------------		With this bit, the measurement can be stopped and restarted. If the measurement is stopped, the BPS only deactivates the laser beam. If the measurement is restarted, measurement values are available again after a few milliseconds. 0: Measurement active 1: Stop measurement
Activate/deactivate standby	0.1	Bit	0 … 1	0	-------------		With this bit, the BPS can be switched to standby; the BPS deactivates laser beam and motor. If standby is then deactivated, the motor must first reach its nominal rotational speed; as a result, it takes several seconds before measurement values are available again. 0: Not active 1: Activate
Acknowledge control or marker bar code	0.2	Bit	0 … 1	0	-------------		With this bit, the acceptance of the detected control or marker bar code can be acknowledged to the PLC. Transition 0 → 1: Acknowledgment
Acknowledge event log	0.3	Bit	0 … 1		-------------		Deletes the event memory from module 25 – device status (input data): 128: Error 129: Warning

8.4.9   Module 9 – Error handling procedures

Module ID: 1009 with submodule ID: 1

- The module makes parameters available to handle any errors should they occur.
- If there is a brief disturbance in the position value or the speed calculation in the device, the BPS sends the last valid measurement value for a configured time.
- If the BPS can again calculate valid measurement values within the error delay time, these are output. The disturbance is made evident only as a small increase in the output measurement value.
- If the problem with the calculation lasts for a longer period of time, it is possible to configure how the BPS is to behave.
- The module contains parameters (with parameter data length of 8 bytes), but no input data and no output data.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Position value in the case of failure	0.0 … 0.1	Bit	0 … 1	1	-------------		Position value in the case of an error after the error delay time elapses: 0: Last valid value 1: Zero
Suppress position status	0.2	Bit	0 … 1	1	-------------		Status bit (module 6 bit 0.0) in the case of an error: 0: OFF (status bit is set immediately) 1: ON (status bit is suppressed for the configured error delay time)
Error delay (position)	0.3	Bit	0 … 1	1	-------------		Position value in the case of an error: 0: OFF (immediately the value of the *Position value in the case of error* parameter) 1: ON (the last valid position value for the configured error delay time)
Error delay time (position)	1 … 2	unsign 16 bit	10 … 4, 000	50	1 ms		Errors that occur are suppressed for the configured time, i.e., if no valid position value can be ascertained in the configured time, the last valid position value is always output. If the error persists after the time elapses, the value of the *Position value in the case of error* parameter is output.
Speed in the case of failure	3.0 … 3.1	Bit	0 … 1	1	-------------		Speed value in the case of an error after the error delay time elapses (speed): 0: Last valid value is output 1: Zero is output
Suppress speed status	3.2	Bit	0 … 1	1	-------------		Status bit (module 16 bit 0.0) in the case of an error: 0: OFF (status bit is set immediately) 1: ON (status bit is suppressed for the configured error delay time)
Error delay (speed)	3.3	Bit	0 … 1	1	-------------		Speed in the case of an error: 0: OFF (immediately outputs the value of the *Speed in the case of error* parameter) 1: ON (outputs the last valid speed for the configured error delay time)

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Error delay time (speed)	4 … 5	unsign 16 bit	10 … 4,000	50	1 ms		Errors that occur are suppressed for the configured time, i.e., if no valid speed can be ascertained in the configured time, the last valid speed is always output. If the error persists after the time elapses, the value of the *Speed in the case of error* parameter is output.

8.4.10 Module 10 – Speed

Module ID: 1010 with submodule ID: 1

- The module is used to output the current speed in the desired resolution.

- The unit (metric or inch) is set via module 1 (position value) and also applies to the speed. If module 1 is not configured, the value is output with the default unit of measurement (metric). The sign of the speed is dependent on the count direction selected in module 1. With the default counting direction (positive), a positive speed is output for movement towards larger tape values. Movement towards smaller tape values results in negative speeds. Measurement value preparation averages all speed values calculated during the selected period (averaging) to yield a speed output value.

- The module contains parameters (with parameter data length of 2 bytes) and input data (with consistent input data length of 4 bytes), but no output data.

