Leuze

Original operating instructions

FBPS 607i
FBPS 617i
Fail-safe bar code positioning system

The Sensor People

We reserve the right to make technical changes
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1 About this document

1.1 Used symbols and signal words

Tab. 1.1: Warning symbols and signal words

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

Tab. 1.2: Other symbols

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

Tab. 1.3: Terms and abbreviations

FBPS	Fail-safe bar code positioning system
FBPS 607i	FBPS with standard SSI protocol
FBPS 617i	FBPS with CRC extension of the SSI protocol
BCB	Bar code tape with 30 mm grid
CFR	Code of Federal Regulations
EMC	Electromagnetic compatibility
EN	European standard
FE	Functional earth
GUI	Graphical User Interface
LED	Light Emitting Diode
LSB	Least Significant Bit
MSB	Most Significant Bit
MVS	Type of control bar code
NEC	National Electric Code
OSHA	Occupational Safety and Health Administration
PELV	Protective Extra-Low Voltage
PLC	Programmable Logic Control Programmable Logic Control
SSI	Synchronous Serial Interface (Digital Synchronous Serial Interface)
USB	Universal Serial Bus
UL	Underwriters Laboratories
XML	Extensible Markup Language

1.2 Scope of delivery

The FBPS package includes the following components:

- The FBPS device
- A safety notice/package insert

2 Safety

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

- Before using the FBPS, perform a risk assessment according to valid standards, for example, in accordance with:
  - ISO / EN ISO 12100
  - ISO / EN ISO 13849-1:2015
  - IEC / EN 62061

The result of the risk assessment determines the required safety level of the safety sensor, see chapter 19.1 "Safety-relevant data".

- For mounting, operating and testing, observe this document as well as all applicable national and international standards, regulations, rules and directives.
- Observe the relevant and supplied documents, print them out and hand them out to the people concerned.
- Before working with the FBPS, fully read and observe the documents applicable to your work.

In particular, the following national and international legal regulations apply for the commissioning, technical inspections and work with safety sensors:

- Directive 2006/42/EC
- Directive 2014/35/EU
- Directive 2014/30/EU
- Directive 2009/104/EC
- OSHA 1919 Subpart O
- Safety regulations
- Accident-prevention regulations and safety rules
- Ordinance on Industrial Safety and Health and employment protection act
- Product Safety Law (ProdSG)

	NOTICE
	For safety-related information you may also contact local authorities (e.g., industrial inspectorate, employer's liability insurance association, labor inspectorate, occupational safety and health authority).

2.1 Intended use

The FBPS fail-safe bar code positioning system is an absolute measurement system for the safe, metric ACTUAL position detection of moving system parts (axes) in machine and system construction.

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.

Areas of application

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

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

CAUTION

Use only approved bar code tapes!

The bar code tapes approved by Leuze and listed on the Leuze website **www.leuze.com** as accessories under the respective FBPS product 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.

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

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

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

Prerequisites for competent persons:

- They have a suitable technical education.
- They know the rules and regulations for labor protection, safety at work and safety technology and can assess the safety of the system.
- They have been instructed by the responsible person on the mounting and operation of the system and of the FBPS.
- They keep their knowledge up to date through continuous further training.

Certified electricians

Electrical work and configurations with the webConfig tool on the FBPS must only 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 FBPS is not used as intended.
- Safety notices are not adhered to.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- The BCB approved by Leuze is not used.
- The SSI cable connection of the FBPS for safe evaluation does not comply with the cable connection specifications.
- Changes (e.g., constructional) are made to the device.

2.5 Laser warning notices

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

3 Components of the fail-safe positioning system

The FBPS fail-safe bar code positioning system is an absolute measurement system for the safe, metric ACTUAL position detection of moving system parts (axes) in machine and system construction.

The FBPS is developed in accordance with the following safety directives:

IEC / EN 61508: SIL 3

IEC / EN 62061: SIL 3

ISO / EN ISO 13849-1:2015: PL e / cat. 4

The measurement system consists of two components that are separated from one another:

- A fail-safe bar code reader (FBPS) for calculating safe, absolute position values.
- A bar code tape (BCB) affixed along the transportation path with consecutively printed 1D bar codes that contain position information. The bar code tape establishes a metrological reference between the system and the FBPS.

3.1 The fail-safe bar code positioning system

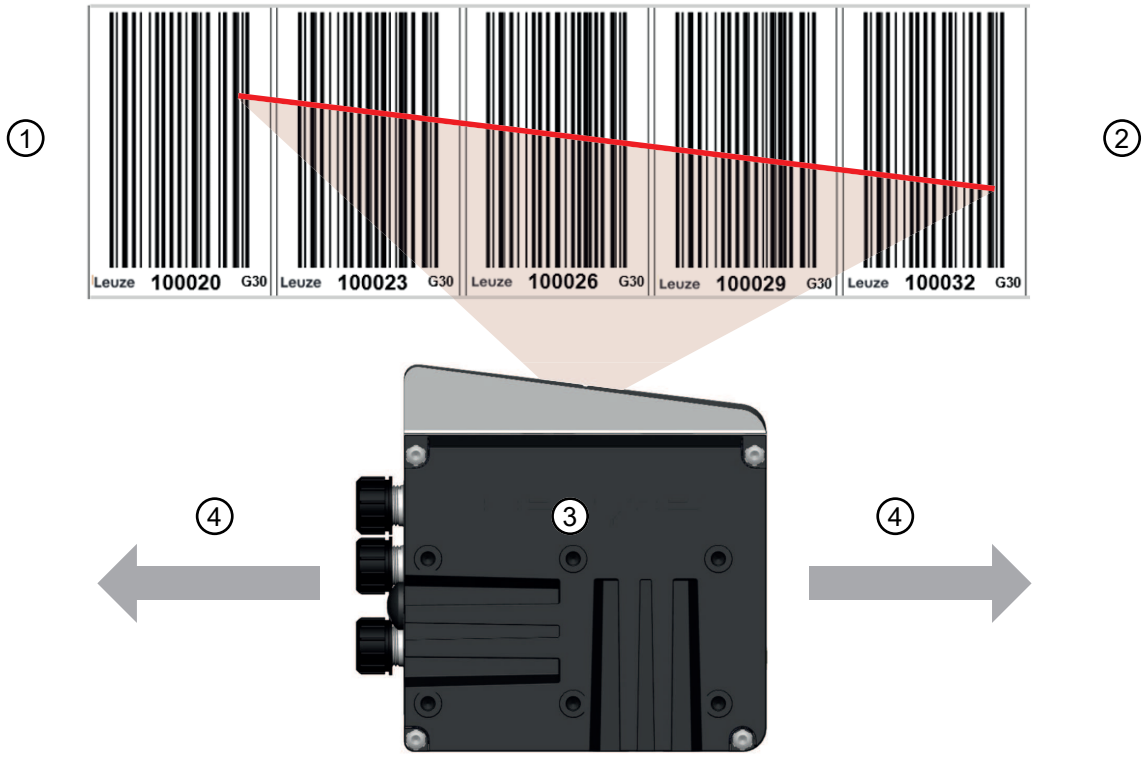
The FBPS uses a visible red laser scanning beam to determine the absolute, metric position information consecutively stored on the BCB.

To do this, the FBPS is mounted at the specified distance parallel to the BCB.

The FBPS and the BCB move relative to one another.

For the function of the safe position evaluation, it plays no role whether the FBPS moves relative to the BCB or vice versa.

The bar code tape and the FBPS may be mounted independent of one another with a rotation of 180 degrees.



1 Bar code tape with consecutive positions
2 Linear red scanning beam
3 Bar code positioning system
4 Relative movement of the FBPS

Fig. 3.1: Relative-movement bar code positioning system – bar code tape

To calculate the safe position value, the scanning beam must detect at least one bar code. The readability of the bar code must be ensured.

If there is excessive soiling, damage or missing bar code information, no position value can be output. Signaling occurs according to the criteria of an external error, see chapter 12.6 "External errors".

Signaling via the status LEDs see chapter 16.3 "Diagnosis via the LED indicators".

The safe position value is made available redundantly via two autonomous SSI output interfaces of the FBPS.

A safety-relevant control with SSI input interfaces evaluates the position values.

The position value is made available Gray-coded on one SSI channel and binary-coded on the second SSI channel.

To eliminate the possibility of bit errors on the SSI transmission path between FBPS and the safe control, a plausibility check of the transmitted position data must be performed in the safety-relevant control (see chapter 13.7.1 "SSI protocol with CRC checksum (FBPS 617i)" and see chapter 13.7.2 "SSI protocol without CRC checksum (FBPS 607i)").

The FBPS uses the detected bar codes to calculate the relative position with respect to the BCB with a reproducibility of just a few 1/10 mm, see chapter 19.1 "Safety-relevant data".

The relative movement (speed) of the FBPS with respect to the BCB can be up to 10 m/s.

The safe position value calculation of the FBPS is performed using a sliding arithmetic average calculation of 8 successive safe position values (integration depth).

The integration depth can be changed via the web-based configuration tool, see chapter 15 "Starting up the device – webConfig tool".

Due to the arithmetic average calculation, the output safe position value is subject to a contouring error of just a few millimeters depending on the relative speed and integration depth.

At a standstill, the contouring error is 0 mm.

3.2 The bar code tape

The bar code tape (BCB) is a self-adhesive plastic tape on which bar codes are affixed consecutively and equidistantly.

Each individual bar code represents an absolute value of 30 mm.

Fig. 3.2: Bar code tape, beginning with position value 1000.20 m, increasing in increments of 3 cm

Lined up sequentially without interruption, the bar codes produce a digitized tape measure with a grid of 30 mm.

The BCB is affixed along the measurement path (track).

	CAUTION
	Use only qualified bar code tapes! The bar code tape is part of the FBPS safe positioning system. Only the bar code tapes qualified by Leuze are approved, see chapter 20.5 "Bar code tapes". The use of unqualified bar code tapes will result in a loss of the safety category of the FBPS and is not in accordance with the intended use.

4 Fast commissioning

	NOTICE
	The action steps described below provide an overview of installation and commissioning of an FBPS system. Included in the individual steps is a reference to the chapters with the corresponding detailed explanations.

Risk assessments in accordance with ISO / EN ISO 13849-1:2015

For the risk assessment of the system part, the required performance level PL r in accordance with ISO / EN ISO 13849-1:2015 or the necessary safety integrity level SIL in accordance with IEC / EN 62061 is to be determined.

European C-standards EN 528 "Rail dependent storage and retrieval equipment – Safety requirements for S/R machines" and EN 619 "Continuous handling equipment and systems" describe the dangers and risks typically present at stacker cranes and continuous conveyors.

Selection of an FBPS model

- FBPS 607i … Safe bar code positioning system with standard SSI protocol
- FBPS 617i … Safe bar code positioning system with an SSI protocol plus a CRC check

see chapter 7 "Device description"

Mounting the FBPS

- Mounting the FBPS at the specified reading distance to the bar code tape, see chapter 10 "Mounting".
- Connecting the FBPS to the supply voltage, see chapter 8 "Electrical connection".
- Connecting the two SSI interfaces, see chapter 8.2 "SSI interface cable".

Selecting and mounting the bar code tape

- Standard tapes or customer-specific special tapes, see chapter 20.5 "Bar code tapes".
- Mounting the bar code tape along the track, see chapter 9.4 "Mounting the bar code tape".

Configuration of the SSI parameters

If necessary, the SSI parameters of the FBPS are adjusted for both SSI channels. The SSI parameters can be adjusted via the integrated webConfig tool using standard address 192.168.61.100, see chapter 15.13.1 "General safety parameters" and see chapter 15.13.2 "Safety parameters for channel X1 SSI1 and channel X2 SSI2".

Using a safety control

- The safe control must provide a 2-channel SSI interface with diversified design.
- For determination of the data integrity, the following comparisons must be performed in the safety control:
  For the FBPS 607i … see chapter 13.7.2 "SSI protocol without CRC checksum (FBPS 607i)"
  - Plausibility check of the two channels with respect to one another
  - Evaluation of at least two successive telegrams for each channel
  For the FBPS 617i … see chapter 13.7.1 "SSI protocol with CRC checksum (FBPS 617i)"
  - Plausibility check of the two channels with respect to one another

Measures during commissioning

With respect to the safety functions of the overall system, the safe position detection of the FBPS must be validated in the context of the safety requirements of the system.

To do this, the FBPS is moved along the entire bar code tape.

Possible operating states and how they are signaled see chapter 12 "Operating states".

Signaling via the status LEDs see chapter 16.3 "Diagnosis via the LED indicators".

The validation of the safe position detection of the FBPS is satisfied if the FBPS can be moved along the entire track with BCB without external or internal error signaling.

Safety levels

In compliance with the stated requirements, the FBPS can be used for safe positioning systems up to the following safety levels:

ISO / EN ISO 13849-1:2015: PL e / cat. 4

IEC / EN 61508: SIL 3

IEC / EN 62061: SIL 3

5 Accuracy of the measurement system

NOTICE
The measurement system consists of two components: 1. A fail-safe bar code reader (FBPS) for calculating safe, absolute position values 2. A bar code tape (BCB) affixed along the transportation path The BCB establishes a metrological reference between the system and the FBPS.

The bar code tape is mounted/affixed in the system at the installation site.

Various factors influence the affixing of the bar code tape and make it necessary to differentiate between the accuracy and the reproducibility of the measurement system.

Accuracy of the measurement system

The following circumstances may result in deviations in the accuracy of the determined position values:

- The BCB has a production-related accuracy of ±1 mm/m.
- Depending on the force that is applied when affixing the BCB (strong tension), it can be stretched.
- With vertical curves, the BCB is splayed by making cuts, see chapter 9.4.4 "Mounting in curves".
- The accuracy of the position may deviate if the FBPS can only detect a position code that is distant from the middle of the device.
- With horizontal curves, the FBPS detects the read bar code with an optical distortion that varies depending on the radius. The accuracy of the position may deviate if the FBPS can only detect a position code that is distant from the middle of the device.
- Distortions in the accuracy arise as a result of the permitted cutting of the BCB at switches and expansion joints.
- The joining together of bar code tapes, e.g., if a bar code tape is delivered that is made up of several rolls.
- The general measurement value noise of the FBPS.

NOTICE
The stated factors affect the accuracy of the measurement system and cannot be qualitatively evaluated by the FBPS. It is not possible to specify an accuracy of the complete system consisting of FBPS and the bar code tape affixed by the user.

The reproducibility of the position values

Positions that are moved to repeatedly are typically stored in the control as target positions of a positioning process and determined by means of a "teach-in" or similar process. The repeatability for the repeated movement to the target positions is referred to as reproducibility or repeatability of the output position. It describes a possible measurement error of the output position values from the actual mechanical position of the axis.

The reproducibility applies at a standstill, with a response time (integration time) of 8 ms and constant ambient temperature. It is ±0.15 mm (1 sigma) and occurs in the form of measurement value noise.

5.1 Safe position

For a safety-rated measurement system, the safe position describes the maximum measurement value deviation of the output distance value to be expected in the event of an internal error that is not detected by the internal detection measures. The safe position is ±3 mm.

5.2 Dynamic measurement error

The dynamic measurement error defines the deviation between the actual distance and output distance at the data interface of the sensor during movement with speed V at a given time.

The dynamic measurement error is also referred to as contouring error.

At constant speed, the dynamic measurement error can be estimated as:

$E_d = V \cdot (T_a/2 + T_t)$

E_d: Dynamic measurement error [mm]

V: Speed [m/s]

T_a: Response time (integration time) (adjustable 2 ms / 8 ms, default 8 ms) [ms]

T_t: Dead time (internal dead time in the sensor, typically 1 ms) [ms]

Comments:

- The transmission time of the position data on the data interface from the sensor to the control is to be considered separately.
- For safety-rated systems in the context of the machinery directive, the time overhead for the data transmission from the sensor for the safe evaluation and the time overhead for the data comparison and the data evaluation in the safe evaluation are to be considered separately for an evaluation of the dynamic deviation of the actual position for a safety function.

6 Applications

To minimize risk at automatically moving system parts, such as high-bay storage devices or transverse transfer cars, control-related safety devices in combination with sensor system in safe or – alternatively – with redundant, diverse technologies, are used.

For the risk assessment, the required performance level PL r in accordance with ISO / EN ISO 13849-1:2015 or the necessary safety integrity level SIL in accordance with IEC / EN 62061 is to be determined.

Both are internationally recognized standards.

European C-standards EN 528 "Rail dependent storage and retrieval equipment – Safety requirements for S/R machines" and EN 619 "Continuous handling equipment and systems" describe the dangers and risks typically present at high-bay storage devices and continuous conveyors.

The applications presented below provide no details on safety-relevant implementations but instead only serve the fundamental understanding of the use of an FBPS.

6.1 High-bay storage devices

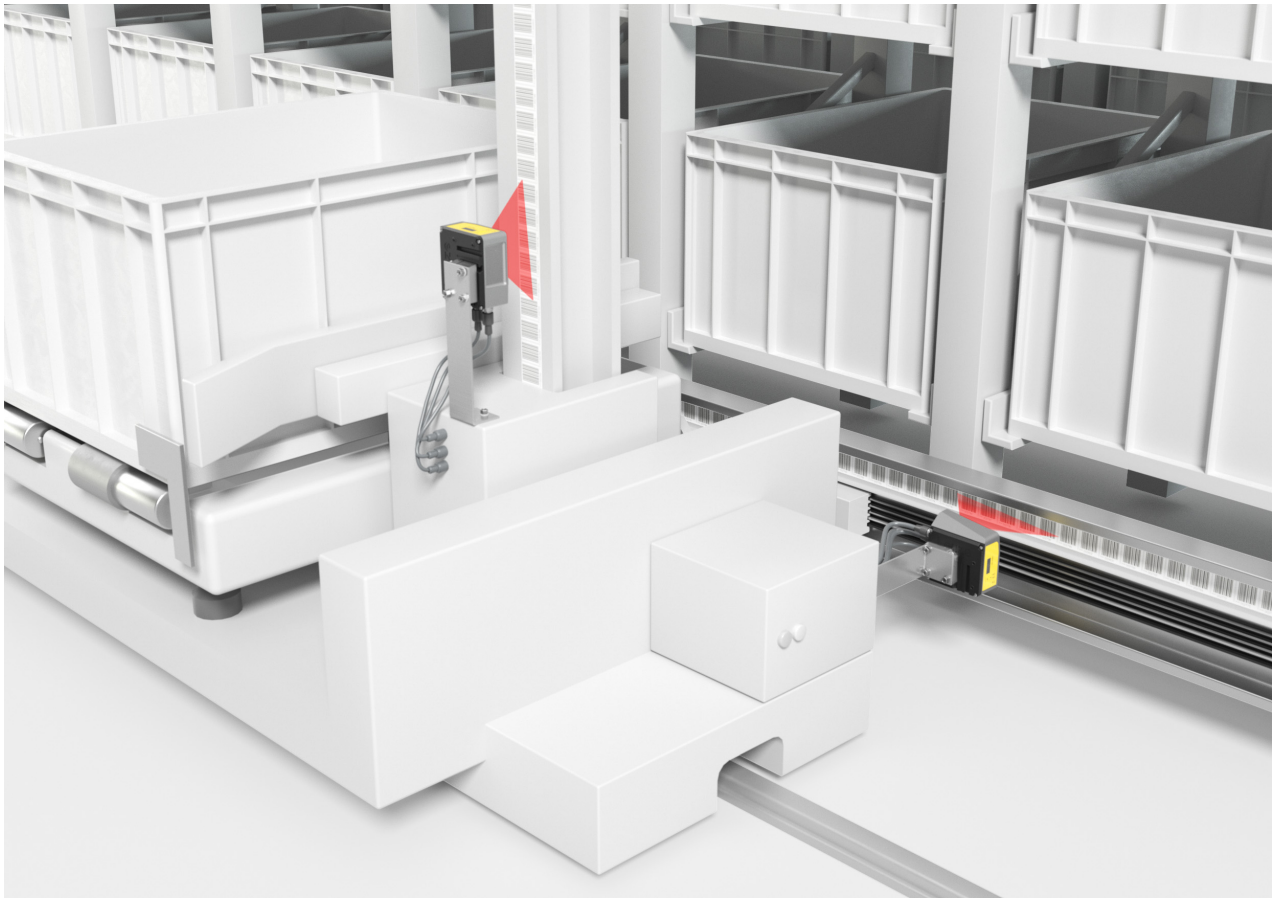


Fig. 6.1: High-bay storage device

- Safe position detection for the x and y-axis
- Precise positioning with a reproducibility of ± 0.15 mm (1 Sigma)
- Safe position detection up to a max. speed of 10 m/s

6.2 Electrical monorail systems

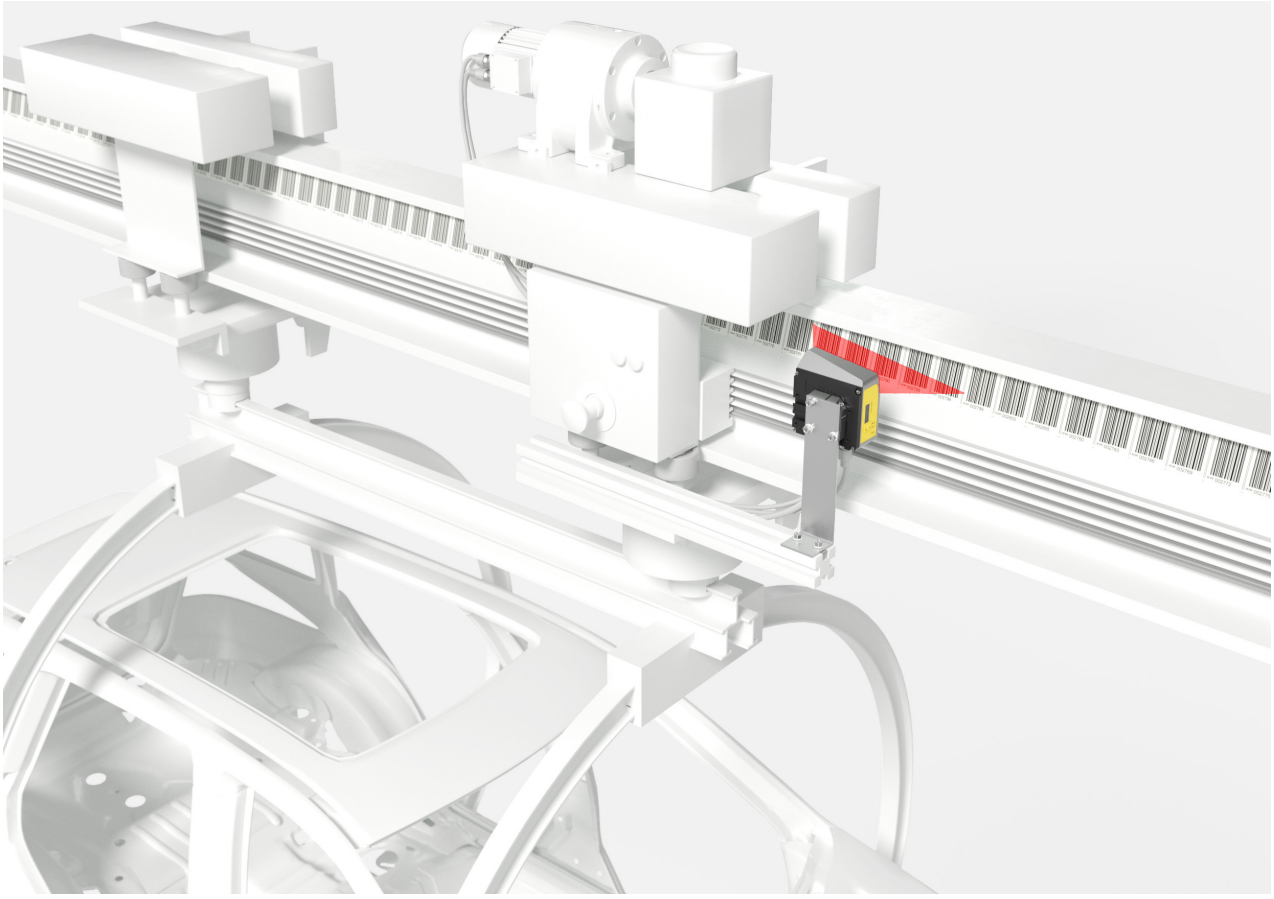


Fig. 6.2: Electrical monorail system

- The working range/depth of field of the FBPS of 50 – 170 mm allows for flexible mounting positions at varying distances.
- Control bar code for the safe position value changeover in the case of switch applications in which different tape values occur.
- Safe position values up to a maximum length of 10000 meters.