Parameter	Rel. addr.	Data type	Value range	De-fault	Unit		Explanation
					Metr.	Inch	
Speed resolution	0.0 … 0.2	Bit	1 … 5	1	mm/s	(in/100)/s	Resolution for the speed value: 001 = 1: 1 010 = 2: 10 011 = 3: 100 100 = 4: 1000
Averaging	0.3 … 0.5	Bit	0 … 5	2	-------------		All calculated velocities are averaged over the specified time: 000 = 0: No averaging 001 = 1: 2 ms 010 = 2: 4 ms 011 = 3: 8 ms 100 = 4: 16 ms 101 = 5: 32 ms

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Speed	0	sign 32 bit	-1,000,000 … +1,000,000	0	Scaled		Current speed.

8.4.11 Module 16 – Speed status

Module ID: 1016 with submodule ID: 1

- The module supplies the interface master with various status information for speed measurement via input data.
- The module contains input data (with input data length of 2 bytes), but no parameters and no output data.

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	**Inch**	
Speed measurement error	0.0	Bit	0 … 1	---	-------------		Signals that no valid speed could be ascertained: 0: No speed limit value violation 1: Speed limit value violation
Movement status	0.6	Bit	0 … 1	---	-------------		Signals whether a movement > 0.1 m/s is currently being detected: 0: No movement 1: Movement
Direction of movement	0.7	Bit	0 … 1	---	-------------		If bit 1 (movement status) is set, this bit indicates the direction: 0: Positive direction 1: Negative direction

8.4.12 Module 23 – Tape value correction

Module ID: 1023 with submodule ID: 1

- The module enables the *Tape value correction* functionality for correcting the deviation of the BCB from the correct (calibrated) millimeter scaling that results from the manufacturing process.
- A suitable measuring device must be used to determine the real (calibrated) length of one meter of bar code tape (as printed). If, for example, one meter of tape corresponds to an actual (calibrated) length of 1001.4 mm, the value *10014* is entered in the *Real length* parameter of this module. The real length is specified with a resolution of 1/10 millimeters.
- To use the exact resolution, it is useful to measure a longer section of BCB and convert the deviation to a length of one meter.
- The *Range start* parameter must be configured according to the real starting value of the used bar code tape. If multiple, different BCBs are pieced together, the *Range end* parameter of the corrected section of tape must also be configured. The entire BCB is corrected with the default value of *10,000,000* for the range end.
- The module contains parameters (with parameter data length of 10 bytes), but no input data and no output data.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Real length	0	unsign 16 bit	0 … 65,535	10,000	mm/10		Real (calibrated) length of one meter of BCB (according to imprint).
Range start	2	unsign 32 bit	0 … 10,000,000	0	mm		The tape value is corrected with the *real length* starting from this position.
Range end	6	unsign 32 bit	0 … 10,000,000	10,000,000	mm		The tape value is corrected with the *real length* up to this position.

8.4.13 Module 24 – Reading quality

Module ID: 1024 with submodule ID: 1

- The module enables the *Reading quality* functionality for transmitting the BPS reading quality and for configuring the parameters for warning threshold, error threshold and smoothing of the reading quality.

- By transmitting the reading quality, continuous monitoring is possible. The operator can immediately see when the reading quality deteriorates due to wear or soiling.

NOTICE
Correct calculation of the reading quality
The evaluation of the reading quality is influenced by several factors, see chapter 4.1 "Evaluation of the reading quality".

- The signaling of the reading quality is configured via the status information in module 6 (see chapter 8.4.8 "Module 6 – Status and control") and via the switching output functions in module 4 (see chapter 8.4.6 "Module 4 – Input/output IO 1") or module 5 (see chapter 8.4.7 "Module 5 – Input/output IO 2").

- The module contains parameters (with parameter data length of 2 bytes) and input data (with input data length of 1 byte), but no output data.

Parameter	Rel. addr.	Data type	Value range	Default	Unit		Explanation
					Metr.	Inch	
Warning threshold reading quality	0	unsign 8 bit	30 … 90	60	-------------		Below this threshold for reading quality in units of [%], the BPS generates a warning event.
Error threshold reading quality	1	unsign 8 bit	10 … 70	30	-------------		Below this threshold for reading quality in units of [%], the BPS generates an error event.
Reading quality smoothing	2	unsign 8 bit	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.

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Reading quality	0	unsign 8 bit	0 … 100	0	%	%	Reading quality in units of [%] as smoothed value, dependent on the *Smoothing of reading quality* parameter.

8.4.14 Module 25 – Device status

Module ID: 1025 with submodule ID: 1

- The module signals various device states via input data.
- The module contains input data (with input data length of 1 byte), but no parameters and no output data.