6.3 Gantry cranes

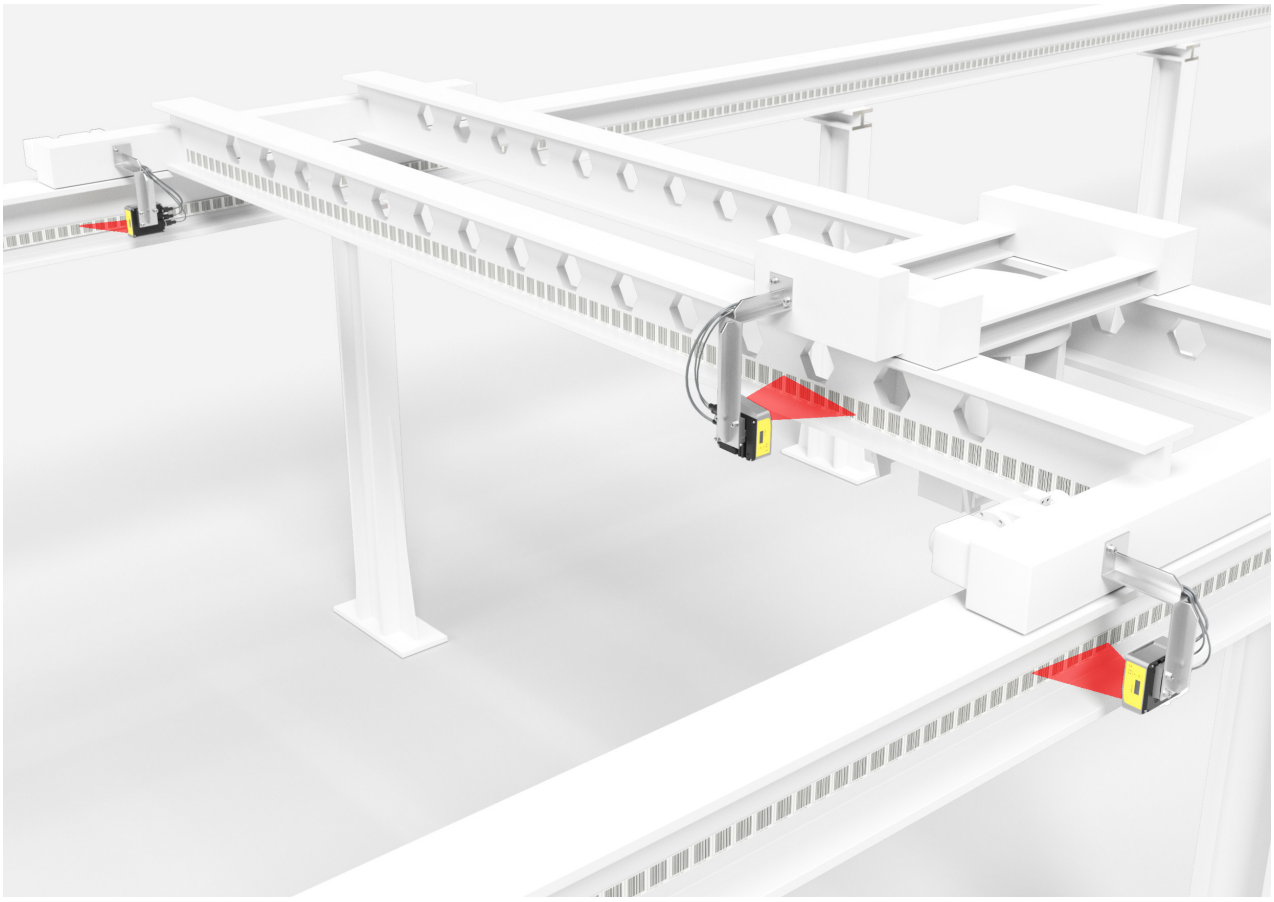


Fig. 6.3: Gantry crane

- Scratch- and smudge-proof, UV-resistant bar code tapes
- Synchronous positioning with TWIN bar code tapes on both longitudinal beams
- Mounting devices for fast, precise mounting

7 Device description

The FBPS is available in the following device models and with the following options:

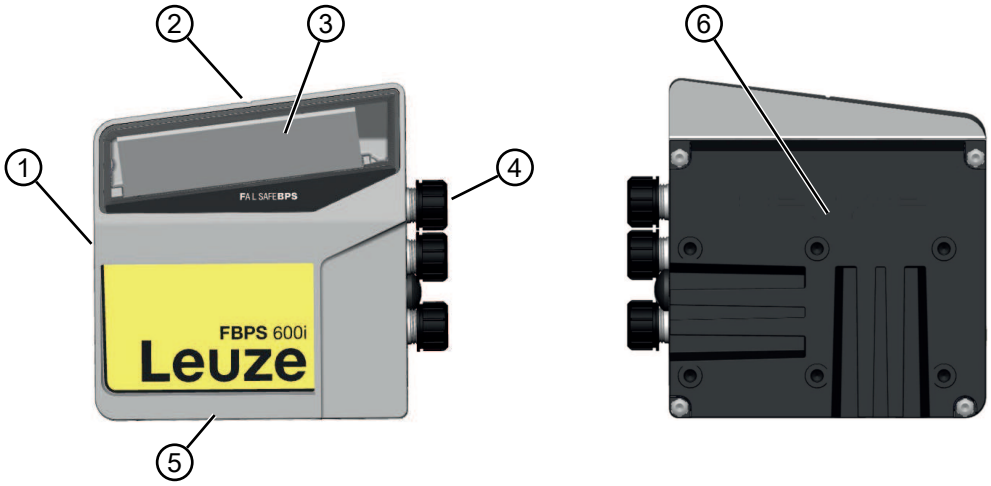
- Devices with 2-channel standard SSI
- Devices with 2-channel SSI with CRC
- Devices with side plug outlet
- Devices with bottom plug outlet
- Devices with display
- Devices with heating

NOTICE
You can find the order guide and type overview at see chapter 20 "Order guide and accessories". A list with all available device types can be found on the Leuze website **www.leuze.com**.

NOTICE
Unless expressly noted in the document, all features described in the following are identical for all FBPS models. In addition, the general term "FBPS" is used in the document. In cases where the features of the individual device models differ, the document will refer directly to the respective designation of the model.

7.1 Devices with side plug outlet

The devices with side plug outlet can be recognized by the three-digit number 100 in the type designation, e.g., FBPS 607i 07 SM **100**.

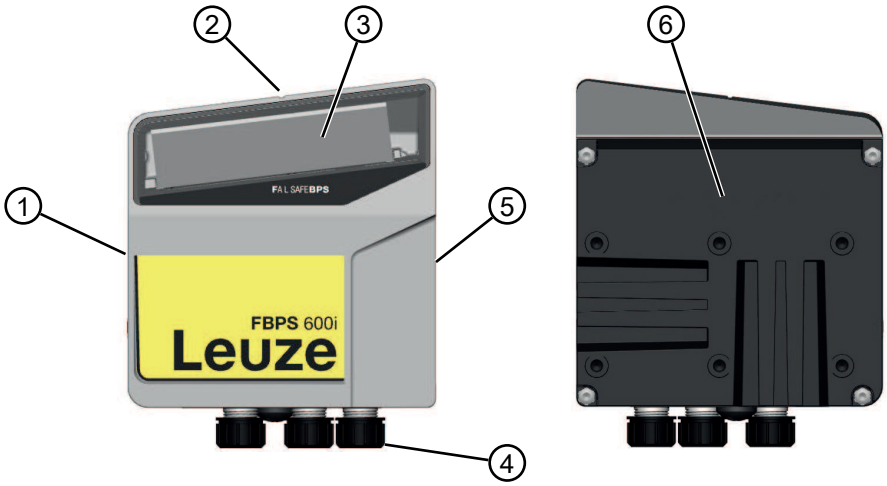


1 Control and display panel (display including control buttons optional)
2 Reference point for position value
3 Scanning beam exit window
4 M12 + USB device connections
5 Name plate
6 Device rear with M4 internal threads and alternative dovetail mounting

Fig. 7.1: Device with side plug outlet

7.2 Devices with bottom plug outlet

The devices with bottom plug outlet can be recognized by the three-digit number 110 in the type designation, e.g., FBPS 607i 07 SM **110**.



1	Control and display panel (display including control buttons optional)
2	Reference point for position value
3	Scanning beam exit window
4	M12 + USB device connections
5	Name plate
6	Device rear with M4 internal threads and alternative dovetail mounting

Fig. 7.2: Device with bottom plug outlet

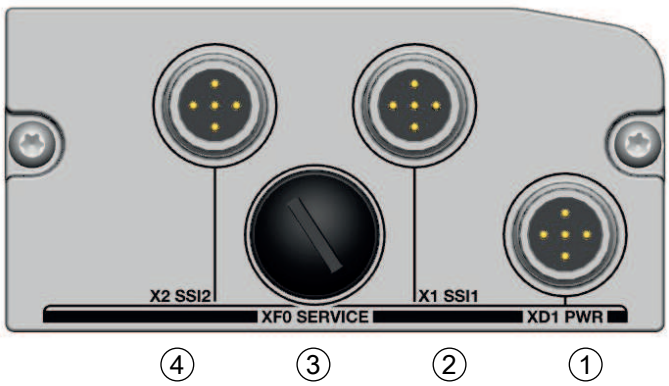
7.3 Connection technology

7.3.1 Device connection

The connection field is identical for the two models with plug outlet located on a different side.

FBPS 607i … SM 100 / FBPS 617i … SM 100: Connection field with side outlet, see chapter 7.1 "Devices with side plug outlet"

FBPS 607i … SM 110 / FBPS 617i … SM 110: Connection field with downward outlet, see chapter 7.2 "Devices with bottom plug outlet"



1	XD1 PWR	Supply voltage / switching input / switching output / functional earth
2	X1 SSI1	SSI1 channel A
3	XF0 SERVICE	USB connection for webConfig tool
4	X2 SSI2	SSI2 channel B

Fig. 7.3: Connection field

7.3.2 Connection XD1 PWR

The connection at socket XD1 PWR is made via an M12 connector, A-coded.

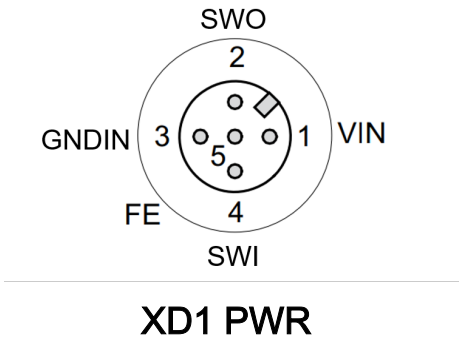


Fig. 7.4: Pin assignment for connection XD1 PWR

Tab. 7.1: XD1 PWR pin assignment

Pin	Connection designation	Function	Comment	Core color
1	VIN	Supply voltage positive pole	see chapter 8 "Electrical connection"	Brown
2	SWO	Switching function Standard function Functions, configurable Switching behavior, configurable Configuration	Switching output Invalid position value Warning threshold reading quality Error threshold reading quality Device error Switch-on delay Inverted output see chapter 15.14 "Configuring general, non-safety parameters"	White
3	GNDIN	Supply voltage negative pole	see chapter 8 "Electrical connection"	Blue
4	SWI	Switching function Standard function Functions, configurable Configuration	Switching input No function Stop/start position measurement Position measurement off ≥ 15 V DC Position measurement on ≥ 5 V DC or input open see chapter 15.14 "Configuring general, non-safety parameters"	Black
5	FE	Functional earth		Gray or green-yellow

The functional earth is in electrical contact with the housing of the FBPS and with the shielding of the two SSI data lines.

NOTICE

The functional earth (PIN 5) as well as the housing must not be used as PE ground connection of the system. The PE connection for grounding the system and the steel construction must be provided via a separate PE connection.

Connection cables for the supply voltage with and without shield in PUR sheathing: see chapter 20.3 "Accessories – connection technology".

7.3.3 Connections X1 SSI1 (channel A) and X2 SSI2 (channel B)

The connections at sockets X1 SSI1 (channel A) and X2 SSI2 (channel B) are made using an M12 connector, B-coded.

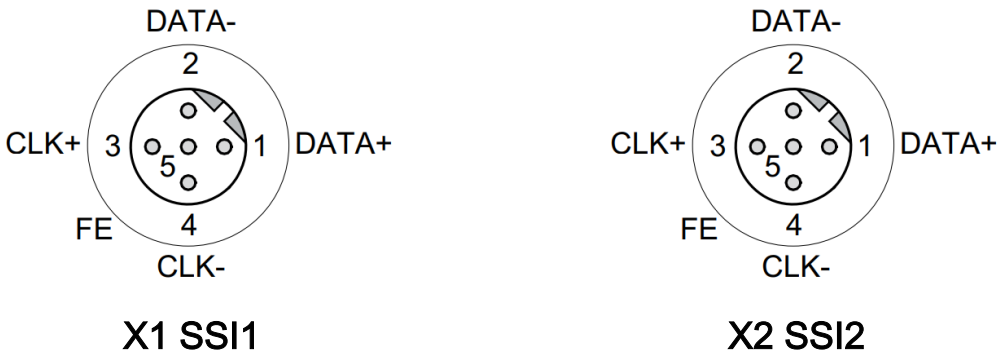


Fig. 7.5: Pin assignment of connections X1 SSI1 and X2 SSI2

Tab. 7.2: X1 SSI1 and X2 SSI2 pin assignment

Pin	Function	Core color
1	SSI DATA+	Yellow
2	SSI DATA-	Green
3	CLK+	Gray
4	CLK-	Pink
5	Functional earth*	Brown

* The functional earth is in electrical contact with the housing of the FBPS 6x7i and by means of this with the shielding of the two SSI data lines and with the FE of XD1 PWR.

NOTICE	
	Observe the specifications of the SSI cable, see chapter 7.3.3 "Connections X1 SSI1 (channel A) and X2 SSI2 (channel B)".

SSI connection cables with shielding in PUR sheathingsee chapter 20.3 "Accessories – connection technology"

7.3.4 USB connection for webConfig

The connection to socket XF0 SERVICE is performed using a USB connector, Mini Type B, USB version 2.0.

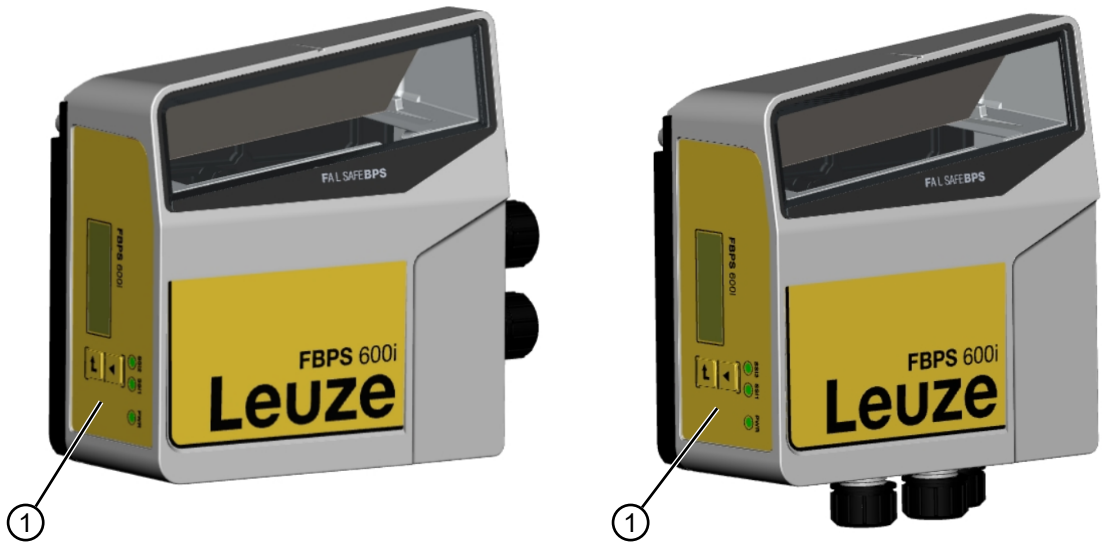
Fig. 7.6: Pin assignment for connection XF0 SERVICE

Tab. 7.3: XF0 SERVICE pin assignment

Pin	Connection designation
1	VB
2	D-
3	D+
4	ID
5	GND

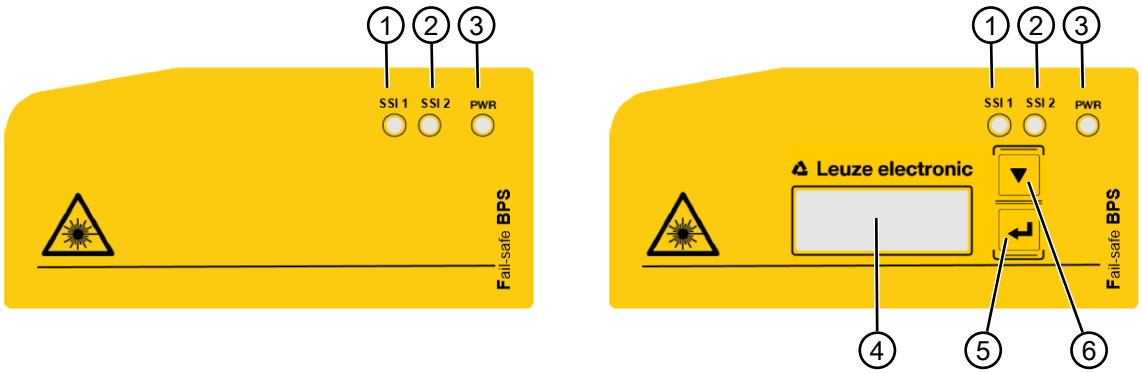
USB interconnection cables: see chapter 20.3 "Accessories – connection technology"

7.4 Display elements



1 Position of display elements

Fig. 7.7: Display elements of the FBPS



1	SSI1 channel A status	Multicolor LED in the colors green, orange and red
2	SSI2 channel B status	Multicolor LED in the colors green, orange and red
3	Power status	Multicolor LED in the colors green, orange and red
4	Display	
5	↵ button	Activates the static display or deactivates the flashing of the display
6	▼ button	Scrolls the various displays

Fig. 7.8: Display field without and with display

NOTICE
The display of the FBPS is optional and shows the status and information for the device. The FBPS cannot be configured via the display. The two buttons can be used to toggle between various information, see chapter 7.4.1 "Display".

7.4.1 Display

Monochromatic, two-line display with background lighting. The lighting is activated at the touch of a button and switches off after approx. 10 minutes. The ↵ button can be used to scroll through the following information.

Tab. 7.4: Information in the display

1st line in the display	2nd line in the display	Comment
Version	SW V1.0.0 / HW 1	Software and hardware version
Position value	Position value	Position value with resolution of 0.1 mm
Quality	0 % - 100 %	Reading quality
FBPS Info	System OK Warning / Error / Fatal Error	• System status messages • System ok: no messages • Warning • Error • Fatal Error
I/O status	SWO: (0 or 1) / SWI: (0 or 1)	Input/output status
Start up	Leuze electronic GmbH +Co.KG	Startup after PWR on
Reload firmware	0 % - 100 %	

7.4.2 LED indicators

Tab. 7.5: PWR (power) status indicator LED

Status indicator	Meaning
Off	• No supply voltage at FBPS • Supply voltage too high (> 34 V DC) • The operating temperature is above or below the specified limit.
	Power on, the FBPS is initialized.
	The FBPS is operating error-free. Position codes are decoded.
	The service mode was activated via the integrated web server.
	External error, see chapter 12.6 "External errors"
	Internal error, see chapter 12.7 "Internal error"

Tab. 7.6: SSI1 and SSI2 status indicator LED

Status indicators	Meaning
Off	• No supply voltage at FBPS • Supply voltage too high (> 34 V DC) • The operating temperature is above or below the specified limit.
	Power on, the FBPS is initialized.
	The FBPS is operating error-free. Position codes are decoded.
	External error, see chapter 12.6 "External errors"
	Internal error, see chapter 12.7 "Internal error" Readback of the SSI parameters via the web server is faulty.

8 Electrical connection

CAUTION

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

CAUTION

UL applications!

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

NOTICE

Protective Extra Low Voltage (PELV)!

The device is designed in accordance with protection class III for supply with PELV (Protective Extra-Low Voltage).

Electrical data

Supply voltage	24 V DC ±25 %
Power consumption without heater	Max. 8.5 W
Current consumption without heater	At 18 V, max. 400 mA At 24 V, max. 350 mA
Power consumption with heater	max. 24 W
Current consumption with heater	At 18 V, max. 1100 mA At 24 V, max. 1000 mA

8.1 Supply voltage cable

NOTICE

For all connections (connection cable, interconnection cable, etc.), use only the cables listed in the accessories, see chapter 20 "Order guide and accessories".

Cables for the supply voltage: see chapter 20.3 "Accessories – connection technology"

NOTICE

For the supply voltage, use cables with a minimum cross section of 0.34 mm². Shielding is recommended.

8.2 SSI interface cable

Requirement for the SSI cable

The SSI cable must satisfy the following requirements:

- Clock lines and data lines are routed under a common shield. Or alternatively
- Clock lines and data lines are each shielded separately. In this case, the two shields can be conductively enclosed by another common shield.

Both cable variants must satisfy the following requirements:

- The two clock lines of an SSI connection must be a twisted pair.
- The two data lines of an SSI connection must be a twisted pair.
- For each channel, the shield must be connected to functional earth at both ends.

NOTICE

- Install SSI cables that carry data separately and not parallel to the power supply cables of motors/frequency inverters or other power-carrying cables.
- Avoid crossing these cables.
- Protect the cables from mechanical damage, especially against crushing.
- When laying cables in the switch cabinet, make certain that the SSI data lines are laid to just before their clamping point in the switch cabinet under the shielded sheathing.

CAUTION

Loss of the safety function

If the specified requirements for the SSI cable are not met, it will not be possible to maintain the safety function of the FBPS in combination with the safe evaluation.

SSI connection cables: see chapter 20.3 "Accessories – connection technology"

9 Bar code tape

The bar code tape (BCB) is a self-adhesive plastic tape on which 1D bar codes are affixed consecutively and equidistantly.

Each individual bar code represents an absolute value of 30 mm.

Fig. 9.1: Bar code tape, beginning with position value 1000.20 m, increasing in increments of 3 cm / 30 mm

Lined up sequentially without interruption, the bar codes produce a digitized tape measure with a grid of 30 mm.

The BCB is affixed along the measurement path (track).

The BCB is part of the FBPS safe positioning system. Only the bar code tapes qualified by Leuze are approved.

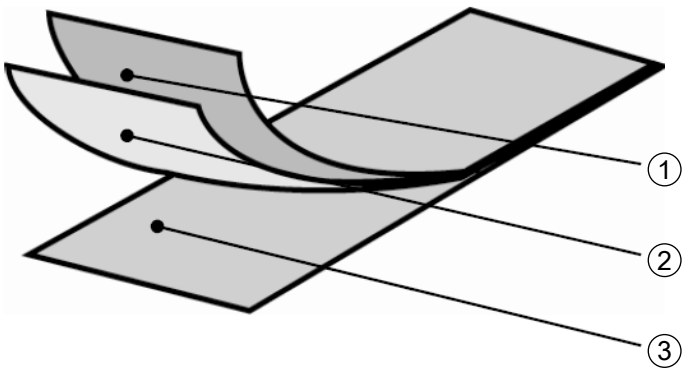
	NOTICE
	The use of unqualified bar code tapes will result in a loss of the safety category of the FBPS and is not in accordance with the intended use.

9.1 Structure of the bar code tape

The BCB consists of three layers:

- A polyester film
- An adhesive
- A protective layer (liner)

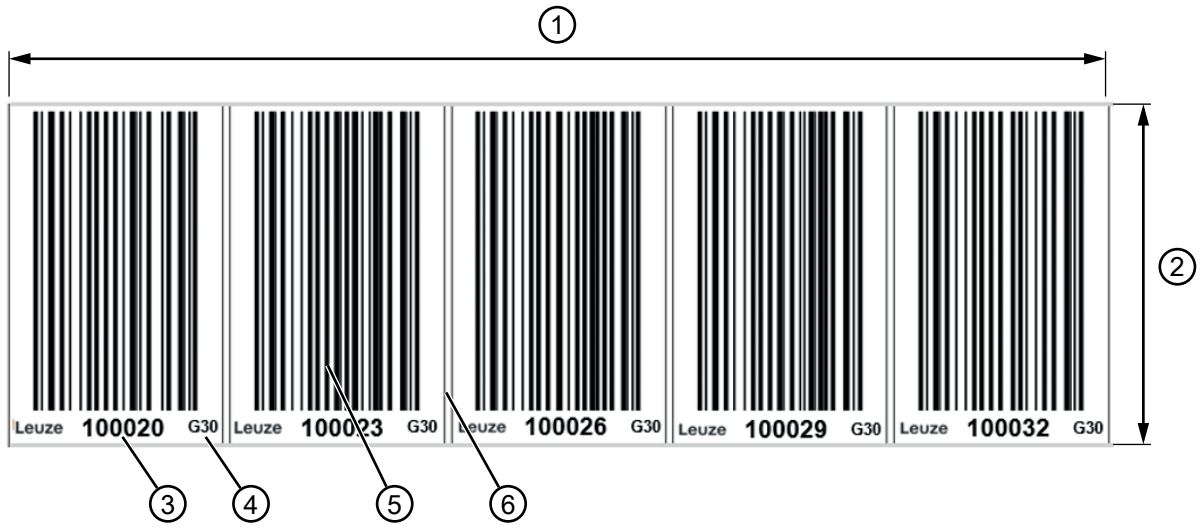
The liner is peeled off immediately prior to affixing the bar code tape.



1 Polyester film (transparent, matt)
2 Adhesive
3 Liner

Fig. 9.2: Structure of the bar code tape

9.2 Dimensions and content of the bar code tape



1 Length of the BCB
2 Height of the BCB
3 Position value in cm
4 G30 = Designation of a bar code tape with 30 mm grid
5 1D bar code with sequential position values with 30 mm grid
6 Cut mark for cutting the BCB

Fig. 9.3: Dimensions and content of the bar code tape

NOTICE

↳ When cutting the BCB at the intended cut mark, observe the notices, see chapter 9.4.5 "Cutting the bar code tape".

9.3 Delivery of bar code tapes

BCBs are delivered as a roll, wound on a core. The maximum length of a roll is 300 m. BCBs longer than 300 m are split over several rolls. Each roll is packed separately.

Fig. 9.4: Bar code tape roll

NOTICE

When using bar code tapes that are delivered on several rolls due to their length, make certain that they are joined together so that the value ranges of two rolls yield consecutive position values.

The position value from one bar code to the next always increases by the value 3.

When joining the two tapes together, the width of the cut mark [2] should correspond to the width of the other cut marks.

1 Last bar code of the previous roll
2 Cut mark between the two tapes
3 First bar code of the next roll

Fig. 9.5: Joining BCB rolls together

NOTICE

TWIN bar code tapes are two tapes of identical length and tolerance that are delivered packed together, see chapter 9.5.5 "TWIN bar code tapes".

9.4 Mounting the bar code tape

9.4.1 Mounting instructions

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, rollers, sponges, etc. Permanent on-board cleaning devices polish the BCB and give it a glossy finish or damage it through mechanical abrasion. The reading quality deteriorates as a result and may even lead to the destruction of the BCB.
- 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 reading quality of the FBPS 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

For the calculation of safe position values, it plays no role whether the BCB is affixed with the position values at the bottom or rotated 180 degrees with the position values at the top.

↳ If BCBs with different value ranges are positioned next to one another, observe the notes see chapter 9.4.5 "Cutting the bar code tape".

9.4.2 Reading quality of the bar code tape

NOTICE

Output of the reading quality

The bar code positioning system can diagnose the reading quality from the arrangement of the FBPS relative to the bar code tape.

↳ The reading quality shown in the display or webConfig is given in % values.

↳ In spite of optimum operating conditions, the reading quality may be slightly below 100 %. This does not indicate a defect of the FBPS or of the bar code tape.

NOTICE

The warning threshold preset ex works for a reading quality < 60 % as well as a switch-off threshold for a reading quality < 30 % corresponds to Leuze's experience in a typical application.

For applications that involve an intentional interruption of the bar code tape (switches, expansion gaps, vertical slopes/descents), the preset limit values can be adapted to the respective application.

The reading quality is dependent on several factors:

- Operation of the FBPS 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 FBPS (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 FBPS

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

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

NOTICE

If the reading quality is influenced by the factors listed above, the reading quality can be reduced to as low as 0 %.

↳ This does not mean that the FBPS is defective, but rather that the reading quality characteristics are reduced to as low as 0 % in the given arrangement.

↳ If, at a reading quality of 0 %, a position value is output, it is correct and valid.