Input data	Rel. addr.	Data type	Value range	Init value	Unit		Explanation
					Metr.	Inch	
Device status	0	unsign 8 bit	0: Initial value 1: Initialization 10: Standby 11: Service 12: Diagnostics 15: Device is ready 128: Error 129: Warning	0	-------------		This byte represents the current device status. The following event messages can be acknowledged via module 6 - status and control (output data bit 0.3): 128: Error 129: Warning
Input data length: 1 byte							

8.4.15 Module 26 – Extended status

- Via input data, the module signals various pieces of extended status information, such as the current read direction of the bar code tape.
- The module contains input data (with input data length of 2 bytes), but no parameters and no output data.

Input data	Rel. addr.	Data type	Value range	Init value	Unit Metr.	Inch	Explanation
Increasing tape direction	0.0	BIT	0: Not increasing 1: increasing	0	-------------		The orientation between BPS and bar code tape (BCB) results in an increasing read direction. If bits 0.0 and 0.1 are not set (0), no read direction can currently be determined.
Decreasing tape direction	0.1	BIT	0: Not decreasing 1: Decreasing	0	-------------		The orientation between BPS and bar code tape (BCB) results in a decreasing read direction. If bits 0.0 and 0.1 are not set (0), no read direction can currently be determined.
Input data length: 2 bytes							

9 Diagnosis and troubleshooting

9.1 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 and the error messages 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 11 "Service and support").

9.1.1 PROFINET-specific diagnostics

The following diagnostics options are available with PROFINET:

• Event-related diagnosis
• State-related diagnosis

The BPS uses the event-related diagnosis for high-prioritized events/errors and the state-related diagnostics for preventive maintenance and the signaling of low-prioritized events or warnings.

Event-related diagnosis

PROFINET transmits events within an automation process as alarms that must be acknowledged by the application process.

The following events are possible:

• Process alarms: Events that originate from the process and are reported to the control.
• Diagnostic alarms: Events that indicate the malfunctioning of an IO device.
• Maintenance alarms: Transmission of information to avoid the failure of a device through preventive maintenance work.
• Manufacturer-specific diagnostics

To identify the alarms uniquely, they are always reported via a slot/subslot.

The user can prioritize diagnostic and process alarms differently.

In addition, all alarms are entered into the diagnostics buffer. The diagnostics buffer can be read by a superior instance via acyclic read services.

State-related diagnosis

To report malfunctioning or status changes in a field device to a system control, it is possible to enter low-priority diagnostics messages or status messages only in the diagnostic buffer instead of actively reporting them to the superior control. This option can also be used for preventive maintenance or for low-priority warnings, for example.

Tab. 9.1: BPS alarm and diagnostic messages

Diagnosis	Description	BPS-Category	API/ Slot/ Subslot	Type	Coming/go-ing
Parameter error	Error in the con-figuration of a module.	Error	0/nn = module number/0	Diagnostics alarm Only diagnostics or process alarms actually trigger the transmission of an alarm. All other types (preventive maintenance and status messages) only lead to an entry into the di-agnostics buffer and are thus part of the state-based diagnostics.	Coming
Configura-tion error	Error in the con-figuration of a module.	Error	0/n/0	Diagnostics alarm	Coming

9.2 Operating indicators of the LEDs

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

Tab. 9.2: 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 11 "Service and sup-port")
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 9.3 "Checklist for causes of errors")
Red, continuous light	Error Device function is limited Internal device error	Contact Leuze customer service (see chapter 11 "Service and sup-port")

9.3 Checklist for causes of errors

Tab. 9.3: Process interface errors – causes and measures

Error	Possible cause	Measures
Sporadic network errors	Check wiring for proper contacting	Check wiring: • Check wire shielding • Check wires used
	EMC coupling	Observe contact quality of screwed or soldered contacts in the wiring Avoid EMC coupling caused by power cables laid parallel to device lines Separate laying of power and data communications cables
	Network expansion exceeded	Check max. network expansion as a function of the max. cable lengths

Tab. 9.4: LED indicators - interface errors – causes and measures

Error	Possible cause	Measures
NET LED "off"	No supply voltage connected to the device	Check supply voltage
	Device not yet recognized by the PROFINET	Check device name, check link and activity LEDs on the connection hood
	Hardware error	Contact Leuze customer service (see chapter 11 "Service and support")
NET LED "red flashing"	Incorrect wiring	Check wiring
	Communication error: configuration failed IO Error: no data exchange	Check configuration, in particular with respect to address assignment (device names/IP address/MAC ID) Carry out a reset on the control
	Communication error on the PROFINET: No communication to IO Controller established ("no data exchange")	Check protocol settings Check configuration, in particular with respect to address assignment (device names/IP address/MAC ID)
	Protocol not released	Activate TCP/IP or UDP
	Wrong device name set	Check configuration, in particular with respect to address assignment (device names/IP address/MAC ID)
	Incorrect configuration	Check configuration, in particular with respect to address assignment (device names/IP address/MAC ID)
	Different protocol settings	Check protocol settings