NOTICE

The values for the reading quality are shown in the optional display (*Quality*) and in the webConfig tool.

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

- The reading quality is constantly bad: Soiling of the FBPS optics.
- The reading quality is always poor at certain position values: Soiling of the bar code tape.

9.4.3 Height offset of the affixed bar code tape

For a reading quality of 100%, at least 3 readable labels must be detected by the scanning beam.

↳ Make certain that the scanning beam always detects at least 3 labels during movement.

Excluded from this requirement are switches and expansion joints in which the bar code tape must be separated for design reasons, see chapter 9.4.5 "Cutting the bar code tape".

The FBPS then also delivers safe position values if only one readable label is detected by the scanning beam. The reading quality is less than 100% in this case, see chapter 9.4.2 "Reading quality of the bar code tape".

If the start and end of the scanning beam leaves the bar code tape, this does not represent any additional impairment to the reading quality.

The goal should, however, be that as many labels as possible be detected by the scanning beam at the appropriate reading distance.

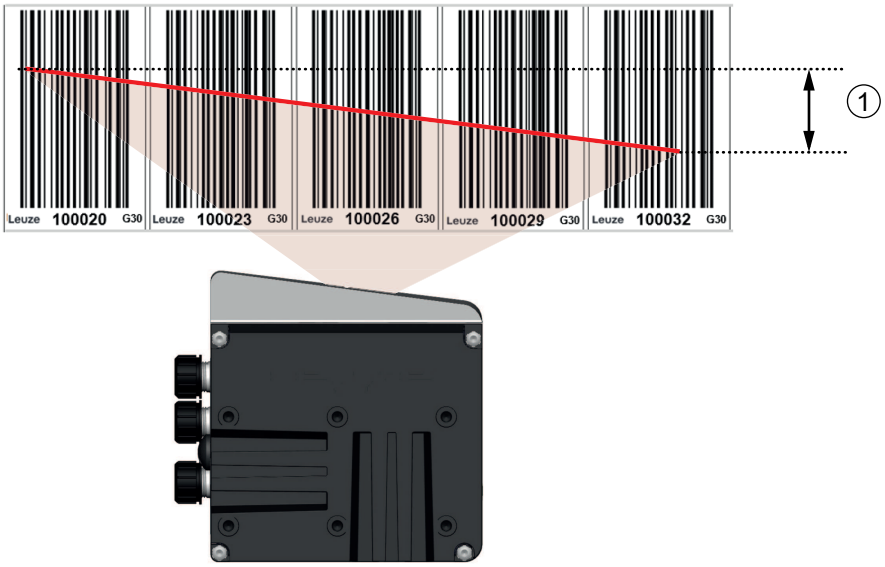
A consistently good projection of the scanning beam on the bar code tape over the length of the track is dependent on the following factors:

- The height offset of the affixed bar code tape.
- The angular height of the scanning beam. The angular height results from the length of the scanning beam and, thus, the reading distance between the FBPS and the bar code tape, see chapter 19.3 "Optical data"*
- The mechanical movement tolerances of the system part on which the FBPS is mounted.

The following relationship applies:

The lower the tape height (e.g., < 25 mm) and the smaller the reading distance between FBPS and BCB (e.g., < 70 mm) are, the smaller the height offset of the affixed BCB is allowed to be.

	NOTICE
	* The scanning beam of the FBPS is longer than the boundary lines of the reading field width, see chapter 19.3 "Optical data". For position labels that are located outside of the reading field, the decodability is limited. Undecodable position labels are not used for position determination by the FBPS. If the FBPS outputs position values, they are valid. If the reading quality is impaired to such an extent that a position can no longer be output, the FBPS signals an external error, see chapter 12.6 "External errors".



1 Angular height of the scanning beam

Fig. 9.6: Angular height of the scanning beam

The scanning beam exits the device at an angle of approx. 7 degrees. The angular height of the scanning beam is dependent on the reading distance, e.g.

- Reading distance 50 mm: angular height approx. 15 mm
- Reading distance 170 mm: angular height approx. 20 mm

1 Height offset downward
2 Height offset upward

Fig. 9.7: Height offset

NOTICE

↳ Affix the bar code tape along an optical reference edge so that the height offset [1] and [2] is as small as possible over the entire affixed edge.

Pay attention to the smallest travel tolerances of the system part on which the FBPS is mounted. Travel tolerances that produce another height offset may result in the scanning beam not being fully projected on the bar code tape. If the bar code can no longer be read, the FBPS responds with an external error, see chapter 12.6 "External errors".

Examples:

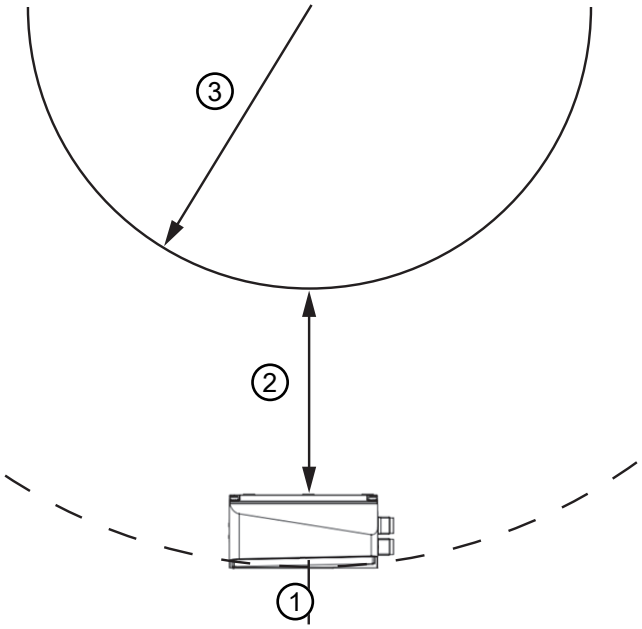
- Height of the bar code tape = 47 mm, angular height of the scanning beam = 15 m at a reading distance of 50 mm.
  A gluing tolerance of approx. 32 mm is present, including the travel tolerances.
- Height of the bar code tape = 20 mm, angular height of the scanning beam = 15 m at a reading distance of 50 mm.
  There is nearly no gluing tolerance present. For this case, the FBPS should be mounted with a reading distance that is as large as possible.

9.4.4 Mounting in curves

	CAUTION
	Check the safety requirements regarding accuracy! The accuracy of the measurement system is subject to the conditions described in chapter 5. ↳ If mounting the bar code in curves, have a competent person determine whether the accuracy is sufficient for the safety requirements of the system.

Horizontal radii

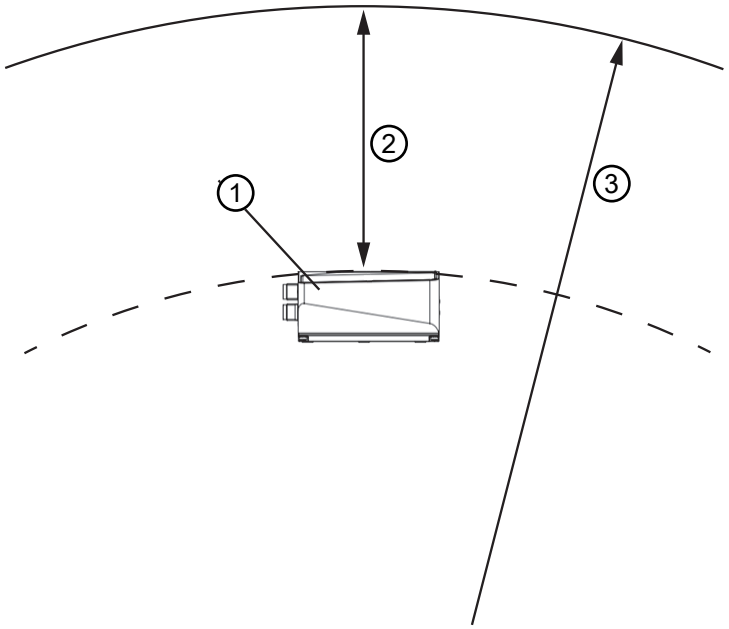
	NOTICE
	Limited accuracy and reproducibility! BCB mounting in curves reduces the accuracy of the FBPS, since the distance between two bar codes is no longer exactly 30 mm due to optical distortions.



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

Fig. 9.8: Mounting the bar code tape in horizontal curves, FBPS traveling on the outside of the curve

The FBPS can be used for position measurement in both the inside and the outside radii of horizontal curves. The radius must not be less than 300 mm.



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

Fig. 9.9: Mounting the bar code tape in horizontal curves, FBPS traveling on the inside of the curve

Vertical radii

The FBPS can be used for position measurement with vertical radii. It plays no role here whether it is an upward or a downward curve. The radius must not be less than 300 mm.

NOTICE	
	Limited absolute measurement accuracy and reproducibility! ↳ BCB mounting in curves decreases the absolute measurement accuracy of the FBPS, since the distance between two bar codes is no longer exactly 30 mm. ↳ In areas where the BCB is fanned out around curves, limitations of the reproducibility must be expected.

Fig. 9.10: Preparing the bar code tape for use in vertical curves

↳ Only partially cut the BCB at the cut mark.
With vertical curves, the BCB is splayed by making cuts when affixing.

↳ Affix the BCB along the curve like a fan.

↳ Ensure that the BCB is affixed without mechanical tension.

NOTICE

No glossy gaps in the bar code tape!

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

9.4.5 Cutting the bar code tape

The bar code tape can be cut and the section after the cut reused. The BCB can be cut after every position code at the corresponding cut mark.

1 Position code before cut point
2 Gap
3 Cut out the next 5 successive position codes
4 First position code after the gap

Fig. 9.11: Cutting the bar code tape

NOTICE

Please note:

The gap [2] must be at least 200 mm in size.

The position code before the gap [1] and the first position code after the gap [4] must not be struck by the scanning beam simultaneously.

After the cut point, at least the first 5 position codes [3] must be cut out to avoid duplicate position values.

NOTICE

The FBPS detects no position code in the gap and signals an external error, see chapter 12.6 "External errors".

Expansion joints

The bar code tape is affixed over mechanical expansion joints up to 30 mm long. The part of the bar code tape that covers the expansion joint can be cut out.

NOTICE

Expansion joints that change in length due to, e.g., the effects of temperature, influence the absolute measurement reference between FBPS and the system. As a result, deviations in the absolute dimension may occur that correspond to the change in length of the expansion joint.

Bar code tapes with different value ranges in the scanning beam

see chapter 9.6 "MVS label control bar code"

9.5 Types of bar code tapes

9.5.1 Standard bar code tapes

Standard bar code tapes have the following features:

Tab. 9.1: Data for standard bar code tapes

Feature	Value
Grid dimension	30 mm (BCB G30 …)
Tape heights	47 mm 25 mm
Tape start value	000000, on the outside of the roll
Tape tolerance	±1 mm/m

Tab. 9.2: Tape lengths

Tape designation	Actual tape length	Tape start value	Tape end value
BCB G30 H.. L005	5.04 m	000000	000501
BCB G30 H.. L010	10.05 m	000000	001002
BCB G30 H.. L020	20.04 m	000000	002001
BCB G30 H.. L030	30.03 m	000000	003000
BCB G30 H.. L040	40.05 m	000000	004002
BCB G30 H.. L050	50.04 m	000000	005001
BCB G30 H.. L060	60.03 m	000000	006000
BCB G30 H.. L070	70.05 m	000000	007002
BCB G30 H.. L080	80.04 m	000000	008001
BCB G30 H.. L090	90.03 m	000000	009000
BCB G30 H.. L100	100.05 m	000000	010002
BCB G30 H.. L110	110.04 m	000000	011001
BCB G30 H.. L120	120.03 m	000000	012000
BCB G30 H.. L130	130.05 m	000000	013002
BCB G30 H.. L140	140.04 m	000000	014001
BCB G30 H.. L150	150.03 m	000000	015000
BCB G30 H.. L200	200.04 m	000000	020001

NOTICE

Use only permissible grid dimension!

For the FBPS, only standard tapes with a grid dimension of 30 mm (BCB G30 …) are permitted.

Standard tapes with a grid dimension of 40 mm (BCB G40 …) are not permitted and will activate an external error on the FBPS, see chapter 12.6 "External errors".

Order guide: see chapter 20.5.1 "Standard bar code tapes"

9.5.2 Special bar code tapes

Special tapes are customer-specific bar code tapes with the following features:

Tab. 9.3: Data for special bar code tapes

Feature	Value
Grid dimension	30 mm (BCB G30 …)
Tape height	Custom, between 20 mm and 140 mm in 1 mm increments
Tape length	Maximum 10000.02 m (BCBs longer than 300 m are divided into a corresponding number of rolls). Each roll is packed separately.
Tape start value	Always divisible by 3 without remainder (grid dimension G30) Minimum value: 000000 cm
Tape end value	Always divisible by 3 without remainder (grid dimension G30) Maximum value: 999999 cm
Tape tolerance	±1 mm/m

NOTICE

Use only permissible grid dimension!

For the FBPS, only special bar code tapes with a grid dimension of 30 mm (BCB G30 …) are permitted.

Special bar code tapes with a grid dimension of 40 mm (BCB G40 …) are not permitted and will activate an external error on the FBPS, see chapter 12.6 "External errors".

Order guide: see chapter 20.5.2 "Special bar code tapes"

9.5.3 Repair bar code tapes

Repair bar code tapes are customer-specific bar code tapes with the following features:

Tab. 9.4: Data for repair bar code tapes

Feature	Value
Grid dimension	30 mm (BCB G30 …)
Tape heights	47 mm 25 mm
Tape length	Maximum 4.98 m (corresponding to grid dimension G30)
Tape start value	Custom in grid dimension G30 Minimum value: 000000 cm
Tape end value	Custom in grid dimension G30 Maximum value: 999999 cm
Tape tolerance	±1 mm/m

NOTICE

Use only permissible grid dimension!

For the FBPS, only repair bar code tapes with a grid dimension of 30 mm (BCB G30 …) are permitted.

Repair bar code tapes with a grid dimension of 40 mm (BCB G40 …) are not permitted and will activate an external error on the FBPS, see chapter 12.6 "External errors".

Order guide: see chapter 20.5.3 "Repair bar code tapes"

9.5.4 Online repair bar code tapes

If the bar code tape is damaged, an online repair bar code tape can be downloaded from the Leuze website as a quick replacement.

On the website, enter the type designation, the part number or search term "FBPS" in the search window. Select one of the listed devices. The online repair bar code tape is the same file for all FBPS devices.

The online repair bar code tapes are listed under the term "Repair kit" in the *Download* tab of the respective device.

	NOTICE
	Do not use the online repair bar code tape on a permanent basis! Self-printed bar code tapes (labels) must not remain permanently in the system. In the area in which the online repair bar code tapes are used, safe position detection may be limited due to poor print quality. 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 tapes should not remain permanently in the system. ↳ Use the bar code tape created with the repair kit only temporarily.

Replacing a defective section of tape

- ↳ Determine the position values of the defective area.
- ↳ On the website, select the repair kit that contains the desired position value.
- ↳ Open the repair kit PDF and scroll to the desired position value.
- ↳ Print the corresponding value range.
- ↳ Affix the printed position values over the defective section of tape.

Printing position values

- ↳ Only print the pages with the position values that you need.
- ↳ Check the correct dimensions of the printed position values by measuring 30 mm between the two cut marks. It may be necessary to adjust the zoom factor of the printer.

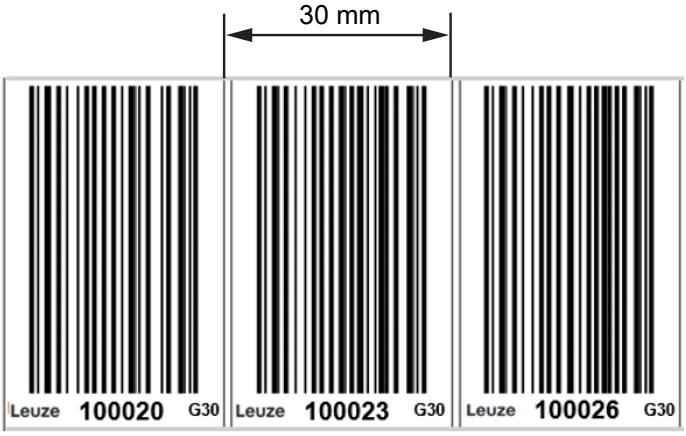


Fig. 9.12: Checking the dimension of 30 mm on the self-printed online repair bar code tape

- ↳ Cut out the necessary position values at the cut marks.
- ↳ Affix the printed and cut out position values over the defective bar code tape.
- ↳ Pay particular attention to the two transitions from the original bar code tape to the printed bar code tape and ensure that the position values increase sequentially by the value 3.

Ordering originally manufactured repair bar code tapes: see chapter 20.5.3 "Repair bar code tapes"

9.5.5 TWIN bar code tapes

TWIN bar code tapes are two customer-specific bar code tapes that are identical with respect to both tape values and tape tolerances. Both tapes are delivered together in a single shrink wrap.

Tab. 9.5: Data for TWIN bar code tapes

Feature	Value
Grid dimension	30 mm (BCB G30 …)
Tape height	Custom, between 20 mm and 140 mm in 1 mm increments
Tape length	Maximum 10000.02 m per single tape
Tape start value	Always divisible by 3 without remainder (grid dimension G30) Minimum value: 000000 cm
Tape end value	Always divisible by 3 without remainder (grid dimension G30) Maximum value: 999999 cm

NOTICE

Use only permissible grid dimension!

For the FBPS, only TWIN bar code tapes with a grid dimension of 30 mm (BCB G30 …) are permitted.

TWIN bar code tapes with a grid dimension of 40 mm (BCB G40 …) are not permitted and will activate an external error on the FBPS, see chapter 12.6 "External errors".

Fig. 9.13: TWIN bar code tape

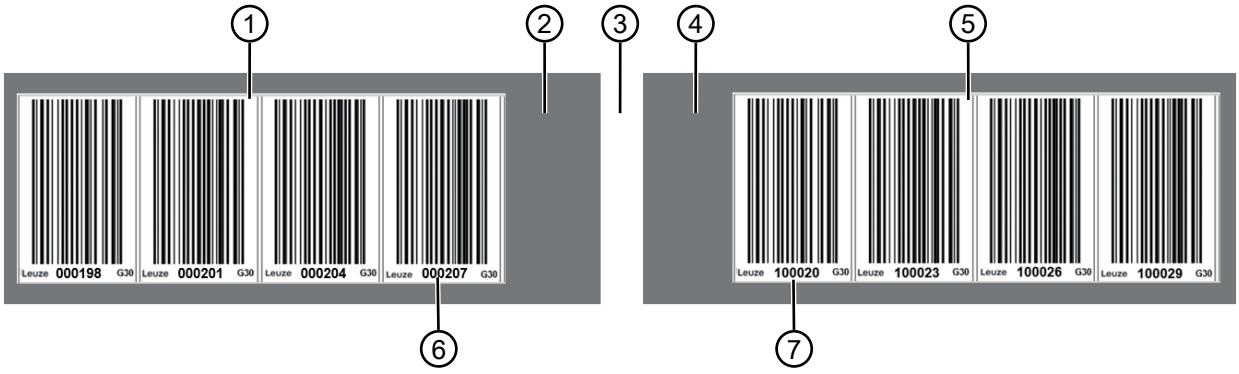
TWIN bar code tapes are labeled below and above the bar code.

Order guide: see chapter 20.5.4 "TWIN bar code tapes"

9.6 MVS label control bar code

Bar code tapes with different value ranges in the scanning beam

In applications such as electrical monorail systems, constellations occur in which bar code tapes with different value ranges are used, e.g., switch functions.



1 Bar code tape with value range 1
2 Area free of bar codes < 30 mm
3 Mechanical cut point / gap ≤ 15 mm
4 Area free of bar codes < 30 mm
5 Bar code tape with value range 2
6 Position value 1 at the cut point
7 Position value 2 at the cut point

Fig. 9.14: Bar code tapes with different value ranges

If bar code tapes with different value ranges are used, the following requirements must be complied with. The requirements apply regardless of whether an MVS label is used for position control, see chapter 9.6.1 "MVS control label".

Tab. 9.6: Requirements for bar code tapes with different value ranges

Criterion	Pos. in image	Value
Difference between the position values at the cut point	6 + 7	≥ 100 cm
Width of the areas at the cut point that are free of bar codes	2 + 4	< 30 mm
Width of the cut point	3	≤ 15 mm

CAUTION

System standstill due to safety control!

If the difference between the two position values at the cut point is less than 100 cm, the output value fluctuates between value range 1 and value range 2.

Due to the measurement value fluctuations that occur, the safety control for evaluating the two SSI channels as well as the position controller in this constellation may activate an error message that results in a system standstill.

↳ Make sure that the difference between the position values at the cut point is greater than 100 cm.

9.6.1 MVS control label

The MVS control bar code is a single label that is marked with "Leuze MVS G30" on the label line.

Tab. 9.7: Data on the MVS control label

Feature	Value
Grid dimension/label width	G30 / 30 mm
Label height	47 mm
Encoding	MVS (Measurement Value Switch)
Label color	Red
Packaging unit	10 pieces

Fig. 9.15: MVS control label

Application

An MVS label is used if two bar code tapes with different value ranges are detected together in the scanning beam, e.g., at switch transitions in electrical monorail systems.

If the preceding BCB (value range 1) as well as the subsequent BCB (value range 2) are detected in the scanning beam of the FBPS, the position output for both SSI channels is controlled as follows.

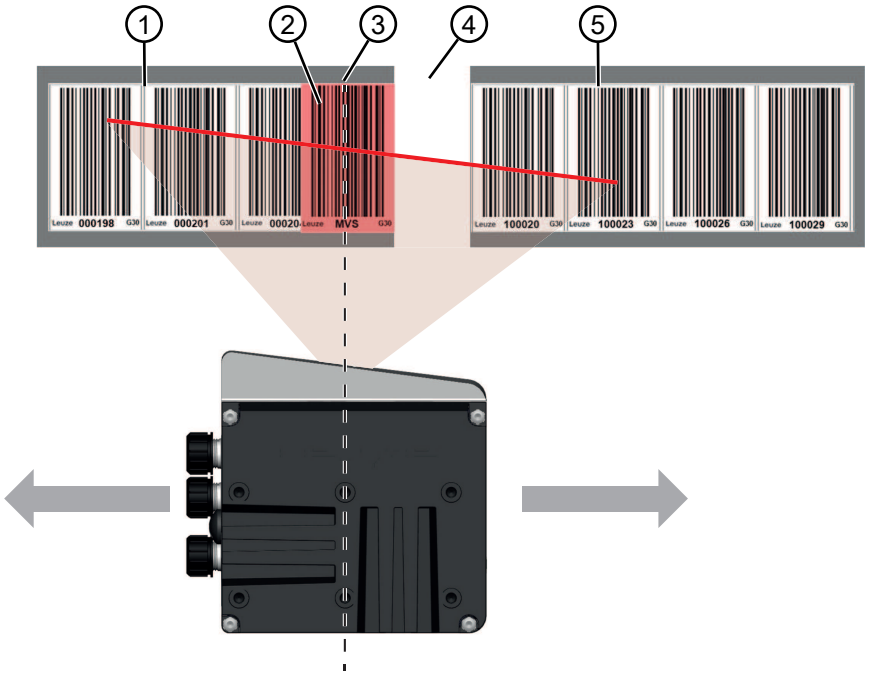
At the moment in which the FBPS with the measurement reference point attached to its housing (see chapter 7.1 "Devices with side plug outlet" or see chapter 7.2 "Devices with bottom plug outlet") is opposite the middle of the MVS label, a position changeover occurs between the two value ranges 1 and 2. The changeover always occurs at the same position regardless of the direction in which the FBPS is moving.

	NOTICE
	The behavior of the FBPS during position value changeover by means of an MVS label can be configured, see chapter 9.6.3 "Configuring MVS position value changeover".

	NOTICE
	Only one MVS label can be detected by the scanning beam at a time. If the scanning beam simultaneously detects two or more MVS control labels, an external error is signaled, see chapter 12.6 "External errors".

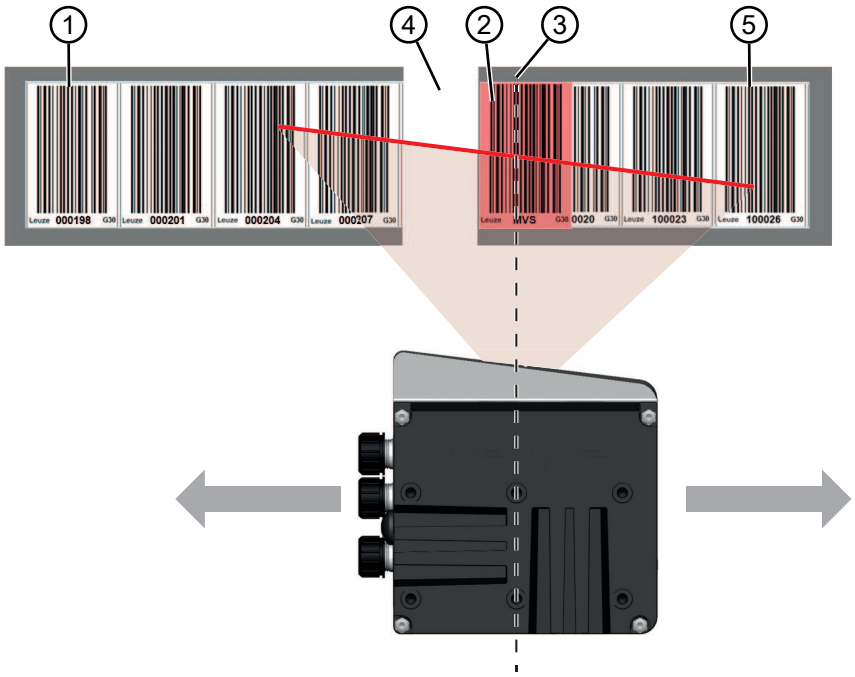
Affixing an MVS label

The MVS label can be affixed in value range 1 as well as in value range 2.



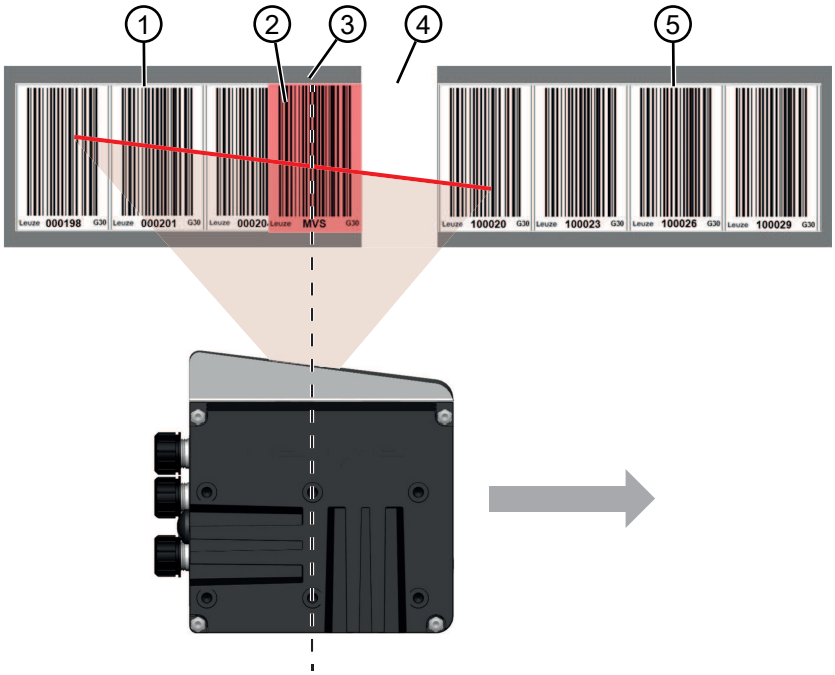
1 Bar code tape value range 1
2 MVS label
3 Middle of FBPS and middle of MVS label
4 Mechanical cut point/gap at switches, expansion joints, etc.
5 Bar code tape value range 2

Fig. 9.16: Value range 1 and 2 in the scanning beam, MVS label affixed in value range 1



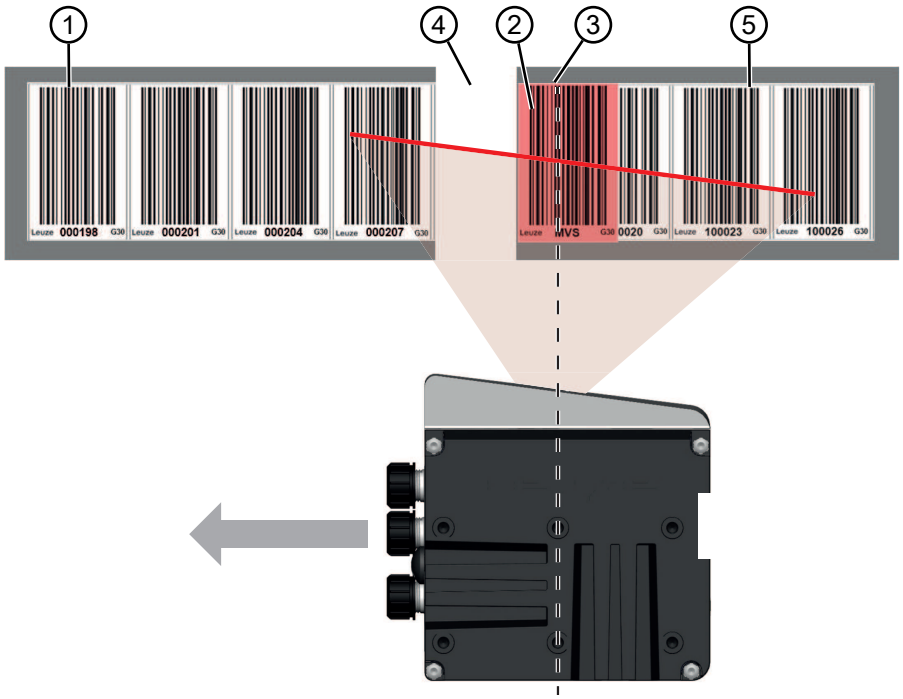
1 Bar code tape value range 1
2 MVS label
3 Middle of FBPS and middle of MVS label
4 Mechanical cut point/gap at switches, expansion joints, etc.
5 Bar code tape value range 2

Fig. 9.17: Value range 1 and 2 in the scanning beam, MVS label affixed in value range 2



1 Bar code tape value range 1
2 MVS label
3 Middle of FBPS and middle of MVS label
4 Mechanical cut point/gap at switches, expansion joints, etc.
5 Bar code tape value range 2

Fig. 9.18: Detection of only one value range in the scanning beam, MVS label affixed in value range 1



1 Bar code tape value range 1
2 MVS label
3 Middle of FBPS and middle of MVS label
4 Mechanical cut point/gap at switches, expansion joints, etc.
5 Bar code tape value range 2

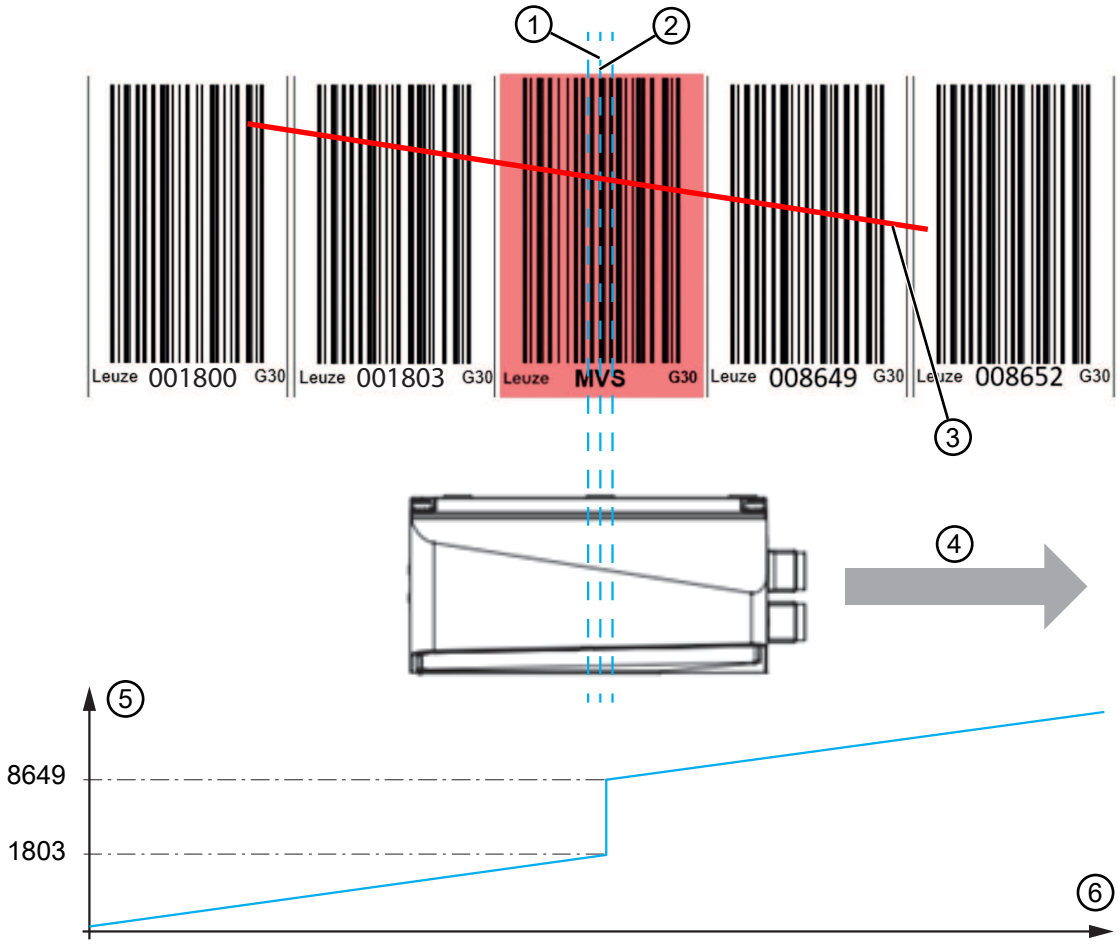
Fig. 9.19: Detection of only one value range in the scanning beam, MVS label affixed in value range 2

NOTICE
It is recommended that the MVS label be affixed flush with the cut point/gap, even if this results in the preceding label no longer being legible. The maximum size of a gap can be calculated from the reading distance and the resulting length of the scanning beam, see chapter 19.3 "Optical data". A position value can only be output if the FBPS can detect and read a complete position value label. The behavior of the FBPS on a position value changeover by means an MVS label can be adapted to the application, see chapter 9.6.3 "Configuring MVS position value changeover".

NOTICE
Cut points, such as switches or expansion joints, require special consideration during commissioning, especially if this is associated with a change in the BCB value ranges. They must be checked according to the following criteria: If only the MVS label is detected within the scanning beam and no other complete position label, an external error is signaled in the following operating states: - after interruption of the scanning beam - after power off/on - after an operating mode change in the webConfig tool from service to process (e.g., by configuring the FBPS) In this case, the FBPS must be moved to a position in which it can detect a complete position value label, e.g., by manually moving the vehicle. At the moment in which the first bar code of the subsequent value range is detected, the signaling of the external error is stopped and the FBPS again makes position values available at the SSI interface.

9.6.2 Reversing the direction of travel

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



1	FBPS center + hysteresis ± 5 mm
2	Center of MVS control label
3	Scanning beam
4	Direction of movement
5	Position values
6	Measurements

Fig. 9.20: Changeover position with MVS control bar code

If the MVS label is passed over, the new tape value is always output relative to the center of the device or label. In this situation, the hysteresis of ±5 mm is irrelevant. If, however, the device is stopped within the hysteresis on the MVS label and the direction changed, the starting position values have an inaccuracy ±5 mm.

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

9.6.3 Configuring MVS position value changeover

The behavior of the FBPS on a position value changeover by means an MVS label can be adapted to the application, see chapter 13.3 "Safety parameters".

***MVS switching tolerance* parameter in default factory setting**

Value 1: Measurement value switching, maximum 15 mm tolerance

Example 1

The scanning beam of the FBPS simultaneously detects the MVS label as well as the position label from value range 1 **and** value range 2 (see figure 9.16 / figure 9.17).

The position value changeover between value range 1 and value range 2 occurs at the moment in which the FBPS, with its measurement reference point, is opposite the middle of the MVS label.

Example 2

The scanning beam of the FBPS detects the MVS label and only position labels from value range 1 **or** value range 2 (figure 9.18 / figure 9.19).

With its measurement reference point, the FBPS outputs the position values according to the detected value range up to the end of the MVS label. This corresponds to an extended measurement data output of 15 mm.

If the FBPS does not detect a new value range at the end of the MVS label, an external error is signaled.

***MVS switching tolerance* parameter without tolerance**

Value 0: Measurement value switching – no tolerance

Example 3

The scanning beam of the FBPS simultaneously detects the MVS label as well as the position label from value range 1 **and** value range 2 (see figure 9.16 / figure 9.17).

The position value changeover between value range 1 and value range 2 occurs at the moment in which the FBPS, with its measurement reference point, is opposite the middle of the MVS label.

Example 4

The scanning beam of the FBPS detects the MVS label and only position labels from value range 1 **or** value range 2 (figure 9.18 / figure 9.19).

If the FBPS with its measurement reference point is opposite the middle of the MVS label and if the new value range (1 or 2) cannot be detected by the scanning beam in the subsequent movement, an external error is signaled, see chapter 12.6 "External errors".

Signaling via the status LEDs see chapter 16.3 "Diagnosis via the LED indicators".

9.7 Negative position values and position 0 (zero)

Position value 0 (zero) and negative position values cannot be transmitted by the FBPS, see chapter 9.7 "Negative position values and position 0 (zero)".

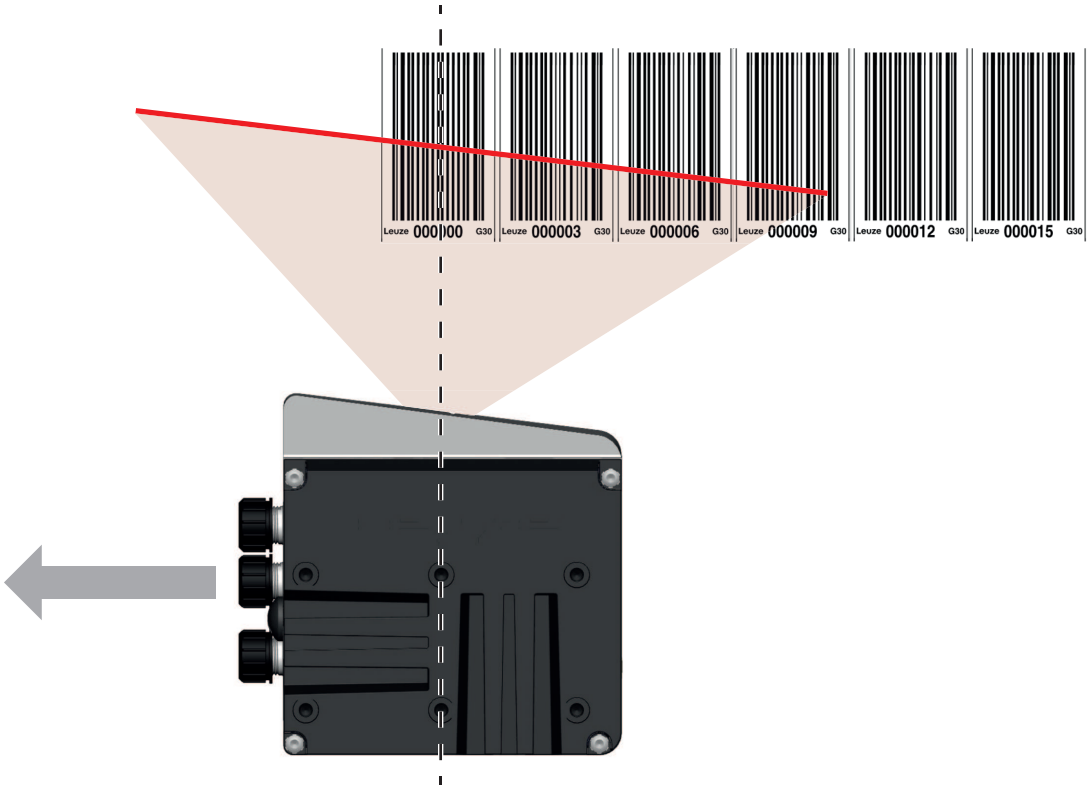


Fig. 9.21: Negative position values

NOTICE
If the FBPS with its reference point for the position calculation is centered opposite position label 0 or if the FBPS is to the left of position label 0, the FBPS signals an external error, see chapter 12.6 "External errors". Position value 0 (zero) or negative position values are not allowed to be generated by means of a configured offset. Negative position values and position value 0 can be avoided by means of a corresponding position offset.

9.8 Qualification of the safety function after affixing the bar code tape

NOTICE
Check the safety function of the entire positioning system! Correct mounting/affixing of the bar code tape is decisive for the safety function of the entire FBPS positioning system. With respect to the safety functions of the overall system, the safe position detection of the FBPS must be qualified in the context of the safety requirements of the system. ↳ Move the FBPS along the bar code tape installed in the system. Possible operating states and how they are signaled are described in chapter 10. Signaling via the status LEDs: see chapter 16.3 "Diagnosis via the LED indicators". ⇨ The safety function of the safe positioning system comprising FBPS and bar code tape is satisfied if the FBPS can be moved along the entire bar code tape without external or internal error signaling.

9.9 Care and cleaning of the bar code tape

↳ Clean the bar code tape as necessary with a mild cleaning agent such as commercial cleaning detergent.

↳ Do not use any cleaning agents with abrasive properties. When cleaning, take care not to scratch the surface of the tape.

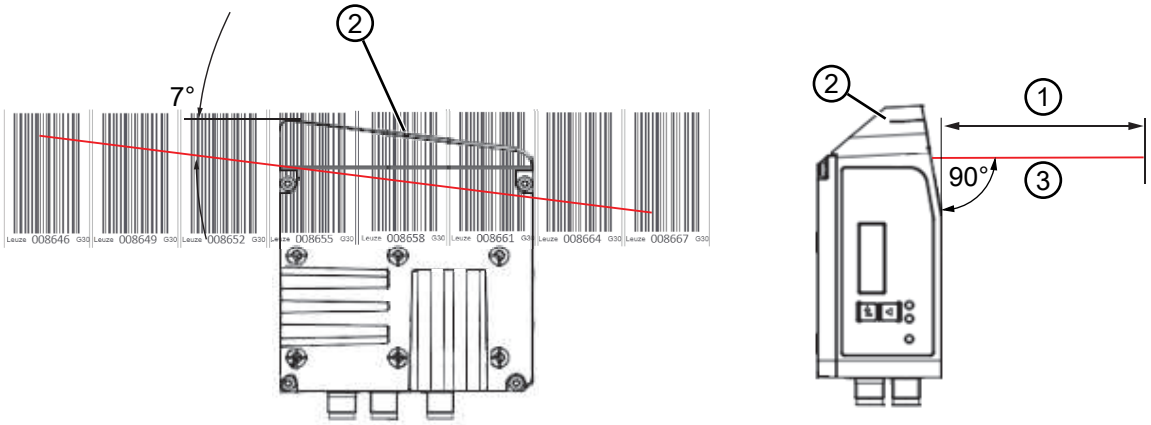
NOTICE
Do not use abrasive cleaning aids! Cleaning devices that constantly travel along and press against the bar code tape such as sponges or brushes are not permitted. Over time, this type of cleaning will give the bar code tape a high-gloss finish, rendering it unreadable.

10 Mounting

10.1 Mounting instructions

NOTICE	
	Select the mounting location. ↳ Make certain that the required environmental conditions (air humidity, temperature) are maintained, see chapter 19.7 "Environmental data". ↳ Make sure that the distance between FBPS and bar code tape lies in the working range of the reading field curve over the entire track, see chapter 19.3 "Optical data". The working range is at a reading distance from 50 mm to 170 mm. With an uninterrupted bar code tape, the scanning beam of the FBPS must detect at least three bar codes. ↳ Mount the FBPS so that no interruptions of the scanning beam occur during operation. ↳ Make certain that the exit window does not become soiled, e.g., by leaking liquids, permanent dust exposure, abrasion from cardboard packaging or residues from packaging material. ↳ Protect the exit window of the FBPS against rain and direct sunlight with a cover installed on-site. Alternatively, the FBPS can be installed in a protective housing. ↳ Mounting the FBPS in a protective housing: When installing the BPS in a protective housing, ensure that the scanning beam can exit the protective housing without obstruction and without having to pass through another glass cover. ↳ At operating temperatures below –5 °C, an FBPS with integrated heating must be used. If the operating temperature is below –25 °C and the device is moved constantly and without interruption, additionally attach e.g. a protective housing to the device so that it is protected against the airflow.

10.2 Orientation of the FBPS to the bar code tape



1 Reading distance
2 Measurement reference point of the FBPS
3 Scanning beam

Fig. 10.1: Beam exit

Upon exit from the housing, the scanning beam is at an angle of 7° (2).

The angle of radiation of the scanning beam to the front is 90° relative to the rear side of the housing (3).

The specified reading distance is to be maintained (1).

10.3 Mounting the FBPS

The FBPS can be mounted in the following ways:

- Mounting using four M4 mounting threads on the rear of the device
- Mounting using a mounting device on the M4 mounting threads on the rear of the device
- Mounting using a mounting device on the fastening grooves

10.3.1 Mounting with M4 fastening screws

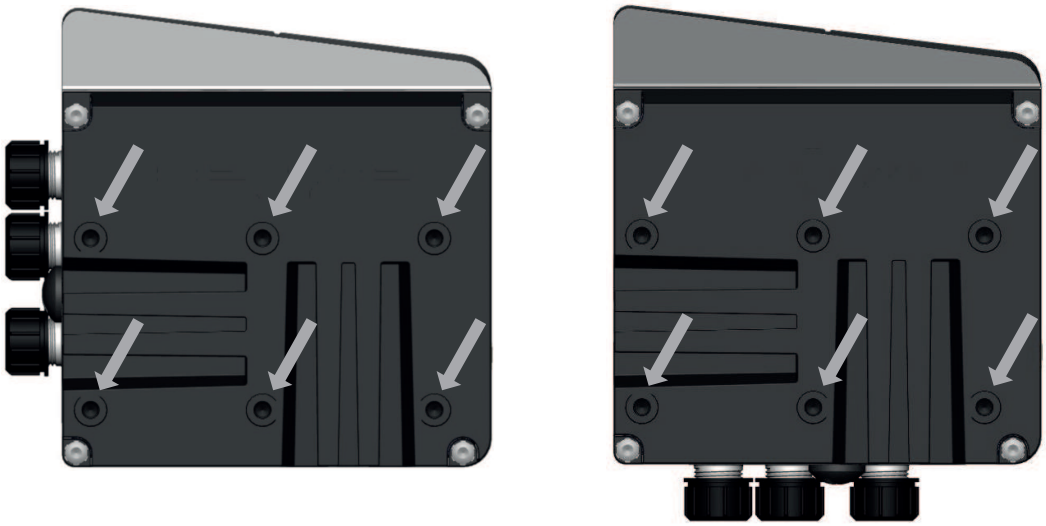


Fig. 10.2: Six M4x5 threaded holes on the rear side of the device

Located on the rear side of the device are six M4x5 threaded holes, arranged in two squares (42 mm x 42 mm).

↳ Mount the FBPS on the system with four M4 fastening screws.
Secure the fastening screws against loosening with a snap ring, lock washer or other means.
Tightening torque of the fastening screws: 1 Nm … max. 2 Nm
Thread depth: min. 3.5 mm

The mounting parts (screws, snap rings, lock washers, etc.) are not included in delivery.

10.3.2 Mounting with the BT 300 W mounting bracket

Mounting of the FBPS with a BT 300 W mounting bracket is intended for base mounting.

For ordering information: see chapter 20.4 "Accessories – mounting systems"

For dimensioned drawing: see chapter 19.10.3 "Dimensioned drawing BT 300-W mounting system"

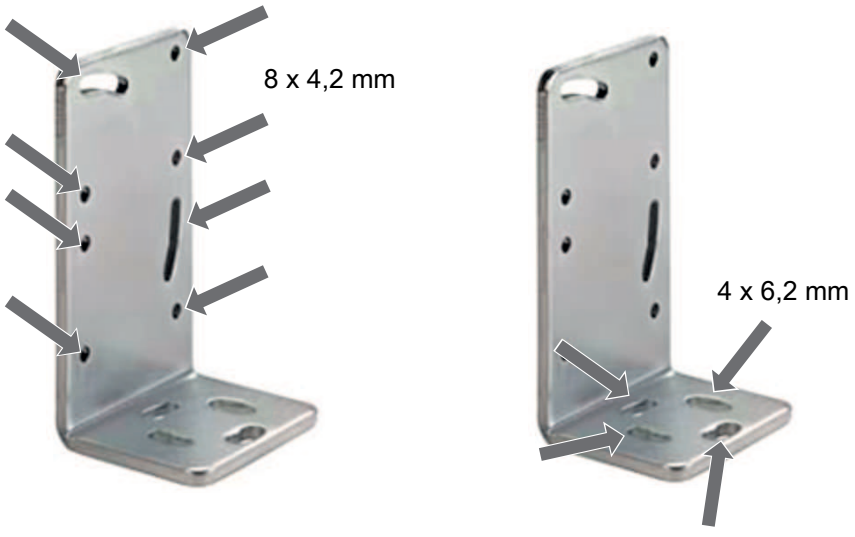


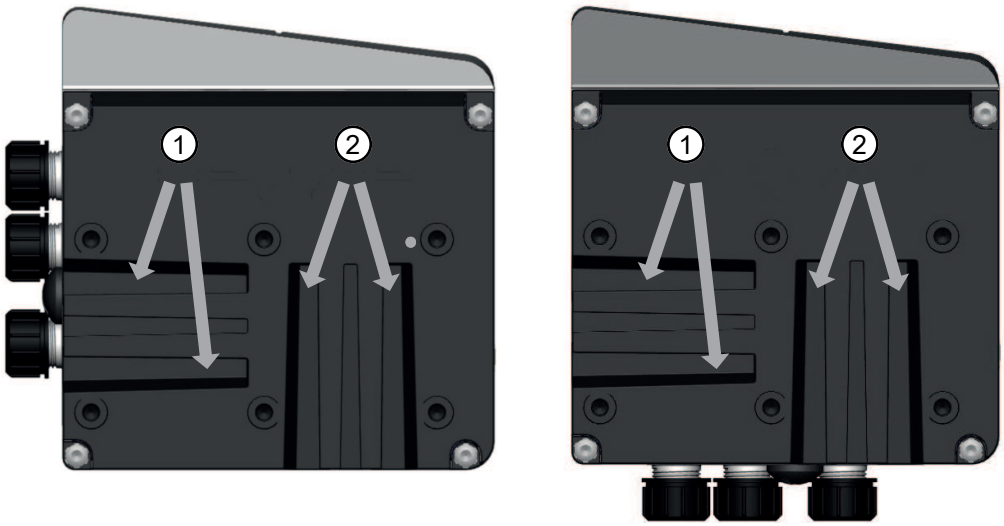
Fig. 10.3: BT 300 W mounting bracket

The FBPS is screwed to the long side of the mounting bracket with four M4 fastening screws. Base mounting requires at least two M6 fastening screws on the short side of the mounting bracket.

- Mount the FBPS on the mounting bracket with four M4 fastening screws (included with delivery) in square or rectangular arrangement.
  Secure the fastening screws against loosening with a spring washer (included with delivery).
  Tightening torque of the fastening screws: 1 Nm … max. 2 Nm
  Thread depth: min. 3.5 mm
- Mount the BT 0300 W mounting bracket on the system side with at least two M6 fastening screws (not included in delivery).
  Secure the fastening screws against loosening with a spring washer.
- Position the device so that the exit window of the FBPS is parallel to the bar code tape. If necessary, turn the mounting bracket using the 6.2 mm slotted holes on the short side.

10.3.3 Mounting with the BTU 0300M-W mounting device (quick-change system)

Dovetail fastening grooves are located on the rear side of the FBPS for mounting the FBPS to a BTU 0300M-W quick-change system.



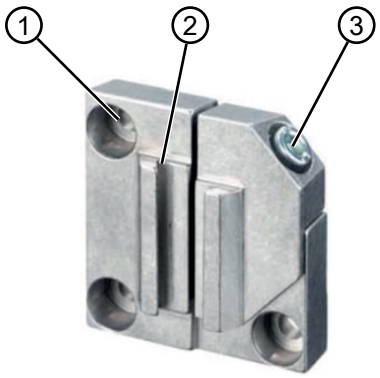
1 Guide the FBPS into the dovetail fastening grooves of the BTU 0300M-W from the side
2 Guide the FBPS into the dovetail fastening grooves of the BTU 0300M-W from above

Fig. 10.4: Dovetail fastening grooves on the rear side of the device

Mounting the FBPS with a BTU 0300M-W mounting device is intended for vertical mounting.