Tab. 9.5:   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 Code not in the working range of the BPS	Align the scanning beam with the bar code tape Align the BPS with the bar code tape (working range 50 mm … 170 mm)
Faulty measurement value	Preset or offset active Incorrect unit or resolution configured	Check the parameter settings in the GSDML file

10 Care, maintenance and disposal

10.1 Cleaning

If there is dust on the device:

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

	NOTICE
(!)	**Do not use aggressive cleaning agents!** ᗷ Do not use aggressive cleaning agents such as thinner or acetone for cleaning the device.

10.2 Servicing

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

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

ᗷ For repairs, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 11 "Service and support").

10.2.1 Firmware update

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

ᗷ For firmware updates, contact your responsible Leuze subsidiary or Leuze customer service (see chapter 11 "Service and support").

10.2.2 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 Leuze website **www.leuze.com**.

	NOTICE
(!)	**Do not use the BCB repair kit on a permanent basis!** ᗷ 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. ᗷ An entry wizard is available for repair tapes on the Leuze website under devices BPS 3000i - 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. ᗷ 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
(i)	In the repair kit files, you will find all position values with 40 mm grid (BCB G40 …).

Layout:

- 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. See graphic below.
	✎ Cut the code strips and arrange them next to one another. The code content must always increase or decrease in increments of 40 mm. Check that the printed values increase by 4 (BCB G40 …).
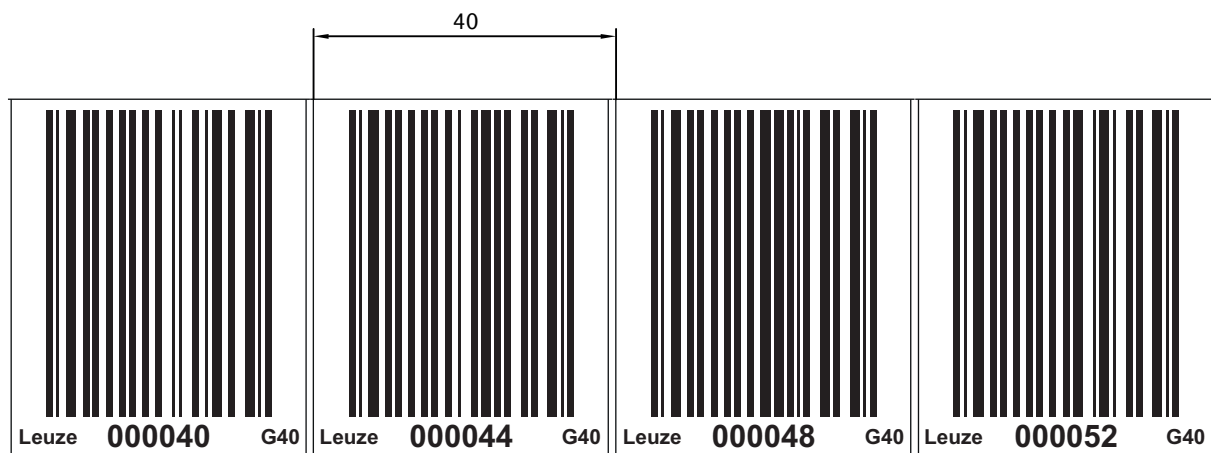
Fig. 10.1:   Checking the print result – BCB G40 …-repair kit (40 mm gird)

10.3 Disposing

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

11 Service and support

Service hotline

You can find the contact information for the hotline in your country on our website **www.leuze.com** under **Contact & Support**.

Repair service and returns

Defective devices are repaired in our service centers competently and quickly. We offer you an extensive service packet to keep any system downtimes to a minimum. Our service center requires the following information:

- Your customer number
- Product description or part description
- Serial number and batch number
- Reason for requesting support together with a description

Please register the merchandise concerned. Simply register return of the merchandise on our website **www.leuze.com** under **Contact & Support > Repair Service & Returns**.