For ordering information: see chapter 20.4 "Accessories – mounting systems"

For dimensioned drawing: see chapter 19.10.4 "Dimensioned drawing BTU 0300M-W mounting system"



1 Ø 6.6 mm through holes for mounting the mounting device on the system
2 Clamping jaws
3 M6 screw for clamping the FBPS to the dovetail

Fig. 10.5: BTU 0300M-W mounting devices

Fig. 10.6: Mounting with BTU 0300M-W

- Use the through holes to mount the BTU 0300M-W on the system side with three M6 fastening screws (not included in delivery contents).
- Mount the FBPS with the dovetail fastening grooves on the clamping jaws of the BTU 0300M-W. Push the FBPS to the limit stop.
- Secure the FBPS in the dovetail grooves with the M6 clamping screw.
  Tightening torque for the clamping screw: 8 Nm … max. 11 Nm

	NOTICE
	If the device needs to be replaced, push the new FBPS with the dovetail grooves to the limit stop again.

11 Device replacement

The FBPS can be replaced if necessary.

	NOTICE
	Only allow competent persons to replace the device, see chapter 2.3 "Competent persons".

11.1 Transferring SSI parameters

	CAUTION
	Transfer the parameter set to the new device! Before you mount and connect the new device to the system and apply voltage, you must transfer the parameter set of the previous FBPS to the new FBPS. The parameter set of the previous FBPS must be available in the system documentation in the form of a printed document. ↳ Ask explicitly for these parameters. ↳ In the webConfig tool of the new FBPS, select the **service** operating mode. ↳ Transfer the parameter set to the new FBPS. Please also observe the notices, see chapter 15.12 "Configuring parameters in the webConfig tool". ↳ If no parameter set can be found, make sure that the previous FBPS was operated with the standard parameters loaded on delivery.

Do not mount and commission the new FBPS until clear information about the parameters of the previous FBPS is available.

11.2 Mounting the new device

Mount the new FBPS in the same way as the previous device.

↳ Observe the mounting instructions, see chapter 10 "Mounting"

↳ Pay attention to the specifications for the tightening torques of the fastening screws.

11.3 Connecting the new device

If the wiring is undamaged, it can be reused for the new device.

If the wiring needs to be replaced, observe the notices, see chapter 7.3 "Connection technology".

	CAUTION
	Risk of mixing up the SSI connections! ↳ Before unscrewing the two SSI connection cables, clearly mark which SSI connection cable is assigned to connection X1 SSI1 and which to connection X2 SSI2. As both SSI connection cables have a B-coded M12 connector plug, there is a risk of mixing them up. ↳ Connect the SSI connection cables to the same connections on the replacement FBPS.

The connection cables for supply voltage and SSI have different connectors and M12 encoding and, as a result, cannot be mixed up.

11.4 Qualification of the safety function after replacement

With respect to the safety function of the overall system, the safe position detection must be qualified in the context of the safety requirements of the system after replacing an FBPS.

↳ Move the replaced FBPS along the entire bar code tape.
Possible operating states and how they are signaledsee chapter 12 "Operating states".
Signaling via the status LEDs: see chapter 16.3 "Diagnosis via the LED indicators".

⇨ The safety function of the overall system is satisfied if the new FBPS can be moved along the entire bar code tape without external or internal error signaling.

	NOTICE
	Do not release the system for operation until the renewed qualification has been completed error-free.

12 Operating states

12.1 Power off

X1 SSI1 (channel A)

The channel is high-impedance, which is equivalent to a cable interruption.

X2 SSI2 (channel B)

The channel is high-impedance, which is equivalent to a cable interruption.

12.2 Signaling during startup

The boot time is the time between "power-on" and the safe measurement value output at the SSI interfaces. At "power on", the ambient temperature and the internal temperature of the FBPS determine the boot time.

Tab. 12.1: Boot time as a function of ambient temperature

Ambient temperature	Boot time
-5 °C … +60 °C	Approx. 10 s
-35 °C	Approx. 30 min

Tab. 12.2: Signaling during startup

Component	Signal/activity
PWR status LED	Flashes green
SSI1 status LED	Flashes green
SSI2 status LED	Flashes green
Laser diode	Is deactivated
X1 SSI1 (channel A)	The driver of the channel is deactivated during the boot time. The CLK and data cables are connected via pull-down or pull-up resistors.
X2 SSI2 (channel B)	The driver of the channel is deactivated during the boot time. The CLK and data cables are connected via pull-down or pull-up resistors.

12.3 Signaling after "power on" without errors

Tab. 12.3: Signaling after "power on" without errors

Component	Signal/activity
PWR status LED	Lights up green
SSI1 status LED	Lights up green
SSI2 status LED	Lights up green
Laser diode	Is activated
X1 SSI1 (channel A)	The channel is ready for clocking out the SSI data. The driver of the channel is activated. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces". Up until the first clocking out of the SSI data, the SSI channel is in the idle state, see chapter 13 "SSI interface description".
X2 SSI2 (channel B)	The channel is ready for clocking out the SSI data. The driver of the channel is activated. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces". Up until the first clocking out of the SSI data, the SSI channel is in the idle state, see chapter 13 "SSI interface description".

12.4 Signaling in the event of overtemperature or undertemperature

Devices without heating

Operating temperature of FBPS without device heating: -5 °C … +60 °C

Signaling of a temperature error

At an ambient temperature lower than -10 °C and higher than +65 °C, the FBPS signals an internal error.

Devices with heating

Operating temperature of FBPS with device heating: -35 °C … +60 °C

Signaling of a temperature error

At an ambient temperature lower than -35 °C and higher than +65 °C, the FBPS signals an internal error.

	NOTICE
	In the case of undertemperature, the warm-up phase is allowed to elapse after power-on. If the operating temperature range is reached during the warm-up phase, the device starts up automatically. If the temperature of the device remains too low after the warm-up phase, the FBPS signals an internal error. Whether or not the system can be restarted is determined by the unit that performs the evaluation or by the safety concept of the system.

Tab. 12.4: Signaling in the event of overtemperature or undertemperature

Component	Signal/activity
PWR status LED	Lights up red
SSI1 status LED	Lights up red
SSI2 status LED	Lights up red
Laser diode	Is deactivated
X1 SSI1 (channel A)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".
X2 SSI2 (channel B)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".

Restarting following an internal error

In the event of an internal error, the FBPS is not automatically restarted. Restarting can only be unlocked on the FBPS by means of power off/on. If the internal error remains, unlocking is not possible.

NOTICE	
	Whether or not the system can be restarted automatically following an internal error is determined by the unit that performs the evaluation or by the safety concept of the system.

12.5 Signaling in the event of overvoltage and undervoltage

The FBPS monitors the supply voltage for the following error thresholds:

- Overvoltage: greater than approx. 34 V DC
- Undervoltage: less than approx. 15 V DC

12.5.1 Signaling in the event of overvoltage

In the case of voltages greater than approx. 34 V DC, the FBPS is internally disconnected from the supply voltage.

Tab. 12.5: Signaling in the event of overvoltage

Component	Signal/activity
PWR status LED	Off
SSI1 status LED	Off
SSI2 status LED	Off
Laser diode	Off
X1 SSI1 (channel A)	The internal supply voltage of the FBPS is interrupted: the state of the SSI cable is equivalent to a cable break in this case. The cable ends of the SSI cable connections are passively connected with pull-up resistors, pull-down resistors and a circuit that corresponds to a protective circuit, see chapter 13.2 "Internal wiring of the SSI interfaces".
X2 SSI2 (channel B)	The internal supply voltage of the FBPS is interrupted: the state of the SSI cable is equivalent to a cable break in this case. The cable ends of the SSI cable connections are passively connected with pull-up resistors, pull-down resistors and a circuit that corresponds to a protective circuit, see chapter 13.2 "Internal wiring of the SSI interfaces".

12.5.2 Signaling in the event of undervoltage

With a voltage of < approx. 8.5 V DC, the state of the FBPS corresponds to the de-energized state.

Tab. 12.6: Signaling in the event of undervoltage

Component	Signal/activity
PWR status LED	Off
SSI1 status LED	Off
SSI2 status LED	Off
Laser diode	Off
X1 SSI1 (channel A)	The state of the SSI cable is equivalent to a cable break in this case. The cable ends of the SSI cable connections are passively connected with pull-up resistors, pull-down resistors and a circuit that corresponds to a protective circuit, see chapter 13.2 "Internal wiring of the SSI interfaces".
X2 SSI2 (channel B)	The state of the SSI cable is equivalent to a cable break in this case. The cable ends of the SSI cable connections are passively connected with pull-up resistors, pull-down resistors and a circuit that corresponds to a protective circuit, see chapter 13.2 "Internal wiring of the SSI interfaces".

If, after an overvoltage (> 34 V DC) or after an undervoltage (< approx. 8.5 V DC), the supply voltage is again in the operating voltage range of 24 V DC ±25%, the FBPS automatically restarts, see chapter 12.2 "Signaling during startup".

NOTICE	
	Whether or not the system can be restarted automatically is determined by the unit that performs the evaluation or by the safety concept of the system.

For voltages between approx. 8.5 V DC … 15 V DC, the FBPS signals an internal error.

Tab. 12.7: Signaling in the event of an internal error

Component	Signal/activity
PWR status LED	Lights up red
SSI1 status LED	Lights up red
SSI2 status LED	Lights up red
Laser diode	Is deactivated
X1 SSI1 (channel A)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".
X2 SSI2 (channel B)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".

Restarting following an internal error

In the event of an internal error, the FBPS is not automatically restarted. Restarting can only be unlocked on the FBPS by means of power off/on. If the internal error remains, unlocking is not possible.

12.6 External errors

12.6.1 Causes of external errors

- No bar code tape with position information in the scanning beam
  - No position label present or readable.
  - After power off/on or after a light beam interruption, there is only an MVS label in the scanning beam.
  - Following the webConfig operating mode change from **service** to **process**, there is an MVS label without subsequent position label in the scanning beam.
- Position values of the bar code tape are not readable due to:
  - Soiling
  - Damaged bar code tape
  - Bar code tape interruptions (gaps) at switches or expansion joints are too large
  - Bar code tape outside of the reading distance
  - Bar code tape not readable due to reading distance at horizontal inner and outer radii
  - Bar code tape with incorrect grid dimension (G40 instead of G30)
    In the event of this error, the device is not restarted automatically.
    The error must be acknowledged after replacing the incorrect tape by means of Power on/off on the FBPS, see chapter 12.6.3 "Restarting following an external error".
- Stop/start of the position measurement via the switching input (configurable option), see chapter 15.14 "Configuring general, non-safety parameters"
- Overflow of the SSI data bits. Number of position data bits does not match the selected resolution, see chapter 13.4 "Maximum position value which can be represented".
- Negative position values, see chapter 12.9 "Negative SSI position values"
- Position value 0 (zero), see chapter 12.8 "SSI position value 0 (zero)"
- Error threshold for overtemperature or undertemperature reached, see chapter 19.7 "Environmental data"
- Maximum permissible speed of 10 m/s exceeded
- Cross-circuit between the clock lines, see chapter 12.11 "Cross-circuit in the wiring between the two SSI channels"

12.6.2 Signaling in the event of an external error

Tab. 12.8: Signaling in the event of an external error

Component	Signal/activity
PWR status LED	• Flashes red • Lights up red in the event of overtemperature or undertemperature
SSI1 status LED	Flashes orange
SSI2 status LED	Flashes orange
Laser diode	Is activated
X1 SSI1 (channel A)	If the channel is Gray coded (standard), all position data bits are set to 0, the error bit is 1. If the channel is binary coded, all position data bits are set to 1, the error bit is 1.
X2 SSI2 (channel B)	If the channel is binary coded (standard), all position data bits are set to 1, the error bit is 1. If the channel is Gray coded, all position data bits are set to 0, the error bit is 1.

Maximum and minimum exposure time in the event of an external error

- Maximum exposure time: duration of the external error state + minimum exposure time
- Minimum exposure time: dependent on the safety parameter of the response time (integration time) (2 – 8 ms), see chapter 13 "SSI interface description"
  - Minimum: 2 ms
  - **Standard: 8 ms**

12.6.3 Restarting following an external error

	NOTICE
	As soon as the external error is no longer present, the FBPS automatically restarts. Whether or not the system can be restarted automatically following an external error is determined by the unit that performs the evaluation or by the safety concept of the system. Excluded from an automatic restart is the detection of an incorrect bar code tape (G40), see chapter 12.6.1 "Causes of external errors". ↳ After replacing the tape, the error must be acknowledged by means of Power on/off on the FBPS.

12.7 Internal error

Causes of internal errors

- Internal hardware or software error
- Overtemperature or undertemperature
- Undervoltage between approx. 8.5 V DC … 15 V DC

Signaling in the event of an internal error

Tab. 12.9: Signaling in the event of an internal error

Component	Signal/activity
PWR status LED	Lights up red
SSI1 status LED	Lights up red
SSI2 status LED	Lights up red
Laser diode	Is deactivated
X1 SSI1 (channel A)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".
X2 SSI2 (channel B)	The driver of the channel is deactivated in the event of an internal error. The CLK and data cables are connected via pull-down or pull-up resistors, see chapter 13.2 "Internal wiring of the SSI interfaces".

Restarting following an internal error

In the event of an internal error, the FBPS is not automatically restarted. Restarting can only be unlocked on the FBPS by means of power off/on. If the internal error remains, unlocking is not possible.

	NOTICE
	Whether or not the system can be restarted automatically following an internal error is determined by the unit that performs the evaluation or by the safety concept of the system.

12.8 SSI position value 0 (zero)

Position value 0 (zero) is blocked for output on both SSI channels.

Causes and measures in the event of position value 0 (zero)

Tab. 12.10: Causes and measures in the event of position value 0 (zero)

Cause	Measure
The FBPS is centered opposite a bar code label with value 000000.	• The output value is configured to a value ≥ zero by means of a corresponding offset. • The FBPS is moved so that a position value ≥ zero is calculated.
Adding a position offset results in output of position value 0 (zero) (see chapter 13.3 "Safety parameters").	The error state must be rectified by correcting the position offset.

Signaling of position value 0 (zero)

In the event of position value 0 (zero), the FBPS switches to the "external error" error state, see chapter 12.6 "External errors".

12.9 Negative SSI position values

Negative position values are blocked for output on both SSI channels.

Causes and measures in the event of negative position values

Tab. 12.11: Causes and measures in the event of negative position values

Cause	Measure
The FBPS is located outside the middle of the bar code label with the value 000000 in such a way that a negative position value occurs.	The output value is configured to a value ≥ zero by means of a corresponding offset, see chapter 13.3 "Safety parameters".
Adding a position offset results in output of a negative position value.	The error state must be rectified by correcting the position offset, see chapter 13.3 "Safety parameters".

Signaling negative position values

In the event of a negative position value, the FBPS switches to the "external error" error state, see chapter 12.6 "External errors".

12.10 Multiple clocking out of the same position value

The output time of the position values on the FBPS is 1 ms for both SSI channels. The provision of new position values occurs synchronously on both channels.

The clock frequency of the SSI master in combination with short clock breaks and excessively short monoflop times (see chapter 13.6 "Monoflop time") between the individual clock bursts results in the same position value being clocked out multiple times until the next update (intervals of 1 ms).

	NOTICE
	During the plausibility check of two successive position values in the safety control, several identical position values may thus be clocked out in succession.

12.11 Cross-circuit in the wiring between the two SSI channels

Cross-circuit between the data lines

A cross-circuit between the data lines of the two SSI channels may, under certain circumstances, result in the safety control (SSI master) receiving the same bit pattern on both channels.

Due to the encoding of the position values in binary and Gray, different position values are received in the safety control. During the plausibility check, this is detected as an error, see chapter 13.7.1 "SSI protocol with CRC checksum (FBPS 617i)" or see chapter 13.7.2 "SSI protocol without CRC checksum (FBPS 607i)".

	NOTICE
	The unit that performs the evaluation or the safety concept of the system decides whether to shut down the system in the event of a cross-circuit and whether to restart it again.

Cross-circuit between the clock lines

A cross-circuit between the clock lines of the two SSI channels can result in the loss of a cycle.

12.12 Error bit in the SSI protocol

The error bit is set upon detection of an external error, see chapter 12.6 "External errors".

The FBPS remains functional.

The error bit is set simultaneously on both channels.

On error bit = 1 (set), the position value of the Gray coding is set to 0.

The binary error bit is appended to the Gray-coded 0 value, see chapter 13.7 "SSI protocol variants".

On error bit = 1 (set), the position value of the binary coding of all position data bits is set to 1.

The error bit is appended to the position value, see chapter 13.7 "SSI protocol variants".

	NOTICE
	As soon as the external error is no longer present, the FBPS automatically restarts; the error bit is reset to the value 0 (zero). Whether or not the system can be restarted following an external error is determined by the unit that performs the evaluation or by the safety concept of the system.

12.13 Behavior of the FBPS in operation with the webConfig tool

A web-based user interface can be activated on the FBPS via the USB connection.

The webConfig tool is activated by entering the IP address (see chapter 19.5.4 "Controls and indicators") in an Internet browser (Edge, Firefox or Chrome).

In the webConfig tool, both the *process* and *service* operating modes are available.

The operating modes affect the behavior of both SSI channels.

Process operating mode

The *process* operating mode is active by default and is set after the FBPS starts up.

The operating mode has no additional effects on the SSI interface.

The descriptions from the chapter on operating states (see chapter 12 "Operating states") and on how they are signaled (see chapter 16.3 "Diagnosis via the LED indicators") apply.

Service operating mode

The *service* operating mode has the following effects:

The FBPS signals an external error. No valid position value is output at the SSI process interfaces.

Tab. 12.12: Signaling

Component	Signal/activity
PWR status LED	Flashes red
SSI1 status LED	Flashes orange
SSI2 status LED	Flashes orange
Laser diode	Is deactivated
X1 SSI1 (channel A)	If the channel is Gray coded (standard), all position data bits are set to 0, the error bit is 1. If the channel is binary coded, all position data bits are set to 1, the error bit is 1.
X2 SSI2 (channel B)	If the channel is binary coded (standard), all position data bits are set to 1, the error bit is 1. If the channel is Gray coded, all position data bits are set to 0, the error bit is 1.

NOTICE

When switching from the *process* operating mode to the *service* operating mode, the FBPS signals an external error. No position values are output. Both SSI interfaces are switched to the data bit values described above. The safety concept of the system and the safety control evaluate the resulting measures.

Typically, the affected axis, parts of the system or even the entire system is brought to a standstill.

NOTICE

In service mode, it is possible to change the safety-relevant parameters of the FBPS.

Changed safety parameters are read back from the FBPS via a defined safety dialog box by means of the webConfig tool.

Changed parameters must be compared with the safety concept of the system, validated and confirmed, all by a competent person, see chapter 2.3 "Competent persons".

NOTICE

When switching from the *service* operating mode to the *process* operating mode in the webConfig tool, the FBPS automatically restarts. Whether or not the system can be restarted after activating the *process* operating mode is determined by the competent person or by the safety concept of the system.

13 SSI interface description

The Synchronous Serial Interface (SSI) is an interface for absolute value encoders (position measuring systems). It is used to receive absolute information about the position via serial data transmission.

Data communication of the SSI interface is based on differential transmission as is used for RS 422 interfaces.

The SSI requires one pair of wires for the clock and a second pair of wires for the data.

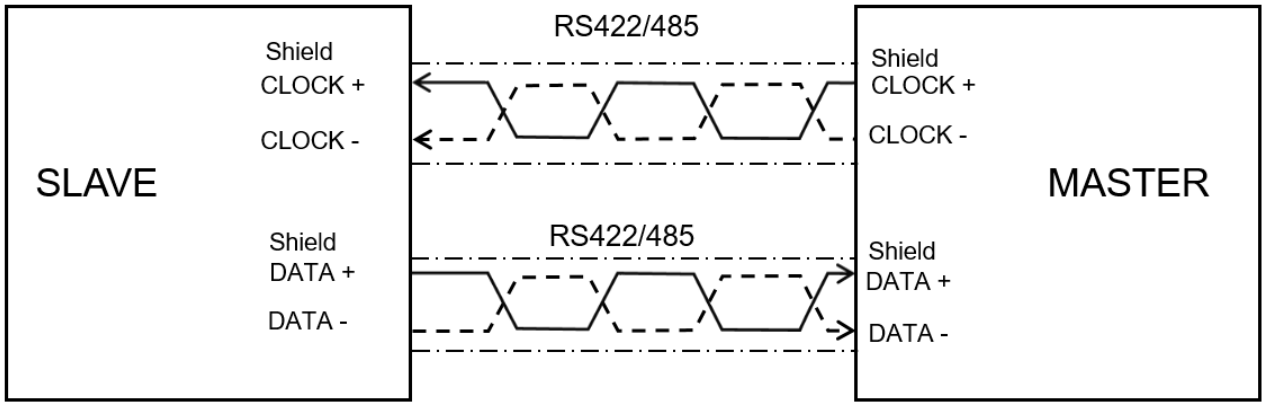


Fig. 13.1: Data transmission via RS 422

In the sensor (slave), a shift register is permanently loaded with the current position data.

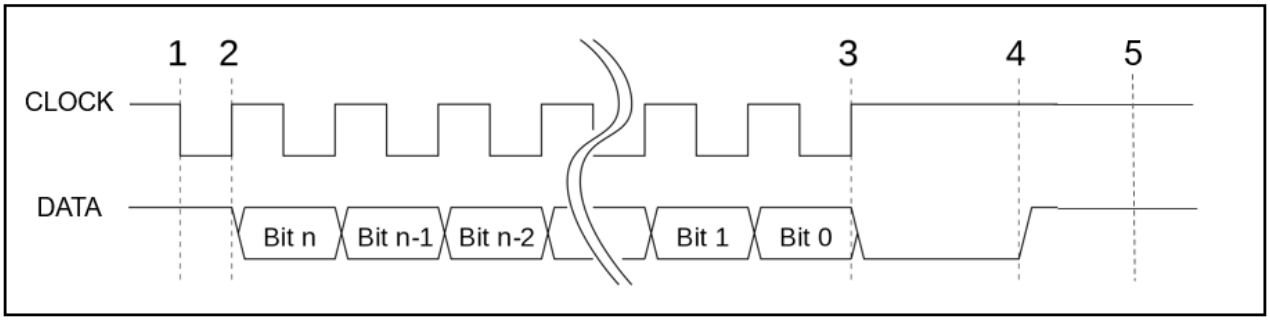
If a data value is to be transmitted by the sensor, the control (master) outputs a clock burst on the clock line.

The first falling edge of the clock burst stores the position value in the shift register of the sensor for the duration of the transmission. On every successive rising edge, a data bit is output.

The cycle is stopped when the least significant bit is received.

In the subsequent monoflop time, the shift register of the sensor loads a new data value.

At the end of the monoflop time, the new position value can be transmitted to the master by sending another clock burst.



1 Position value is stored in the shift register of the sensor.
2 Output of the first data bit
3 All data bits are transmitted, the monoflop time starts.
4 The monoflop bit returns its base state, a new transmission (clock burst) can be started.
5 Clock break = idle state

Fig. 13.2: Data transmission

Clock frequency as a function of cable length

The data rate of the SSI interface depends on the cable length. The permissible data rate for each cable length must not be exceeded.

Data rate	80 kbit/s	100 kbit/s	200 kbit/s	300 kbit/s	400 kbit/s	500 kbit/s	1000 kbit/s
Max. cable length (typical)	500 m	400 m	200 m	100 m	50 m	25 m	10 m

NOTICE
The maximum data rate (clock frequency) of the FBPS is 800 kHz.

Response time (integration time) of the FBPS

The standard response time (integration time) of the position values of the FBPS is 8 ms and can be configured in the range from 2 ms to 8 ms.

13.1 SSI channels

The FBPS makes an identical, safe position value available simultaneously on a first channel X1 SSI1 (channel A) and on a second channel X2 SSI2 (channel B), see chapter 7.3.1 "Device connection".

NOTICE
Both channels can be operated independently of one another with different, non-synchronized clock frequencies.

NOTICE
With an updating time of 1 ms, the FBPS simultaneously makes identical and safe position values available on both SSI channels for clocking out. If both channels are operated with asynchronous or different clock frequencies, the position values differ from one another. How much the two channels differ from one another is dependent on the asynchronicity of the two clock frequencies, the pause between the clocking out operations and on the travel speed. If the clocking out occurs asynchronously, this must be taken into account during the plausibility check in the safety control. In this case, it is not possible to check for equality of the position values of both channels. If a specific tolerance of the two position values with respect to one another is required during the plausibility check, this must be in consensus with the required performance level and must correspond to the required safety function.

13.2 Internal wiring of the SSI interfaces

The internal wiring of the two SSI interfaces is of significance for the following signaling types:

Signaling of an internal error

The SSI drivers are deactivated. The data and clock cables are connected via the pull-up/pull-down resistor network, see chapter 12.7 "Internal error".

Signaling during the FBPS boot time

The SSI drivers are deactivated. The data and clock cables are connected via the pull-up/pull-down resistor network, see chapter 12.2 "Signaling during startup".

Signaling of overvoltage

The internal supply voltage is switched off. The state corresponds to the interruption of the SSI cable, see chapter 12.5 "Signaling in the event of overvoltage and undervoltage".

Connection X1 SSI1 channel A and X2 SSI2 channel B

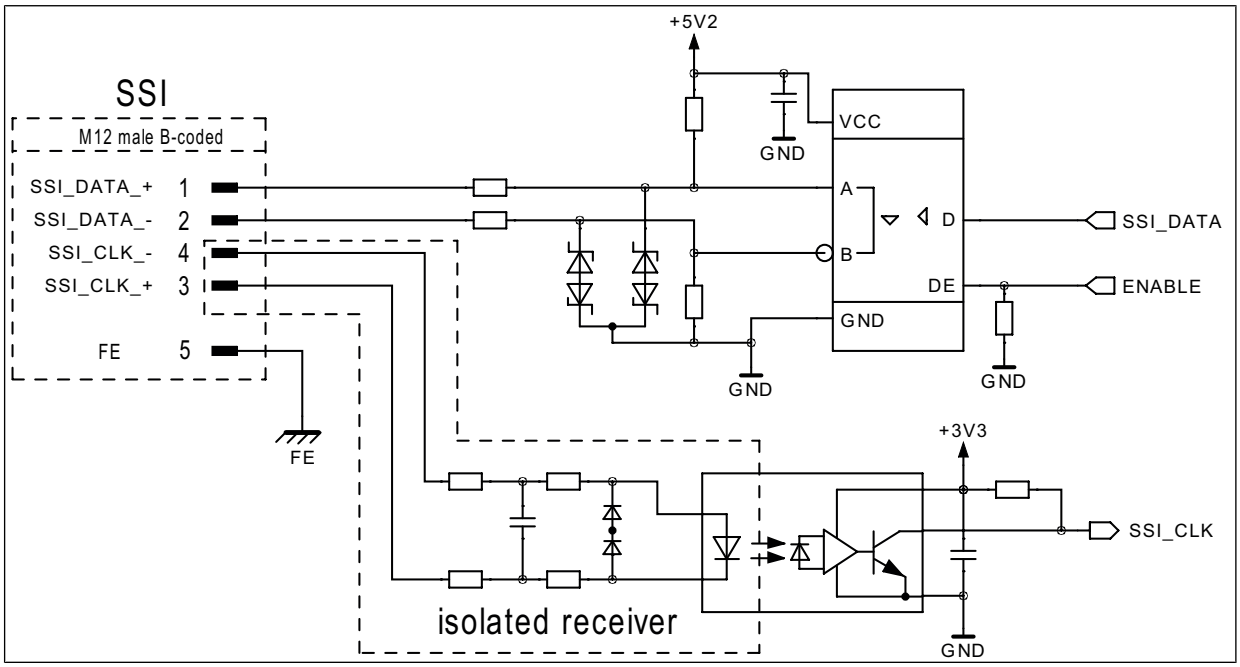


Fig. 13.3: SSI connection channel A and channel B

13.3 Safety parameters

The parameters of the FBPS can be adapted in a defined range (see the *Value range* column in the table). These parameters can be accessed using a web-based user interface that is integrated in the FBPS, see chapter 15.11 "Configuring the FBPS".