To ensure quick and easy processing of your request, we will send you a returns order with the returns address in digital form.

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:	
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

12   Technical data

12.1   General specifications

Tab. 12.1:   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 60825-1:2014 / EN 60825-1:2014+A11:2021
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).
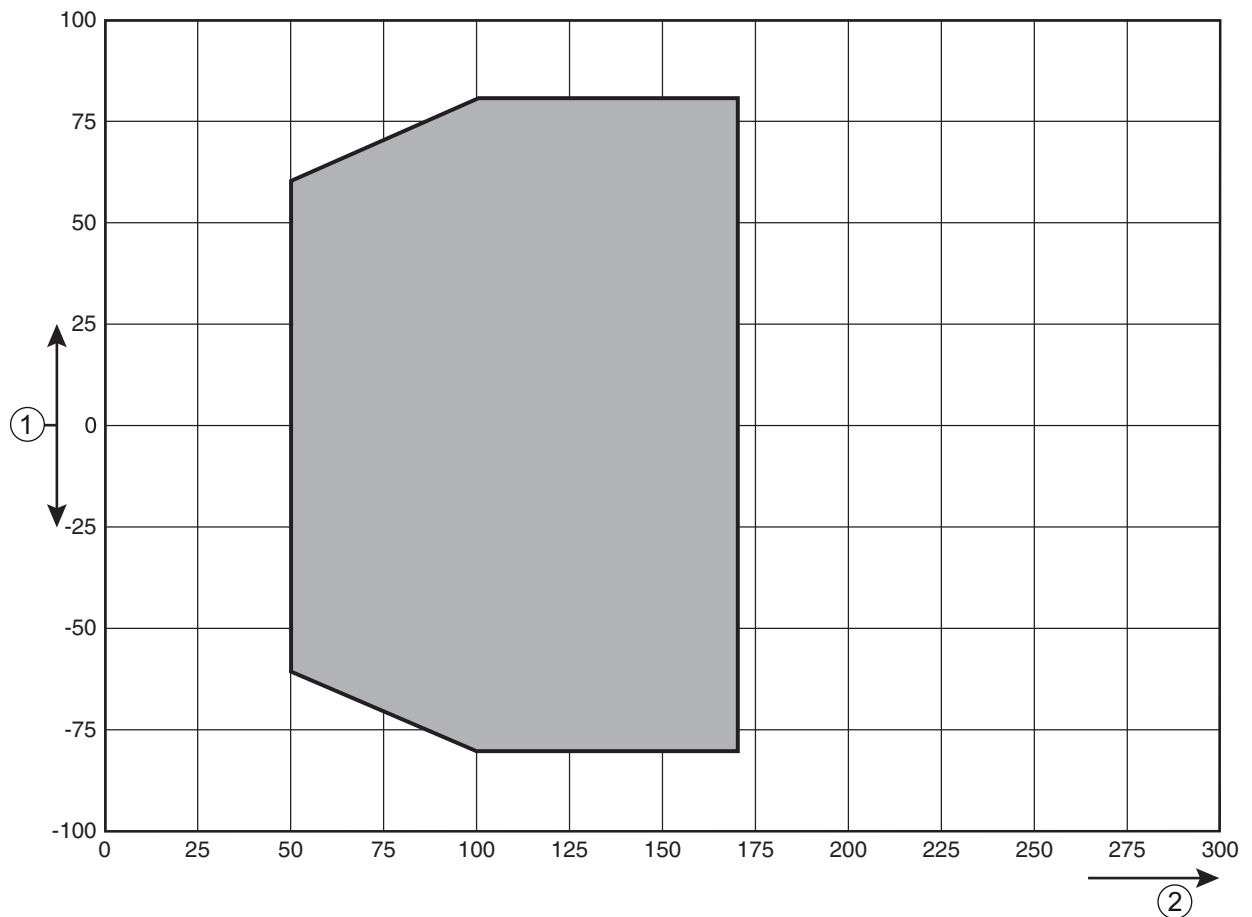
1   Reading field width [mm]
2   Reading distance [mm]

Fig. 12.1:   BPS reading field curve

Tab. 12.2:   Measurement data

Reproducibility (1 sigma)	±0.05 mm
Output time	2 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. 12.3:   Operating and display elements

LEDs	Two LEDs for power (PWR) and bus state (NET), two-colored (red/green)