Various user rolls for operating the web interface protect the FBPS from unauthorized access, see chapter 15.10.1 "The role concept in the webConfig tool".

The safety parameters of the SSI interface listed in the following table can be changed via a defined safety dialog in the web interface of the FBPS, see chapter 15.13.3 "Parameters of the safety dialog box".

The *Value range* column describes the adjustment range for the safety parameters.

The *Standard* column describes the default settings (factory settings) of the FBPS.

Data types

- U8: (Unsigned) positive whole numbers
- S32: (Signed) positive/negative whole numbers
- Enum: Variable with a defined, finite value set

Tab. 13.1: General parameters

General parameters, valid for both channels				
Name	**Description**	**Data type**	**Value range**	**Standard**
Integration depth	Number of successive measurements that the FBPS uses for position determination.	U8	2 … **8**	8
Counting direction	Counting direction for position calculation	Enum	**0: positive** 1: negative	0
Offset	Adds a position offset to the measurement value: Output value = measurement value + offset	S32	-10.000.000 mm to +10.000.000 mm	0
SSI measurement value encoding	Data encoding of the position values within the SSI data for channel A/channel B. Value 1: X1 SSI1 (channel A) = Gray Value 1: X2 SSI2 (channel B) = binary Value 2: X1 SSI1 (channel A) = binary Value 2: X2 SSI2 (channel B) = Gray	Enum	**1: Gray/Bin** 2: Bin/Gray	1
Error reaction time	Adjustable	Enum	**1: 10 ms** 2: 20 ms 5: 50 ms 10: 100 ms 20: 200 ms 40: 400 ms	1
MVS switching tolerance	Measurement value switching - no tolerance - max. 15 mm tolerance	Enum	0: no tolerance **1: up to 15 mm tolerance**	1

Tab. 13.2: SSI parameters channel A

Parameter X1 SSI1 channel A				
Name	**Description**	**Data type**	**Value range**	**Standard**
Position resolution	Resolution of the position value	Enum	2: 0.01 mm **3: 0.1 mm** 4: 1 mm	3
Number of bits, SSI position value	Number of SSI data bits in the SSI protocol	Enum	**3: 24 bits** 4: 25 bits 5: 26 bits **6: 27 bits**	3 (FBPS 607i) 6 (FBPS 617i)
SSI master clock	The choice of the master clock changes the SSI monoflop time in the FBPS, see chapter 13.6 "Monoflop time".	Enum	0: 50 … 79 kHz **1: 80 … 800 kHz**	1
SSI error bit	Error bit after the LSB of the position value	Bool	FALSE (output without error bit) **TRUE (output with error bit)**	TRUE

Tab. 13.3: SSI parameters channel B

Parameter X2 SSI2 channel B				
Name	**Description**	**Data type**	**Value range**	**Standard**
Position resolution	Resolution of the position value	Enum	2: 0.01 mm **3: 0.1 mm** 4: 1 mm	3
Number of bits, SSI position value	Number of SSI data bits in the SSI protocol	Enum	**3: 24 bits** 4: 25 bits 5: 26 bits **6: 27 bits**	3 (FBPS 607i) 6 (FBPS 617i)
SSI master clock	The choice of the master clock changes the SSI monoflop time in the FBPS, see chapter 13.6 "Monoflop time".	Enum	0: 50 … 79 kHz **1: 80 … 800 kHz**	1
SSI error bit	Error bit after the LSB of the position value	Bool	FALSE (output without error bit) **TRUE (output with error bit)**	TRUE

13.4 Maximum position value which can be represented

The maximum displayable position value is limited by the number of data bits in relation to the resolution. An incorrectly selected position range of the BCB can lead to an overflow of the position value in relation to the configured resolution.

Example:

- Number of data bits: 24
- Resolution: 0.1 mm

If a position range of the bar code tape greater than 1677 m is used, an overflow of the SSI position value will occur.

Tab. 13.4: Maximum position value which can be represented

SSI configuration	Maximum position value which can be represented	Possible position overflow
24 bits; resolution 0.01 mm	167 m	X
24 bits; resolution 0.1 mm	1677 m	X
24 bits; resolution 1 mm	16777 m → BCB is limited to 10000 m	
25 bits; resolution 0.01 mm	335 m	X
25 bits; resolution 0.1 mm	3355 m	X
25 bits; resolution 1 mm	33554 m → BCB is limited to 10000 m	
26 bits; resolution 0.01 mm	671 m	X
26 bits; resolution 0.1 mm	6710 m	X
26 bits; resolution 1 mm	67108 m → BCB is limited to 10000 m	
27 bits; resolution 0.01 mm	1342 m	X
27 bits; resolution 0.1 mm	13421 m → BCB is limited to 10000 m	
27 bits; resolution 1 mm	134217 m → BCB is limited to 10000 m	

Reaction of the FBPS to position value overflow

A position value overflow is handled according to the criteria of an external error, see chapter 12.6 "External errors".

13.5 Acyclic clocking out of the position values

If the position values of both channels are read out acyclically with a time difference of, e.g., 2.5 ms, this leads to a calculated position difference of 25 mm at a travel speed of 10 m/s.

With a configured measurement value resolution of 0.1 mm, this results in a position difference of 250/10 mm.

	NOTICE
	Also to be taken into account with acyclic clocking is that a small measurement value noise of the FBPS must also be added. - With a difference of 25 mm, this can thus lead to a disparity of the data bits on the last 5 bits. - With 250/10 mm, the disparity of the data bits can occur on the last 9 bits. With acyclic clocking out of the position values, it is not possible to perform a bit-wise comparison in the evaluation unit.

13.6 Monoflop time

Clock frequencies 80 – 800 kHz (standard)

If the defined monoflop time of ≤ 20 µs is not met and the subsequent clock burst is started before the 20 µs has elapsed, the same position value is clocked out again.

Clock frequencies: 50 – 79 kHz

If the defined monoflop time of ≤ 30 µs is not met and the subsequent clock burst is started before the 30 µs has elapsed, the same position value is clocked out again.

13.7 SSI protocol variants

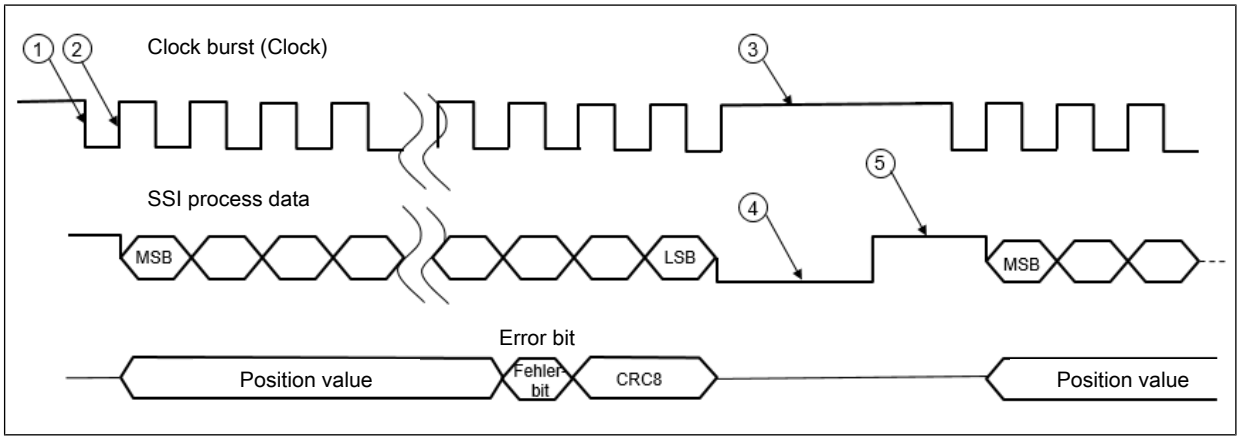
The FBPS is available in two SSI protocol variants. These differ with respect to the structure of the SSI protocol.

- SSI protocol **with** CRC checksum: FBPS 6**1**7i
- SSI protocol **without** CRC checksum: FBPS 6**0**7i

In the following specification of the SSI interface, a distinction is made between the two variants.

13.7.1 SSI protocol with CRC checksum (FBPS 617i)

Data stream of the SSI protocol with CRC checksum



1 The first falling edge of the clock burst stores the position value for the duration of the transmission in the shift register of the sensor.

2 On every successive rising clock edge, a data bit of the sensor is output, starting with the MSB of the position value.

3 If the CRC checksum is received, the control/master ends the clocking out operation.

4 At the end of the monoflop time, the shift register of the sensor loads a new data value.
The monoflop time is dependent on the set clock frequency.

5 At the end of the monoflop, the data line switches to the high level. Transmission begins again with the first falling edge of the clock burst.

Fig. 13.4: SSI protocol with CRC checksum

Calculation of the CRC checksum

An 8-bit CRC checksum is calculated over all user data in the SSI telegram and any necessary virtual filling bits and appended to the SSI telegram.

The following boundary conditions apply for the CRC algorithm:

- CRC-8 polynomial: x8 + x5 + x4 + 1 (0x31hex)
- CRC starting value: 0x00
- XOR result: 0x00 (not active)
- Input data: mirrored/reflected
- Output data: mirrored/reflected
- Secure data: SSI user data (position + error bit)

Virtual filling bits

The CRC calculation is always performed using a number of bits that is divisible by eight (24 or 32). This means that, depending on the selected number of data bits for the position value (24 to 27), the appropriate number of filling bits is calculated.

The filling bits always have the value 0.

Example of a CRC-8 calculation for X1 SSI1 channel A (position value is Gray coded)

27-bit Gray coded position (standard resolution 0.1 mm)

+ 1 error bit

+ 4 virtual filling bits

+ 8-bit CRC

Raw position (27-bit Gray coded)

001 1010 1100 0011 1001 0011 1110 bin

MSB LSB

28064062dec Gray coded corresponds to 20435412dec binary coded.

Raw position with appended error bit (standard)

0011 0101 1000 0111 0010 0111 1100 bin (27-bit position + 1 error bit)

MSB LSB The LSB is the error bit. It remains binary coded.

Fill up to 32 bits for CRC-8 calculation

(The error bit is part of the CRC-8 calculation.)*

00110101100001110010011111000000 bin (32 bits for CRC calculation)

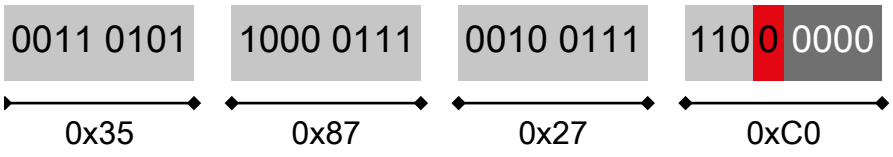
Position value Gray LSB Error bit Fill bit

* If the position value is transmitted without error bit and/or if the number of bits of the position value is changed via the configuration, the number of filling bits for the CRC-8 calculation must be increased to 24 or 32 bits.

In the FBPS, the number of virtual filling bits is calculated automatically. In the safe evaluation unit, the CRC-8 calculation may need to be modified manually.

The filling bits always have the value 0.

CRC-8 calculation



The CRC algorithm contains the data field {0x35, 0x87, 0x27, 0xC0}.

The CRC-8 result is: **1011 0100** bin (0xB4)

SSI output bitstream including CRC-8 for channel A (position value Gray coded)*

* only the position value is transmitted Gray coded. Error bit and CRC-8 remain in the binary representation.

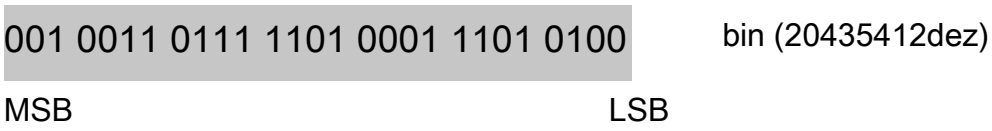
Example of a CRC-8 calculation for X2 SSI2 channel B (position value is binary coded)

27-bit binary coded position (standard resolution 0.1 mm)

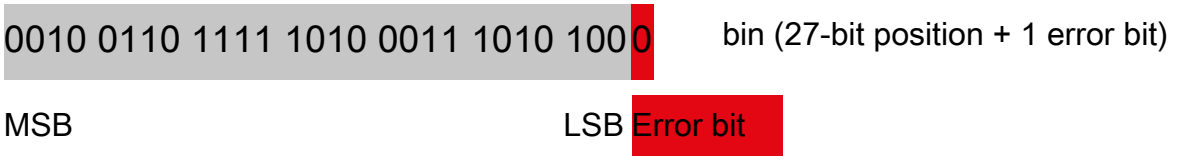
+ 1 error bit

+ 8-bit CRC

Raw position (27-bit binary coded)

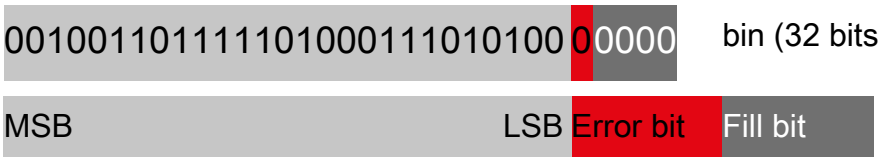


Raw position with appended error bit (standard)



Fill up to 32 bits for CRC-8 calculation

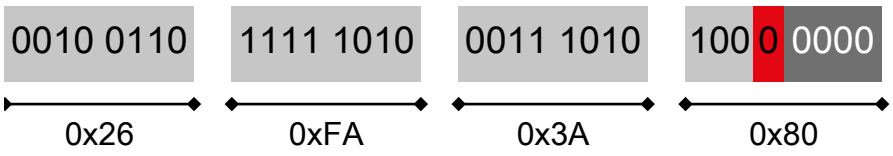
(The error bit is part of the CRC-8 calculation.)*



* If the position value is transmitted without error bit and/or if the number of bits of the position value is changed via the configuration, the number of filling bits for the CRC-8 calculation must be increased to 24 or 32 bits.

The filling bits always have the value 0.

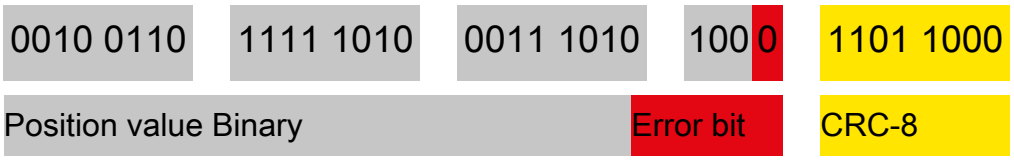
CRC-8 calculation



The CRC algorithm contains the data field {0x26, 0xFA, 0x3A, 0x80}.

The CRC-8 result is: **1101 1000** bin (0xD8)

SSI output bitstream including CRC8 for channel B (position value binary coded)

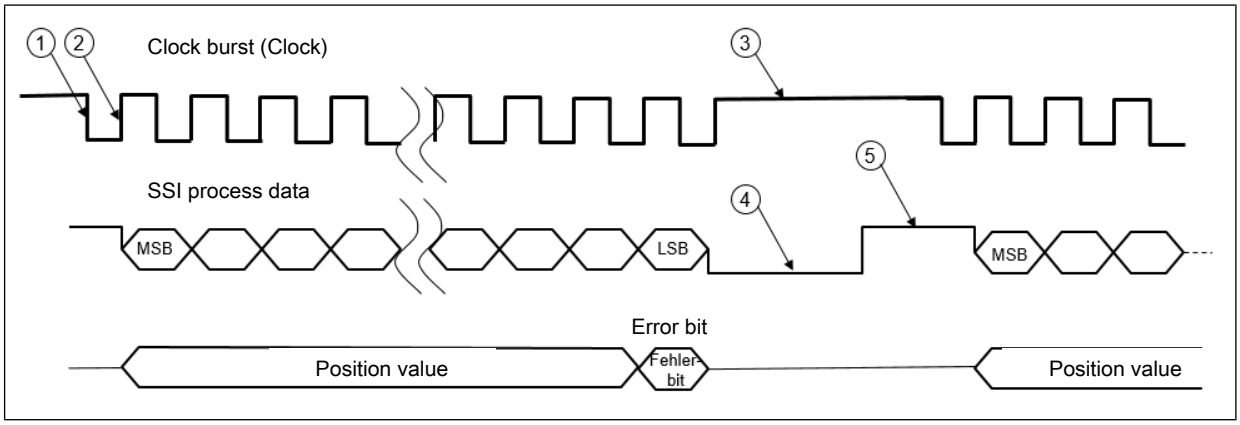


Data integrity measures for the FBPS 617i

	NOTICE
	Required as data integrity measures of the bus communication system in the safety-related control/master are, among other things, plausibility checks of the two channels with respect to one another.

13.7.2 SSI protocol without CRC checksum (FBPS 607i)

Data stream of the SSI protocol without CRC checksum



1 The first falling edge of the clock burst stores the position value for the duration of the transmission in the shift register of the sensor.

2 On every successive rising clock edge, a data bit of the sensor is output, starting with the MSB of the position value.

3 The control/master ends the clocking out when the least significant bit is received. In the default setting, the LSB is the error bit.

4 At the end of the monoflop time, the shift register of the sensor loads a new data value.
The monoflop time is dependent on the set clock frequency.

5 At the end of the monoflop, the data line switches to the high level. Transmission begins again with the first falling edge of the clock burst.

Fig. 13.5: SSI protocol without CRC checksum

Example of a position calculation for X1 SSI1 channel A (position value is Gray coded)

24-bit Gray coded position (standard resolution 0.1 mm)

+ 1 error bit

Raw position (24-bit Gray coded)

0111 0011 0100 1110 0110 0000 bin

MSB LSB

7556704dec Gray coded corresponds to 6130623dec binary coded.

Raw position with appended error bit (standard)

0 1110 0110 1001 1100 1100 0000 bin (24-bit position + 1 error bit)

MSB LSB The LSB is the error bit.

SSI output bit stream for channel X1 SSI1 (position value Gray coded)*

01110011010011100110000000 bin (24-bit position + 1 error bit)

Position value Gray Error bit

* only the position value is transmitted Gray coded. The error bit remains in the binary representation.

Example of a position calculation for X2 SSI2 channel B (position value is binary coded)

24-bit binary coded position (standard resolution 0.1 mm)

+ 1 error bit

Raw position (24-bit binary coded)

0101 1101 1000 1011 1011 1111 bin (6130623dec binary coded)

MSB LSB

Raw position with appended error bit (standard)

0 1011 1011 0001 0111 0111 111 0 bin (24-bit position + 1 error bit)

MSB LSB The LSB is the error bit.

SSI output bit stream for channel X2 SSI2 (position value binary coded)*

0101110110001011101111110 bin (24-bit position + 1 error bit)

Position value Binary Error bit

Data integrity measures for the FBPS 607i

	NOTICE
	Required in the safety-related control/master as data integrity measures of the bus communication system are, among other things, plausibility checks of the two channels with respect to one another as well as the evaluation of at least two successive telegrams per channel.

14 Validating the safety function

The safe positioning system consists of two spatially separated components:

- the bar code tape (BCB)
- the read head for the determination of the safe position (FBPS)

In the system, the two components are combined to form a safe positioning system.

During commissioning, the safe position of the positioning system must be validated in the position ranges in which a safety function is planned by means of the safety concept.

↳ Make sure that the read head (FBPS) and the bar code tape (BCB) are installed in accordance with the specifications described in the manual.

↳ Perform a reference movement.

The determined safe position of the FBPS is dependent on the mounting of the FBPS with respect to the BCB and on the attachment of the BCB.

The determined safe position data of the FBPS is transmitted to the safe control by traveling over the entire traversing path. The FBPS must signal neither external nor internal errors.

Part of the commissioning process is to check the plausibility and to validate these safe distance values with the expected values in the safe control.

If safe speeds or accelerations that are to be monitored are derived from the position data in the safe control, the system planner is responsible for validating the correct, safety-relevant behavior of the system (use of suitable safety functions) and for commissioning.

The reference movement validates the output of safe position values e.g. in the case of:

- Expansion joints
- Switches
- Paths with rising and falling gradients
- Damages and deliberate interruptions of the BCB
- Possible partial electromagnetic coupling with the FBPS

The safety function of the positioning system must be validated and logged by a safety officer.

15 Starting up the device – webConfig tool

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

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

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

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

15.1 System requirements

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

Tab. 15.1: webConfig system requirements

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

Clear browser history

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

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

Note limit of Firefox sessions for version 30.0 and higher

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

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

15.2 Install USB driver

NOTICE

If a USB driver for the webConfig tool is already installed on your computer, the USB driver does not need to be installed again.

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

NOTICE

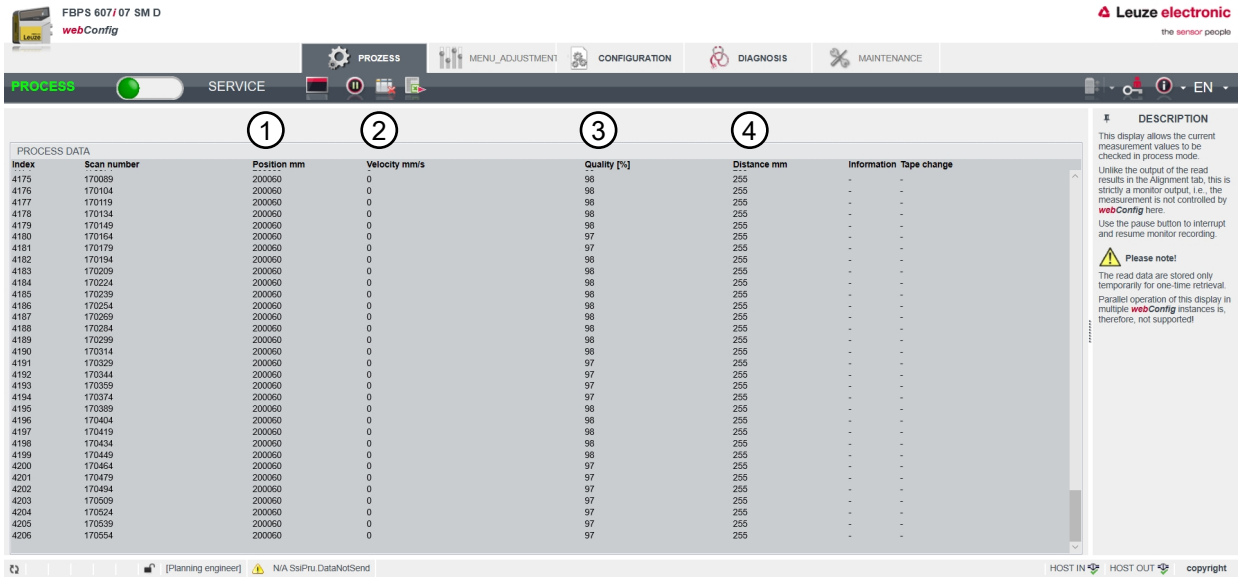
Alternatively, you can manually install the **LEO_RNDIS.inf** USB driver.

Contact your network administrator if the installation fails.

15.3 Start webConfig tool

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

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



1 Current position value
2 Current speed
3 Current reading quality
4 Reading distance to the bar code tape

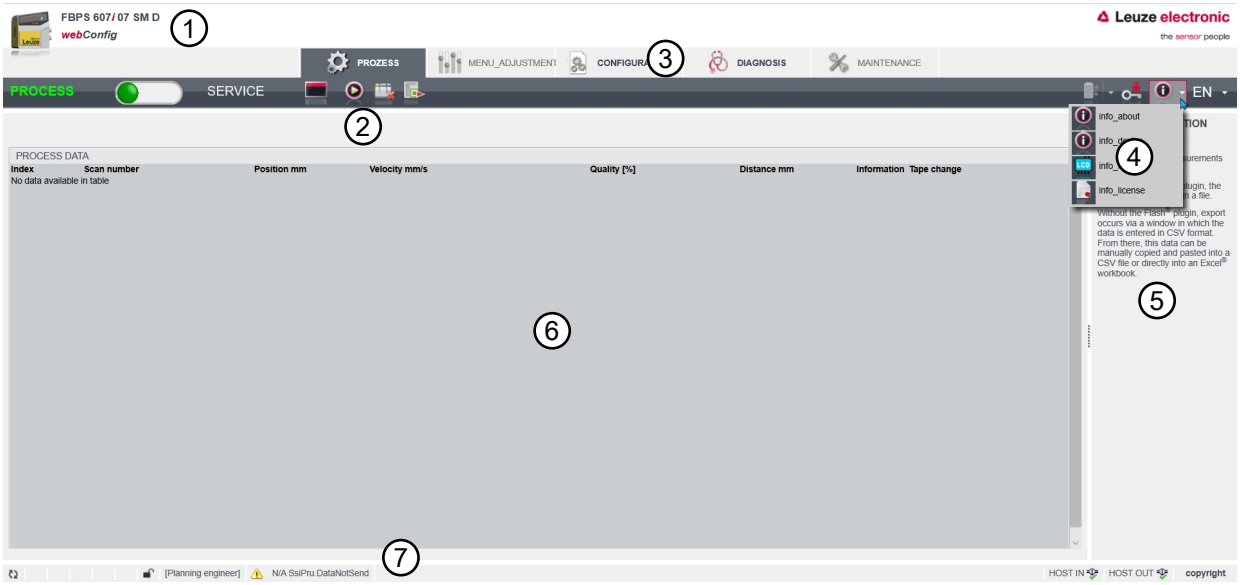
Fig. 15.1: The start page of the webConfig tool

NOTICE

The webConfig tool is started in the *process* operating mode after startup.