Tab. 12.4:   Mechanical data

Housing	Diecast aluminum
Connection technology	• BPS with MS 3048: M12 connectors • BPS with MK 3048: Terminal blocks with spring-cage terminals (5-pin)
Degree of protection	IP 65
Weight	Approx. 580 g (without connection hood)
Dimensions of the BPS 3048i without connection hood	(H x W x D) 108.7 mm x 100.0 mm x 48.3 mm
Dimensions (with MS 3048 connection hood)	(H x W x D) 108.7 mm x 100.0 mm x 48.3 mm
Dimensions (with MK 3048 connection hood)	(H x W x D) 147.4 mm x 100.0 mm x 48.3 mm
Dimensions of MS 3048 connection hood	(H x W x D) 64.0 mm x 43.5 mm x 33.5 mm
Dimensions of MK 3048 connection hood	(H x W x D) 64.0 mm x 43.5 mm x 83.5 mm

Tab. 12.5:   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. 12.6:   Certifications, conformity

Conformity	CE

12.1.1 BPS

Tab. 12.7:   Electrical equipment

Interface type	PROFINET-RT with integrated switch for BUS IN and BUS OUT
	Protocol: PROFINET RT communication
	Conformance Class: B
Switching input / switching output	Two switching inputs/outputs
	Functions are freely programmable via PROFINET 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!
PWR LED green	Device ready (power on)
Operating voltage U_B	18 … 30 VDC (Class 2, protection class III)
Power consumption	Max. 3.7 W

Tab. 12.8:   Ambient temperature

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

12.2   Bar code tape

Tab. 12.9:   Dimensions of bar code tape … G40 …

| Grid	40 mm
Standard height	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 13 "Order guide and accessories"
Tape tolerance	±1 mm per meter

---

① 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 3000i - *Accessories* tab. 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. 12.10:   BCB environmental data

Recommended processing temperature	0 °C … +45 °C
Ambient temperature	-40 °C … +120 °C
Curing	Final curing after 72 h the BPS can detect the position immediately after the BCB is affixed.
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)
Mounting surface	Grease-free, dry, clean, smooth
Mechanical properties	Scratch and wipe resistant, UV resistant, moisture resistant, partly chemical resistant

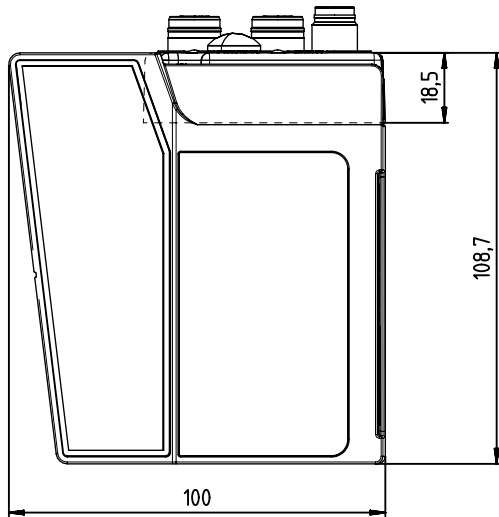## 12.3   Dimensioned drawings
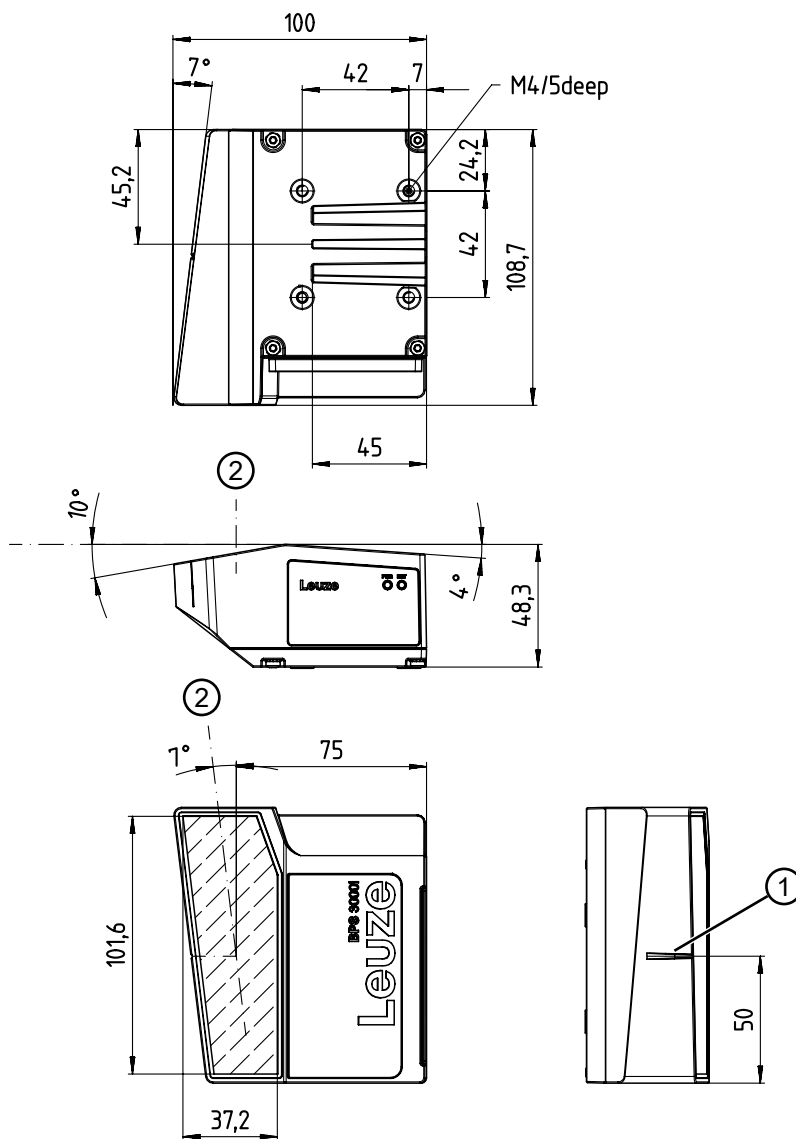
all dimensions in mm

1   Reference point for the bar code position

2   Optical axis

Fig. 12.2:   Dimensioned drawing BPS without connection hood

all dimensions in mm

Fig. 12.3:   Dimensioned drawing BPS with MS 3048 connection hood
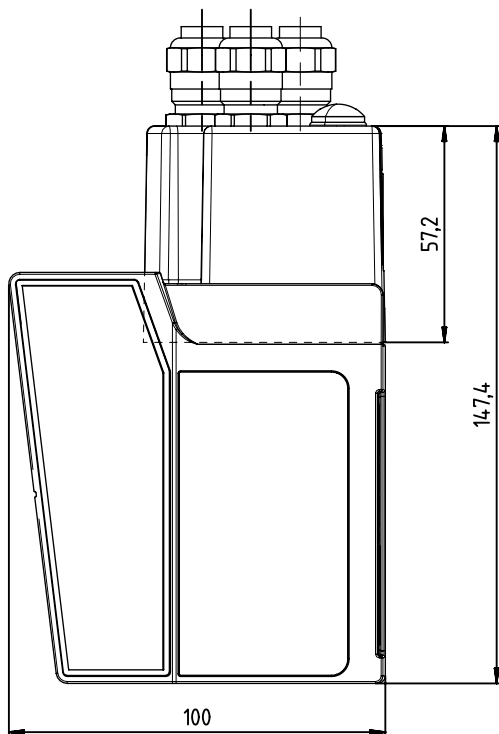
all dimensions in mm

Fig. 12.4:   Dimensioned drawing BPS with MK 3048 connection hood

12.4 Dimensioned drawings: Accessories
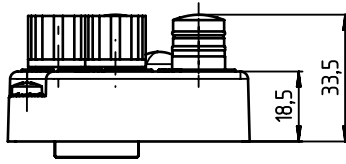
all dimensions in mm

Fig. 12.5: Dimensioned drawing MS 3048 connection hood
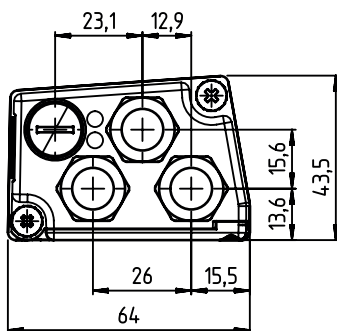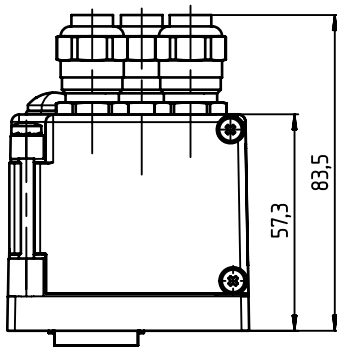
all dimensions in mm
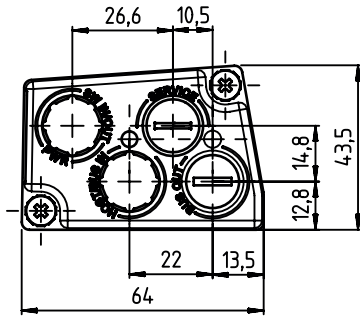
Fig. 12.6: Dimensioned drawing MK 3048 connection hood