If the FBPS reads a 30 mm (BCB G30 …) bar code tape, the position value, the speed, the reading quality and the reading distance, among other things, are displayed on the start page.

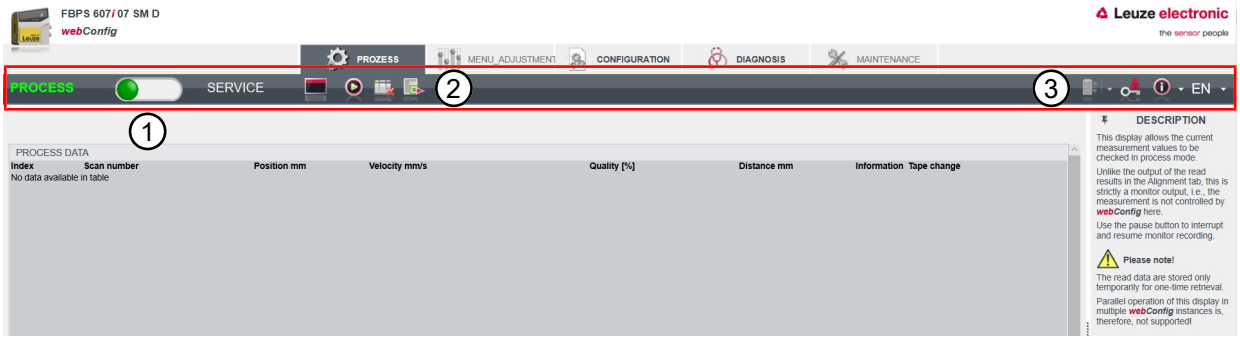
15.4 Overview



1 Product designation
2 Toolbar, see below
3 Navigation bar
4 Info area
5 Multi-purpose and help area
6 Main window work area
7 Status bar

Fig. 15.2: webConfig tool – layout

Toolbar



1 Switching between the *process* and *service* operating modes
2 Main area toolbar; context-sensitive operational controls that vary depending on navigation function
3 4 buttons:
- Connection in service mode
- User login
- General information about the connected FBPS
- Language selection

Fig. 15.3: webConfig tool – toolbar

15.5 Process operating mode

The *process* operating mode is activated after starting up the FBPS and enables read access in the tabs

- Process
- Configuration
- Diagnosis

The tabs

- Alignment
- Maintenance

cannot be activated in the *process* operating mode.

In the *process* operating mode, safe position values are made available via the two SSI channels.

15.6 Service operating mode

The *service* operating mode is activated on request in webConfig and enables write and read access in the tabs

- Process
- Configuration
- Diagnosis
- Alignment
- Maintenance

Both SSI channels are deactivated in *service* operating mode. The FBPS subsequently signals an external error, see chapter 12.6 "External errors".

NOTICE

If parameters of the FBPS were changed in the *Service* operating mode – especially *safety parameters* (see chapter 13.3 "Safety parameters" – the safe position detection in the context of the safety requirements of the system must be qualified again with respect to the safety functions of the overall system.

↳ To do this, move the FBPS along the entire bar code tape.

⇨ Possible operating states and how they are signaled see chapter 12 "Operating states", signaling via the status LEDs: see chapter 16.3 "Diagnosis via the LED indicators".

⇨ The safety function of the overall system is satisfied if the FBPS can be moved along the entire bar code tape without external or internal error signaling.

NOTICE

Do not release the system for operation until the renewed qualification has been completed error-free.

15.7 Menu structure

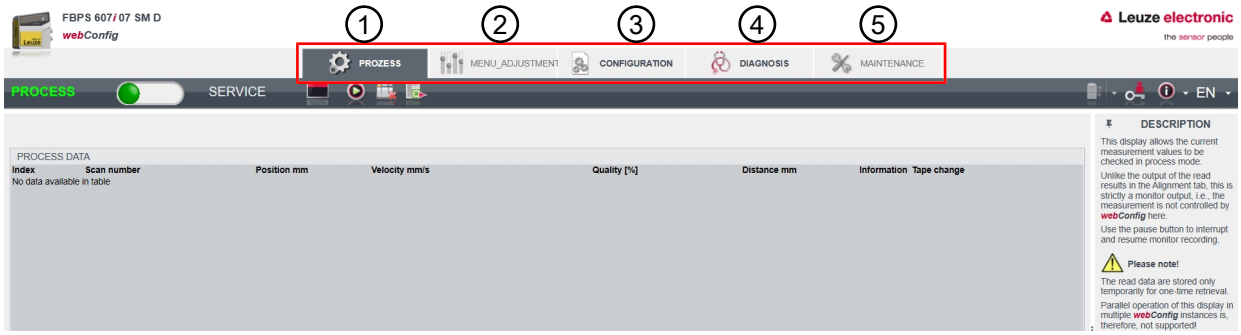


Fig. 15.4: webConfig tool – navigation bar

Tab. 15.2: Menu structure of the webConfig tool

Pos.	Function	Level 1	Level 2	Level 3	Comment
1	Process				Process mode (standard)
2	Alignment	Measurement values			Display of the position values
		Reading quality			Display of the reading quality
3	Configuration	Module overview	Laser		FBPS function modules
			Measurement data		
			Data processing		
			Control		
			Output		
			Switching input		
			Display		
			Switching output		
			Communication		
		Parameter overview	Overview of the changed parameters		Overview of the changed parameters
		Safety	Parameters, general		Safety parameters
			Parameter X1 SSI1		
			Parameter X2 SSI2		
		Output	Preparations		Setting the resolution for the host interface and setting the resolution of the speed and position for the webConfig tool
			Formatting		Configuration of the output data / output interfaces
		Communication	USB		Configuration of USB service interface
		Device	Digital I/Os	Passive	Configuration I/Os
				Output	
				Input	
			Display	Background lighting	Display settings
				Contrast	
4	Diagnosis	Event log			Errors and warnings
		Statistics	Parameter statistics		Parameter statistics

Pos.	Function	Level 1	Level 2	Level 3	Comment
5	Maintenance	User management	Role description	Observer	User management
				Operator	
				Maintenance	
				Planning engineer	
		Backup/Restore		Backup	Creation of system backup
				Restore	
		Firmware update		Reload options	
		System clock		System clock	Time settings / synchronization
				Output format	
		Settings		Change of operating mode	Confirmation message upon changing the operating mode

15.8 Status bar

1 Status of the communication between sensor and PC
2 Change marker
3 File upload/download marker
4 Status of the session availability

no active session present. Active session is in use by a different interface.

active session is available.

5 <username> and [user role] currently in use
6 Last current system message (info / warning / error), highlighted in color
7 HOST IN connection status
8 HOST OUT connection status

Fig. 15.5: webConfig tool – status bar

NOTICE

When the mouse is moved over an operational control, a function note about the given button appears.

15.9 Diagnostics function

The *Diagnostics* function can be activated in the navigation bar in the *process* and *service* operating modes.

In the *process* operating mode, only read access is possible; in the *service* operating mode it is possible to acknowledge or delete displayed messages or to save them in a report file.

NOTICE

The event log lists the last 25 events.

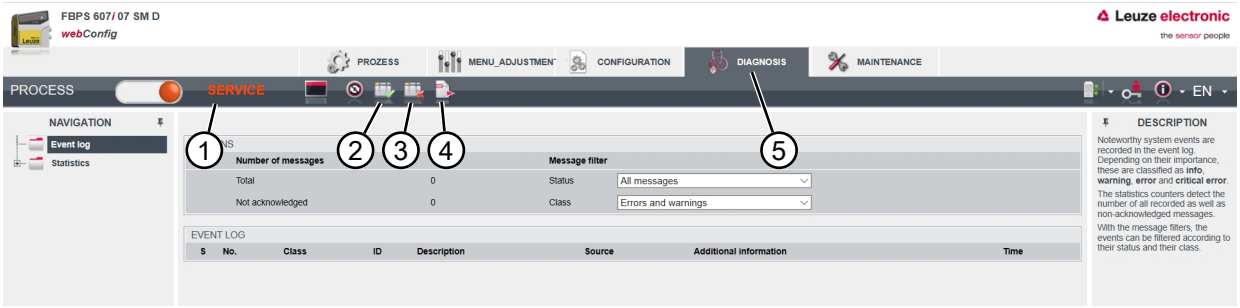
The evaluation of the displayed messages is reserved for Leuze Service.

Events that are relevant to the safety evaluation of the device are signaled directly via the two SSI process interfaces (see chapter 13 "SSI interface description") and via the LED status indicators (see chapter 16.3 "Diagnosis via the LED indicators").

Not every listed event has a detrimental effect on the safety of the FBPS.

As a single event can result in a wide range of follow-up messages, the number of displayed messages is not a criterion for assessing the quality or the safety of the FBPS.

If necessary, the displayed messages can be deleted and the recording restarted.



1 *Service* operating mode
2 Acknowledge all messages
3 Delete all messages
4 Save the event log in a report file
5 Navigation bar – *Diagnostics* tab

Fig. 15.6: webConfig tool – *Diagnostics* function

	NOTICE
	When the mouse is moved over an operational control, a function note about the given button appears.

15.10 User roles

15.10.1 The role concept in the webConfig tool

The web-based graphical terminal program of the FBPS offers the possibility of defining user roles for operating or configuring the FBPS.

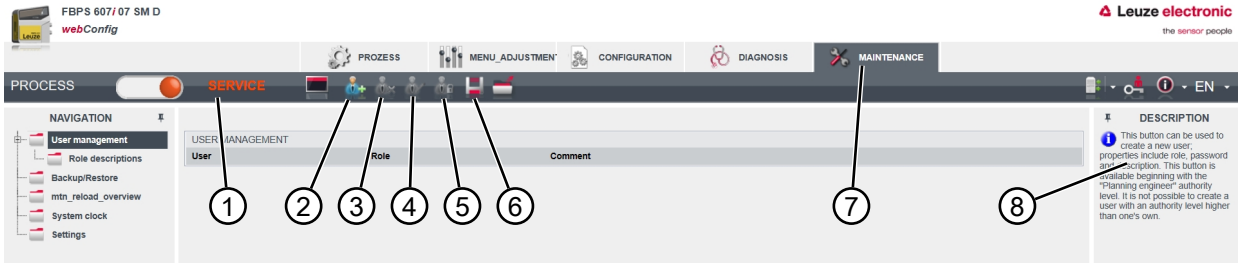
The user roles are set up in the webConfig tool in the *service* operating mode under the *Maintenance* function.

The user roles are structured in such a way that a logical operating sequence corresponding to the users results. The user roles are based on the tasks that are to be performed and the associated roles.

In the factory settings, the *Planning Engineer* role is activated. This role has extensive capabilities for accessing the FBPS. These include the configuration of safety parameters of the FBPS.

	NOTICE
	System changes or errors caused by unauthorized or unintentional access To protect the FBPS from unauthorized or unintentional access, we recommend changing from the standard role of *Planning Engineer* to the *Observer* role after commissioning. An *Observer* is not authorized to switch the FBPS from the *process* operating mode to the *service* operating mode. This prevent an unintentional switch to the *service* operating mode and, thus, the signaling of an external error, see chapter 12.6 "External errors".

15.10.2 User management in the webConfig tool



1 *Service* operating mode
2 Create new user
3 Delete user
4 Change user data
5 Set default role
6 Save user data
7 *Maintenance* function
8 Description of the elements of the toolbar

Fig. 15.7: webConfig tool – user management

NOTICE

When the mouse is moved over an operational control, a function note about the given button appears.

Create new user

A new user is created in the toolbar under item [2]. The following input mask is displayed for this purpose.

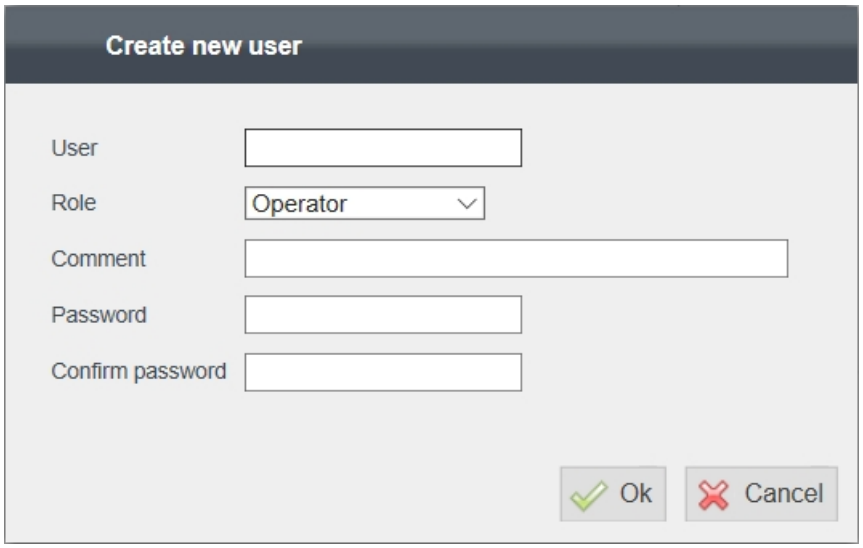


Fig. 15.8: *Create new user* dialog box

NOTICE

If the password is lost, please contact our service department, see chapter 18 "Service and support".

15.10.3 Overview of user roles

The webConfig operating concept offers the following roles:

- Observer: Display of general information
- Operator: Operate sensor
- Maintenance: Operate and set up sensor
- Planning Engineer: Extended competencies, e.g., project management

The 4 roles give the user access to the webConfig tool of the FBPS.

The permissions of the individual roles are given in ascending order:

The *Observer* role has the lowest access permissions, the *Planning Engineer* role the most extensive access permissions.

In the factory settings, the *Planning Engineer* role is the standard role. It is the role that functions without explicitly created users. It can be changed to any other role as soon as a user with the *Planning Engineer* role has been defined.

15.10.4 The Observer role

The *Observer* role plays a strictly passive role. The *Observer* can only view the general device data that is displayed on the start page. The *Observer* does not need a password to log in as he has no other permissions.

- Permitted tasks:
  - View general/public data:
  - Start page
  - Name plate
  - Hardware and software version numbers
  - Installation description
  - Technical data
- Login

An *Observer* cannot change device parameters.

The possibility of switching the operating mode from *process* to *service* is blocked for the Observer.

15.10.5 The Operator role

The *Operator* role is strictly an operator of the sensor who accompanies/observes production operation (*process* mode). He is also an *observer*. He can read the parameters for production operation but cannot change them.

	NOTICE
	The *Operator* can activate the *process* and *service* operating modes. In *service* mode, the FBPS signals an external error via the two SSI channels, see chapter 12.6 "External errors".

Permitted tasks:

- Permitted tasks of the *Observer* role
- Execution of alignment actions without changing the parameter properties of the device
- Switching the operating mode (*process*, *service*)
- Restart the device (reset)
- View selected device parameters
- View selected production parameters
- Observe the current production progress (current result, production statistics error messages)

- Call up diagnostics functions (read-only/acknowledge):
  - Read event logs
  - Acknowledge event logs
  - Read statistical data
  - Read firmware information

15.10.6 The Maintenance role

The *Maintenance* role is an operator with extended permissions.

Permitted tasks:

- Permitted tasks of the *Operator* role
- Extended switching of the operating state (host-in/host-out switch)
- Execution of teach functions for configuration of the device
- Change selected device parameters
- Change I/O parameters (digital I/O and communication parameters)
- Reset process-related statistical data
- Delete event log

	NOTICE
	The *Maintenance* role can activate the *process* and *service* operating modes. In *service* mode, the FBPS signals an external error via the two SSI channels, see chapter 12.6 "External errors".

15.10.7 The Planning Engineer role

The *Planning Engineer* role (or Specialist/Supervisor) can configure safety parameters of the two SSI channels, change I/O parameters, update firmware and manage users (roles).

Permitted tasks:

- Permitted tasks of the *Maintenance* role
- Reset the device to factory settings
- Manage user data (create, delete or change users)
- Define startup role (Observer, Operator, Maintenance or Planning Engineer)
- Reset selected statistics (customer)
- Update firmware (customer)

15.11 Configuring the FBPS

The parameters of the FBPS can be set via the webConfig tool. To do this, the FBPS must be switched to the *service* operating mode.

	NOTICE
	Upon activation of the *service* operating mode, the FBPS signals an external error. After returning to the *process* operating mode, the FBPS deactivates the external error. Provided the FBPS starts up without errors, position data is made available on both SSI channels. Also observe: Notices see chapter 12.6 "External errors", especially automatic restart see chapter 12.6.3 "Restarting following an external error".

NOTICE

If parameters of the FBPS were changed in the *Service* operating mode – especially *safety parameters* (see chapter 13.3 "Safety parameters" – the safe position detection in the context of the safety requirements of the system must be qualified again with respect to the safety functions of the overall system.

↳ To do this, move the FBPS along the entire bar code tape.

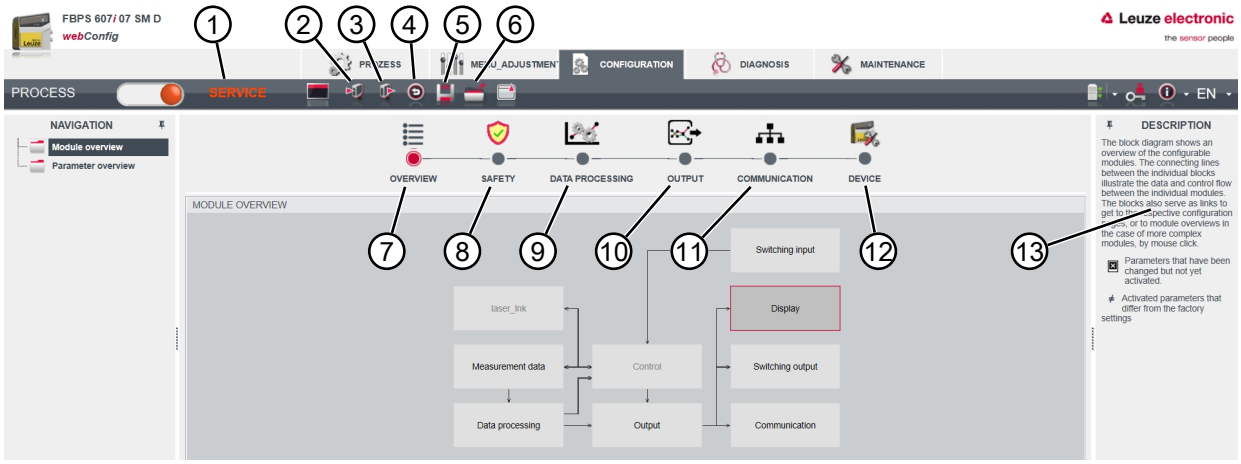
⇨ Possible operating states and how they are signaled see chapter 12 "Operating states", signaling via the status LEDs: see chapter 16.3 "Diagnosis via the LED indicators".

⇨ The safety function of the overall system is satisfied if the FBPS can be moved along the entire bar code tape without external or internal error signaling.

NOTICE

Do not release the system for operation until the renewed qualification has been completed error-free.

15.12 Configuring parameters in the webConfig tool



1	*Service* operating mode
2	Transfer parameters to the FBPS
3	Load parameters from FBPS
4	Set standard parameters
5	Save parameter configuration to a local file
6	Load parameter configuration from a local file
7	Overview of the individual configuration modules
8	Configuration of safety parameters
9	Configuration of safety and non-safety parameters
10	Position and speed output for display in the webConfig tool
11	Network addresses (IP address / net mask / gateway)
12	Device (configuration of the inputs and outputs)
13	Descriptions of points 1 – 12

Fig. 15.9: webConfig tool - Configuration

NOTICE

When the mouse is moved over an operational control, a function note about the given button appears.

15.13 Configuring safety parameters

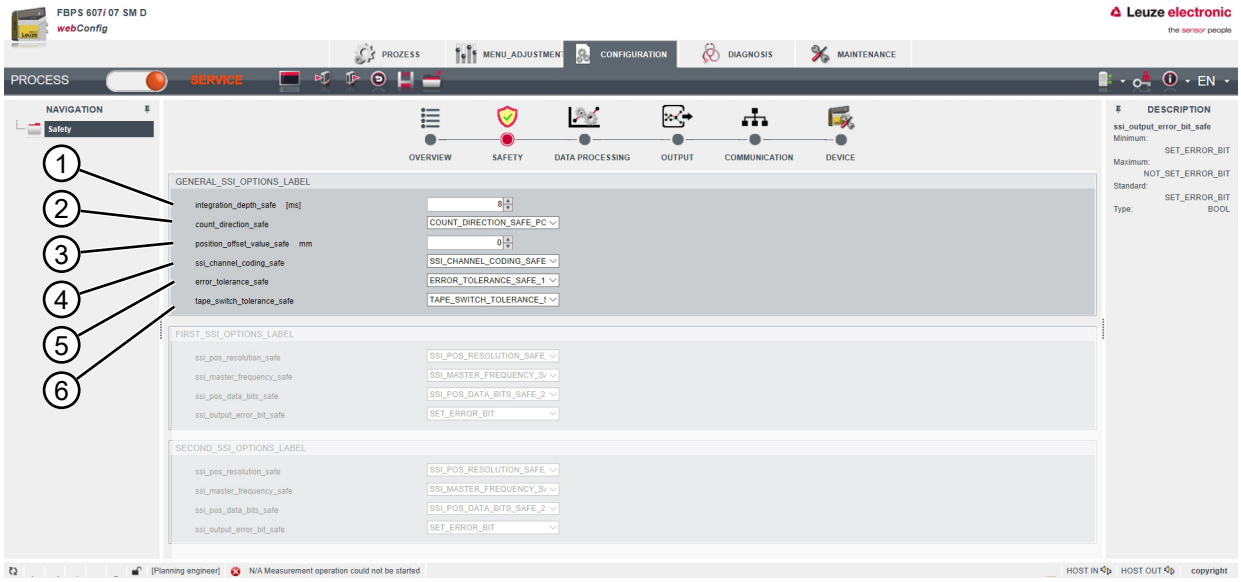
The safety parameters are divided into:

- General safety parameters
- Safety parameters for channel X1 SSI1 and channel X2 SSI2

see chapter 13.3 "Safety parameters"

15.13.1 General safety parameters

The general safety parameters are valid for both SSI channels X1 SSI1 and X2 SSI2.



1	Integration depth
2	Counting direction
3	Offset in mm
4	Data encoding
5	Error reaction time
6	MVS label for measurement range changeover

Fig. 15.10: General safety parameters

Integration depth

Minimum value = 2

Default value = 8

The safe position value of both SSI channels is calculated as a sliding arithmetic mean from the internal integration memory.

The integration memory is organized as a FiFo memory. Every 1 ms, a current position value is written to the internal memory; the oldest value is deleted.

Every 1 ms, the FBPS uses the values in the integration memory to calculate the arithmetic mean and then makes this available at the two SSI channels for clocking out. Output time = 1 ms

The following relationship applies accordingly:

The smaller the number of values in the integration memory, the smaller the offset (dynamic measurement error) of the output position relative to the actual position of the axis.

Due to the low number of values in the memory, the position value increases by a few 1/10 mm due to noise effects.

The information in the manual regarding the reproducible accuracy of a position value is based on the default value of 8.

Counting direction

Positive counting direction:

- Default setting
- The position output follows the position tape values.

Negative counting direction:

- For a negative counting direction, a minus sign precedes the position value determined using the bar code tape.
- The negative counting direction must always be used in combination with a start offset.

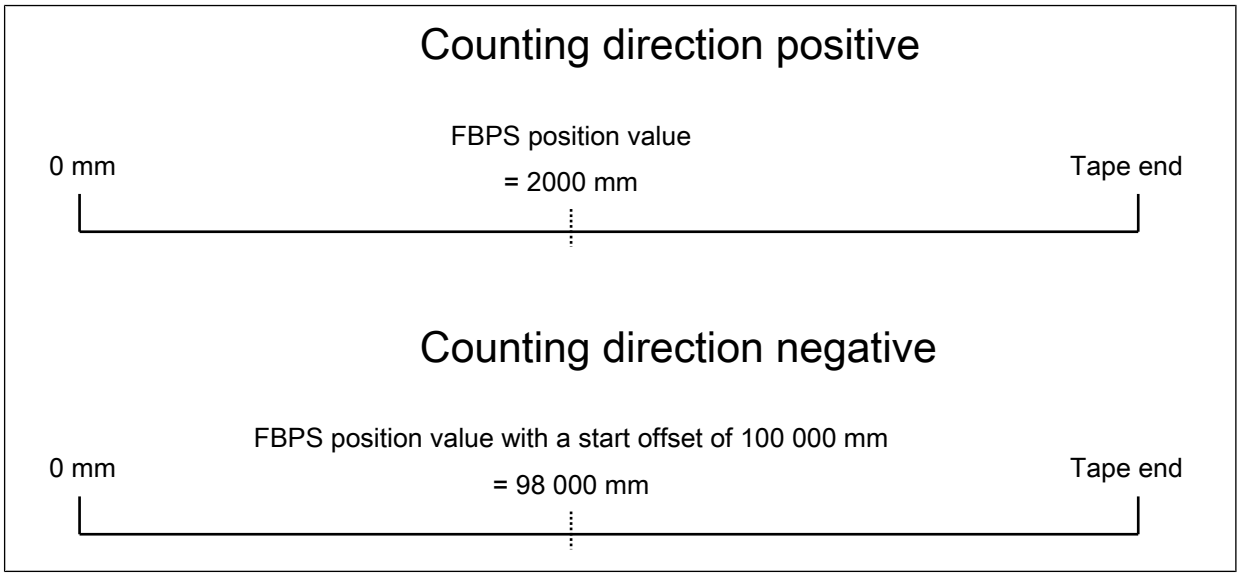


Fig. 15.11: Counting direction

Example of positive counting direction:

The determined safe position value of 2000 mm is transmitted to the two SSI channels.

Example of negative counting direction:

The start offset was configured with 100000 mm.

The determined safe position value of 100000 mm – 2000 mm = 98000 mm is transferred to the two SSI channels.

	NOTICE
	The counting direction must not produce any negative position values or the position value 0 (zero). These position values result in an external error, see chapter 12.6 "External errors".

The position value must be representable by the number of SSI data bits (24 bits – 27 bits) as well as by the selected resolution of the position value (0.01 mm … 1 mm), see chapter 13.4 "Maximum position value which can be represented".

If the position value cannot be represented by the number of data bits and by the selected resolution, this leads to a position value overflow. This results in an external error.