all dimensions in mm

Fig. 12.7:   Dimensioned drawing BTU 0300M-W mounting device

all dimensions in mm

Fig. 12.8:   Dimensioned drawing BT 300-W mounting bracket

12.5 Dimensioned drawing bar code tape
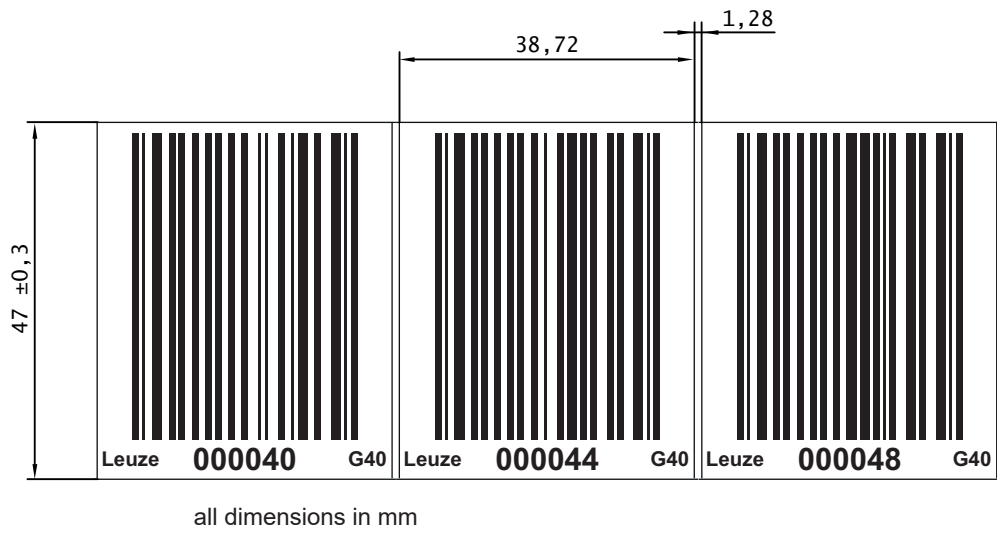
all dimensions in mm

Fig. 12.9: Dimensioned drawing bar code tape … G40 … with 40 mm grid

13 Order guide and accessories

13.1 Type overview

Tab. 13.1: BPS 3048i type overview

Part no.	Part designation	Description
50148806	BPS 3048i SM 100	BPS with PROFINET RT interface

13.2 Connection hoods

Tab. 13.2: BPS connection hoods

Part no.	Part designation	Description
50148810	MS 3048	Connection hood with M12 connectors
50148811	MK 3048	Connection hood with spring-cage terminals

13.3 Cables accessories

Tab. 13.3: 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. 13.4: 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. 13.5: 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. 13.6: 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

13.4 Other accessories

Tab. 13.7: 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. 13.8: 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

13.5 Bar code tapes

13.5.1 Standard bar code tapes

Leuze offers a wide selection of standardized bar code tapes.

Tab. 13.9: Data for standard bar code tapes

Feature	Value
Grid dimensions	40 mm (… 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.

13.5.2 Special bar code tapes

Special tapes are produced according to customer specifications.

Tab. 13.10: Data for special bar code tapes

Feature	Value
Grid dimensions	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
Tape end value	According to customer specifications, 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 3000i - *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.

13.5.3 Twin tapes

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

Tab. 13.11: Data for Twin tapes

Feature	Value
Grid dimensions	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
Tape end value	According to customer specifications, 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 3000i - *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.

13.5.4 Repair tapes

Repair tapes are produced according to customer specifications.

Tab. 13.12: Data for repair tapes

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

- 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 3000i - *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 EC Declaration of Conformity

The bar code positioning systems of the BPS 3000i series have been developed and manufactured in accordance with the applicable European standards and directives.

15   Appendix

15.1   Bar code sample

Bar code tape … G40 … with 40 mm grid

Leuze **000000** G40	Leuze **000004** G40	Leuze **000008** G40	Leuze **000012** G40

Fig. 15.1:   Continuous, 40 mm grid