An appropriately configured position offset avoids the output of these values and, thus, of an external error.

Offset

The parameter adds a position offset to the determined position value.

The offset value is entered in millimeters independent of the set resolution of the position output value.

Default setting: 0 mm

Adjustment range: between -10,000,000 mm and + 10,000,000 mm

NOTICE
The offset must not produce any negative output position values or the output position value 0 (zero). These position values result in an external error, see chapter 12.6 "External errors".

Data encoding

A significant part of the safety concept of the FBPS is the provision of the safe position values in different encoding on both SSI channels.

The same safe position values are created in binary encoding for one SSI channel and in Gray coding for the other.

The assignment of the encoding to the SSI channel can be set.

- Default setting = parameter value 1
  X1 SSI1 channel A = Gray
  X2 SSI2 channel B = binary
- Alternative configuration = parameter value 2
  X1 SSI1 channel A = binary
  X2 SSI2 channel B = Gray

Error reaction time

The error reaction time of the FBPS can be adapted to the application.

The following relationship applies: The slower the speed of the moving axis, the longer the error reaction time that can be selected. Under certain circumstances, a longer error reaction time results in a more stable and more error-free operation of the system.

NOTICE
Adjustment of the error reaction time must always be in consensus with the required performance level and must not jeopardize the safety of the system.

NOTICE
External errors The error reaction time effects a switch-on delay on the signaling of external errors, see chapter 12.6 "External errors". If the error ceases to exist within the error reaction time, no error is signaled. Default setting of the error reaction time: 10 ms Alternative configuration: 10; 20; 50; 100; 200 or 400 ms. **Internal error** The signaling of internal errors occurs delay-free, see chapter 12.7 "Internal error".

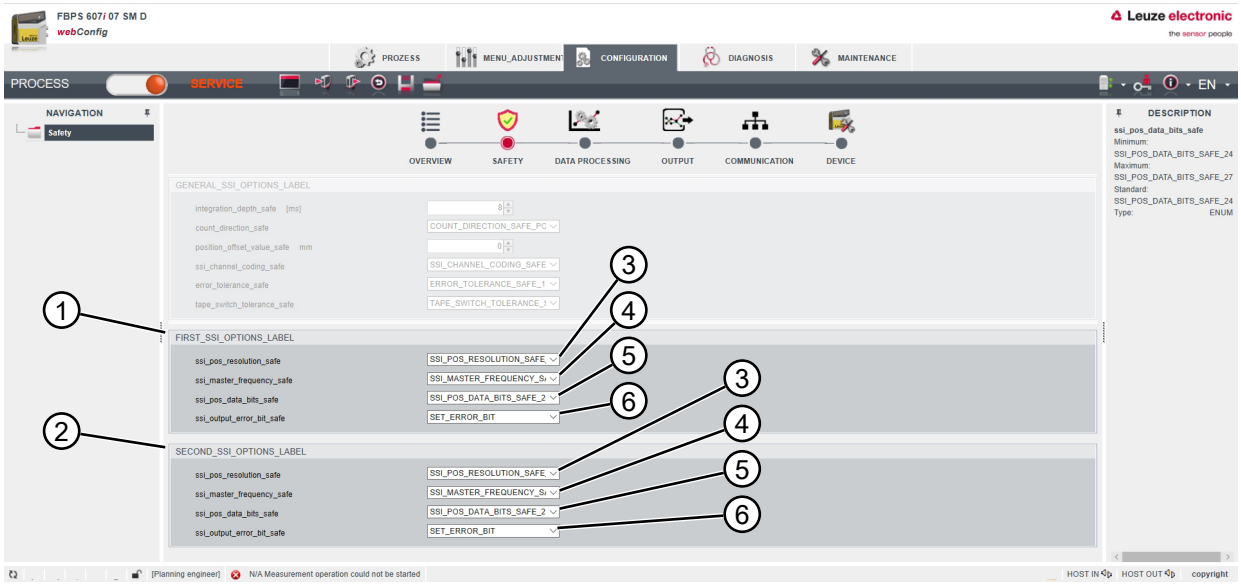
MVS label for measurement range changeover

The measurement range changeover when an MVS label used is described in chapter 8.6, the corresponding configuration is described in chapter 8.6.3, see chapter 9.6 "MVS label control bar code" and see chapter 9.6.3 "Configuring MVS position value changeover".

- Default setting = parameter setting 1
  The measurement range changeover takes place at the left or right edge of the MVS label, depending on the direction of movement.
- Alternative configuration = parameter value 0
  The measurement range changeover occurs in the middle of the MVS label.

15.13.2 Safety parameters for channel X1 SSI1 and channel X2 SSI2

The parameters for SSI1 and SSI2 are identical. The parameter content can, however, be configured separately for each channel. The description of the parameter content is identical for both SSI channels.



1 Parameter X1 SSI1 channel A
2 Parameter X2 SSI2 channel B
3 Resolution of the position value
4 Clock frequency of SSI master
5 Data width of the position value
6 Position value with/without error bit

Fig. 15.12: Safety parameters for SSI channels

Resolution of the position value

Default setting = Parameter value 3: 0.1 mm

- Parameter value 2: 0.01 mm
- Parameter value 3: 0.1 mm
- Parameter value 4: 1 mm

Clock frequency of SSI master

Default setting = Parameter value TRUE: 80 to 800 kHz

Alternative configuration = Parameter value FALSE: 50 to 79 kHz

	NOTICE
	With parameter value TRUE, a monoflop time of ≥ 20 µs is defined. With parameter value FALSE, a monoflop time of ≥ 30 µs is defined.

Data width of the position value

Default setting = Parameter value 3: 24 bit

Alternative configuration:

- Parameter value 4: 25 bit
- Parameter value 5: 26 bit
- Parameter value 6: 27 bit

NOTICE

If the position value cannot be represented with the data width of the configured data bits, this leads to a position value overflow. This results in an external error, see chapter 12.6 "External errors".

Error bit of the position value

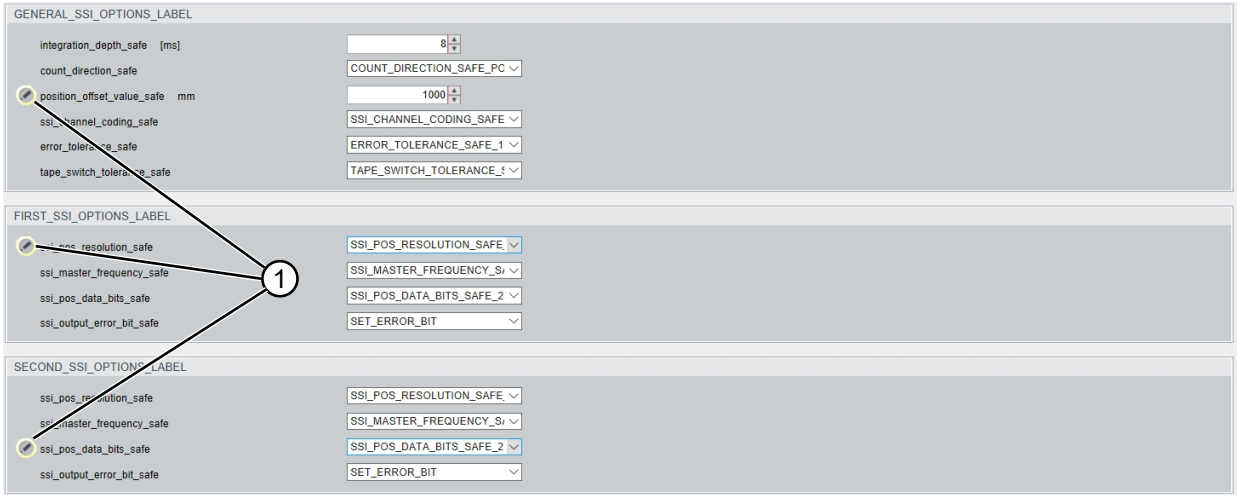
The error bit is set upon detection of an external error, see chapter 12.6 "External errors".

The position of the error bit within the SSI protocol and its representation in Gray-coded or binary-coded transmission of the position values see chapter 13.7 "SSI protocol variants".

Default setting = TRUE: SSI protocol with appended error bit

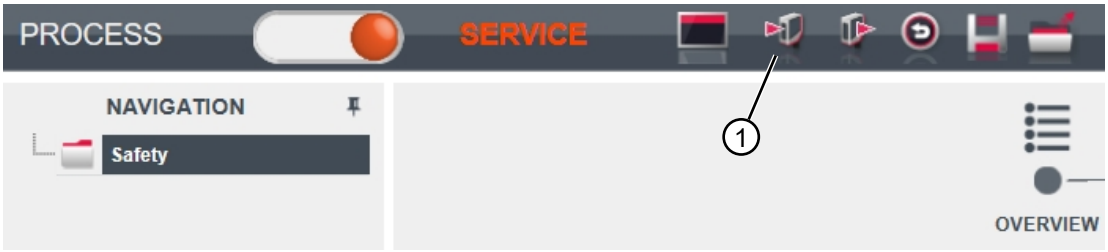
Alternative configuration = FALSE: SSI protocol without error bit

15.13.3 Parameters of the safety dialog box



1 Changed parameters are marked in the webConfig tool.

Fig. 15.13: Changed parameters



1 *Transfer parameters* function

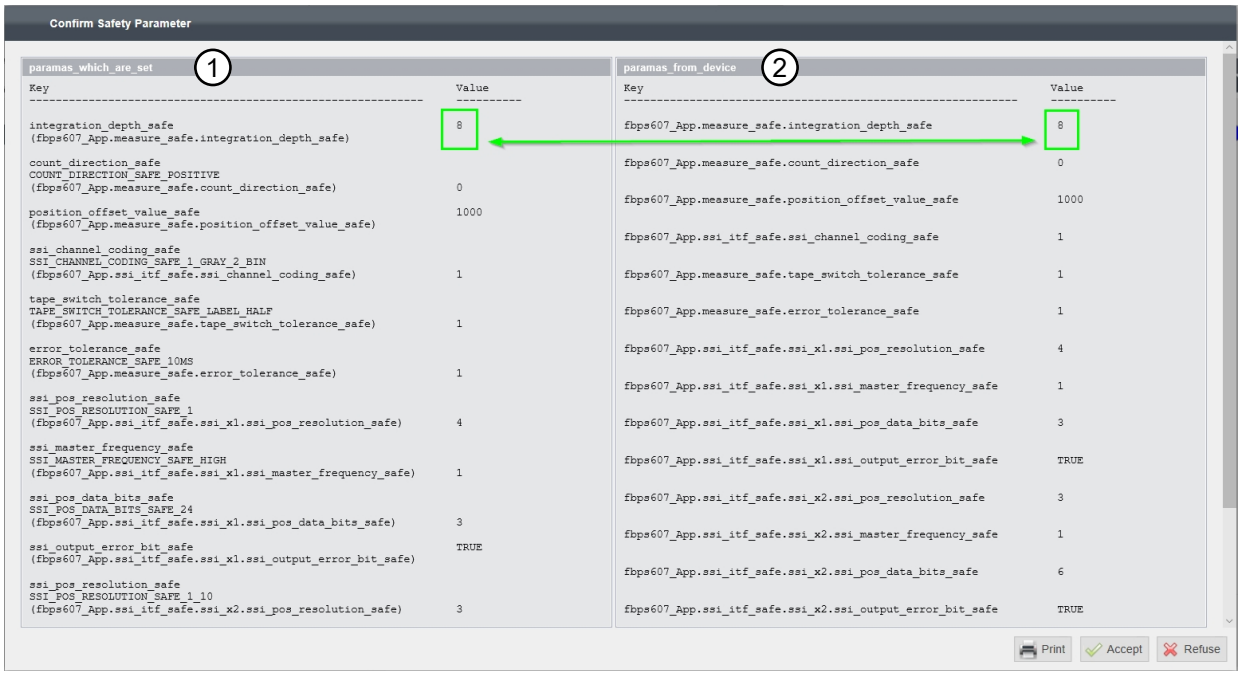
Fig. 15.14: Transferring parameters to the FBPS

↳ Transfer the changed parameters to the FBPS.

Validation of the safety parameters that have been read back

After all parameters have been transferred to the FBPS, the safety parameters are read back from the device to the webConfig interface and displayed in a dialog box.

↳ Compare in detail the set parameters with those that were read back.



1 Set safety parameters
2 Safety parameters that have been read back

Fig. 15.15: Validating parameters

Confirmation of the safety parameters

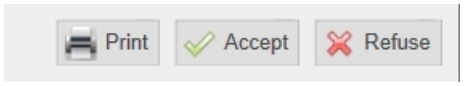


Fig. 15.16: Confirming safety parameters

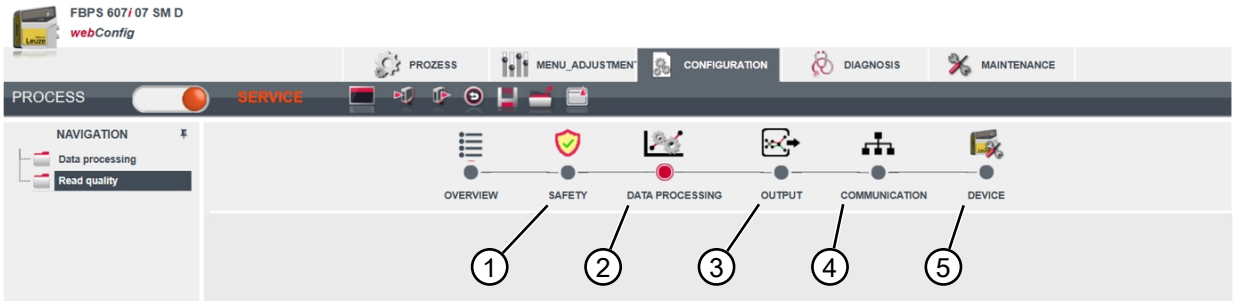
Print: The read-back dialog box is printed.

Accept: The parameters are activated in the FBPS.

Refuse: The changed parameters are not activated.

15.14 Configuring general, non-safety parameters

In the *service* operating mode, the *Configuration* tab can be used to configure not only the safety parameters but also the non-safety parameters of the FBPS.



1 Configuration of safety parameters
2 Configuration of safety and non-safety parameters
3 Position and speed output for display in the webConfig tool
4 Communication
5 Device

Fig. 15.17: Configuring non-safety parameters

Safety

Configuration of safety parameters, see chapter 15.13 "Configuring safety parameters".

Output

Resolution of the position values and speed values for display in the webConfig tool.

Resolution of the position values

- Factor 0.1
- Factor 1
- Factor 10

Resolution of the speed values

- Factor 1
- Factor 10
- Factor 100

Communication

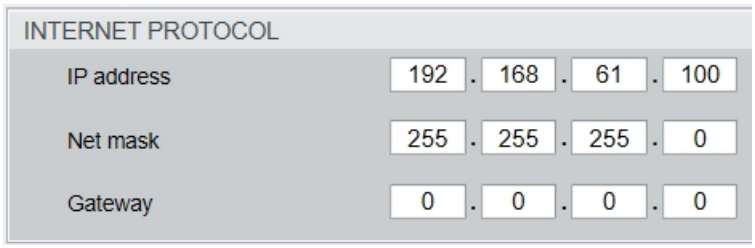


Fig. 15.18: Communication of the network addresses

Device

Digital I/Os

Configuration of the switching input / switching output functions of pin 2 and pin 4 of the PWR connector plug, see chapter 7.3.2 "Connection XD1 PWR".

Tab. 15.3: PIN 2

Switching function	Switching output
Default setting	Invalid position value
Alternative configuration	Warning threshold for read quality reached Error threshold for read quality reached Device error
Signal output, configurable	Switch-on delay Inverted

Tab. 15.4: PIN 4

Switching function	Switching input
Default setting	No function
Alternative configuration	Stop / start position measurement *
Signal output, configurable	Signal delay Pulse duration

	NOTICE
	* If the switching input function is configured as stop / start position measurement, then the stopping of position measurement triggers an external error, see chapter 12.6 "External errors". The starting of position measurement deactivates the external error. In this context, observe see chapter 12.6.3 "Restarting following an external error".

Display

Configuration of the background lighting timeout and the display contrast.

16 Diagnosis and troubleshooting

16.1 System restart

NOTICE
The FBPS signals various system and error messages via the two SSI channels, the display elements and the webConfig tool. ↳ In this regard, it is essential that you carefully read chapter 12 Operating states of the FBPS and how they are signaled, see chapter 12 "Operating states". All restart concepts of the FBPS for all operation and system states are described there. ↳ When defining the system-side safety concept, note that the FBPS does not have a restart interlock following the rectification of errors.

The elimination of the cause of an error does not necessarily need to occur through the active intervention of a person.

Examples:

1. Direct sunlight on the bar code tape or on the optics of the FBPS can trigger an external error due to the resulting reduction in reading quality. This is automatically rectified as soon as the sunlight is no longer present.
2. If, following an overvoltage or undervoltage diagnosed by the FBPS, the supply voltage is again in the specified range, the FBPS automatically starts up. If startup occurs error-free, the FBPS begins to operate.

Whether or not the system can be restarted automatically after an error signal sent by the FBPS has been rectified, is determined by the unit that performs the evaluation or by the safety concept of the system.

NOTICE
In the service mode of the web-based user interface, it is possible to change the safety-relevant parameters of the FBPS. Safety parameters that are changed are read back from the FBPS via a defined safety dialog box by means of webConfig, see chapter 15.13.3 "Parameters of the safety dialog box". Changed parameters must be compared with the safety concept of the system, validated and confirmed, all by a competent person, see chapter 2.3 "Competent persons".

NOTICE
When switching from the *service* operating mode to the *process* operating mode, the FBPS automatically restarts.

16.2 What to do in case of failure?

After switching on the FBPS, the display elements assist in checking that everything is functioning correctly and in identifying errors or malfunctions.

In the case of an error, the LEDs indicate possible error sources by means of various display colors and different flashing frequencies. Using this information, it is possible to determine the cause of an error and take measures for error rectification.

The *FBPS Info* info line in the optional display shows which error category is present: Info and/or Warning and/or Error. The DIAGNOSIS tab of the webConfig tool (standard IP address: 192.168.61.100) breaks down detailed information on Info, Warning and Error.

If the error state of the FBPS cannot be rectified:

↳ Switch off the system and leave it switched off.
The safety functions monitored through the use of the FBPS can no longer be ensured.

↳ Contact the responsible Leuze subsidiary or Leuze service, see chapter 18 "Service and support".

16.3 Diagnosis via the LED indicators

Tab. 16.1: PWR (power) status indicator LED

Status indicator	Possible cause	Measures
Off	• No supply voltage • Supply voltage too high (> 34 V DC) • Operating temperature exceeded or not met	• Check supply voltage • Check operating temperature
	Power on, the FBPS is initialized	• Observe the warmup time, see chapter 19.8 "Startup and warmup times" • Send the FBPS in for repair if the status does not change
	The FBPS is operating error-free	-
	Service mode active	Activate process mode
	External error, see chapter 12.6 "External errors"	Rectify causes, see chapter 12.6 "External errors"
	Internal error, see chapter 12.7 "Internal error"	• Send the FBPS in for repair if startup does not occur after power off/on • Check supply voltage

Tab. 16.2: SSI1 and SSI2 status indicator LED

Status indicator	Possible cause	Measures
Off	• No supply voltage • Supply voltage too high (> 34 V DC) • Operating temperature exceeded or not met	• Check supply voltage • Check operating temperature
	Power on, the FBPS is initialized	• Observe the warmup time, see chapter 19.8 "Startup and warmup times" • Send the FBPS in for repair if the status does not change
	The FBPS is operating error-free	-
	External error, see chapter 12.6 "External errors"	Rectify causes, see chapter 12.6 "External errors"
	• Internal error, see chapter 12.7 "Internal error" • Read-back of changed SSI parameters not possible	• Send the FBPS in for repair if startup does not occur after power off/on • Send FBPS in for repair

17 Care, maintenance and disposal

Cleaning

If there is dust on the device:

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

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

	NOTICE
	Cleaning notices for the bar code tape see chapter 9.9 "Care and cleaning of the bar code tape" When using a repair tape, observe the notices: see chapter 9.5.3 "Repair bar code tapes" and see chapter 9.5.4 "Online repair bar code tapes".

Servicing

	NOTICE
	Safety sensors must be replaced after the specified mission time T_M, see chapter 19.1 "Safety-relevant data". Always exchange entire safety sensors. Perform the replacement in accordance with the explanations in chapter 11, see chapter 11 "Device replacement".

Disposing

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

18 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.

19 Technical data

19.1 Safety-relevant data

Tab. 19.1: Safety-relevant data

SIL in accordance with IEC / EN 62061	SIL 3
SIL in accordance with EN 61508	SIL 3
Performance Level (PL) in accordance with ISO / EN ISO 13849-1:2015	PL e
Category in accordance with ISO / EN ISO 13849-1:2015	Cat. 4
Dangerous failures per hour (PFH_d)	< 9.5 x 10^{-9} 1/h
Mission time (T_M)	20 years (ISO / EN ISO 13849-1:2015)
$MTTF_d$ (without device heating)	64 years
$MTTF_d$ (with device heating)	52 years
DC avg	> 99.3 %
Error reaction time	Adjustable (10 / 20 / 50 /100 / 200 / 400 ms) Standard: 10 ms
Accuracy	see chapter 5 "Accuracy of the measurement system"
Reproducibility	±0.15 mm (1 sigma) with a response time (integration time) of 8 ms Accuracy of the measurement system
Safe position	see chapter 5 "Accuracy of the measurement system"
Maximum speed with respect to the BCB	10 m/s

19.2 Certifications, conformity

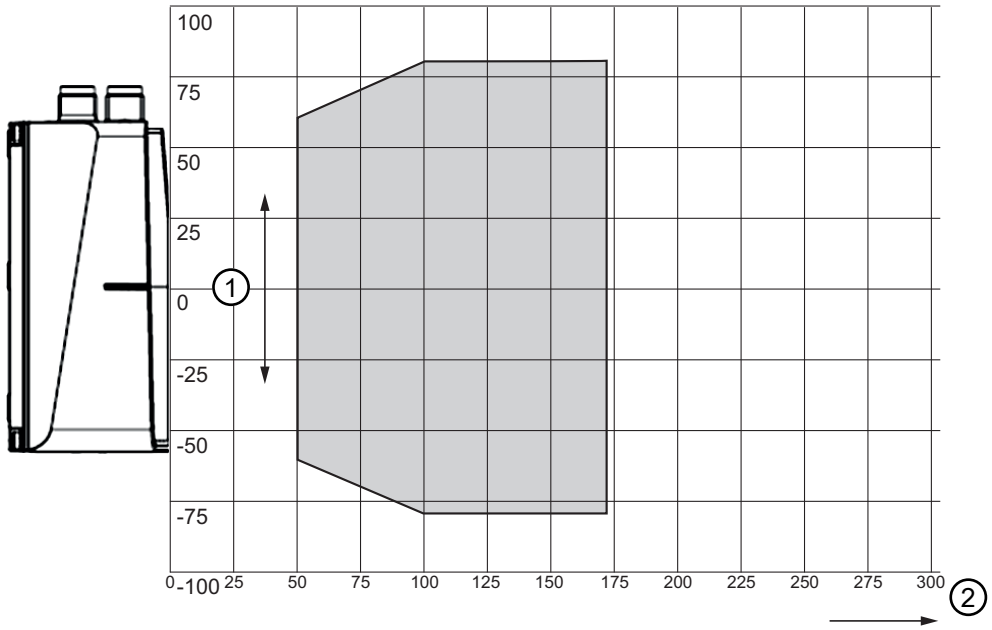
Tab. 19.2: Certifications, conformity

Certifications	
UL	UL 62368-1
CSA	CAN/CSA C22.2 No. 62368-1-14
NRTL	c TÜV NRTL US
TÜV	TÜV Süd
CE conformity	
CE	CE
Degree of protection	IP65
Protection class	III

19.3 Optical data

Tab. 19.3: Optical data

Light source	Laser diode
Wavelength	655 nm
Ambient light sensitivity	30000 lx (on the bar code tape)
Life expectancy laser diode	250,000 h (typ. at +25 °C)
Beam deflection	Via rotating polygon wheel
Exit window	Glass
Laser class	1 (acc. to IEC / EN 60825-1:2014)
Working range	50 mm … 170 mm Reading distance 50 mm: reading field 120 mm Reading distance from 100 mm: reading field width 160 mm



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

Fig. 19.1: Reading field curve FBPS 600i

19.4 Measurement data

Tab. 19.4: Measurement data

Reproducibility (1 sigma)	±0.15 mm, see chapter 5 "Accuracy of the measurement system" Valid for an uninterrupted, contiguously affixed bar code tape
Response time (integration time)	8 ms
Output time	1 ms
Dynamic measurement error	see chapter 5.2 "Dynamic measurement error"

Measurement range	0 … 10,000,000 mm Dependent on the value range of the bar code tape and on the selected resolution and number of bits for the SSI interfaces
Maximum detectable speed	10 m/s
Maximum acceleration	±100 m/s²

19.5 Electrical data

19.5.1 Supply voltage, power consumption, inputs/outputs

Supply voltage, PWR, 5-pin M12 connector plug, A-coded

Tab. 19.5: M12 connection XD1 PWR

Pin 1: Supply voltage - Vin	24 V DC ±25 %
Pin 2: Switching output SWO (non-safe)	24 V DC ± 25% maximum load = 60 mA Standard: invalid position Configurable: • Warning threshold reading quality • Error threshold reading quality • Device error
Pin 3: Supply voltage - GNDIN	0 V DC
Pin 4: Switching input SWI	24 V DC ±25 % Standard: no function Configurable: • Stop / start position measurement • Position measurement off ≥ 15 V DC • Position measurement on ≤ 5 V DC or input open
Pin 5: Functional earth FE	Earth potential
M12 thread	M12 thread is conductively connected (0 Ω) to the FBPS housing
Power consumption without device heating	max. 8.5 W
Current consumption without device heating at 18 V DC	max. 400 mA
Current consumption without device heating at 24 V DC	max. 350 mA
Power consumption with device heating	max. 24 W
Current consumption with device heating at 18 V DC	1100 mA
Current consumption with device heating at 24 V DC	1000 mA
Cable cross section	Cable cross section for the supply voltage. at least 0.34 mm² Note: Due to the cable cross section, it is not permissible to wire the supply voltage through to multiple heating devices.

CAUTION

UL applications!

For UL applications, the supply is only permitted according to UL 62368-1 ES1/PS2 or SELV/ LPS according to UL 60950-1.

NOTICE

Protective Extra Low Voltage (PELV)!

The device is designed in accordance with protection class III (EN 61140/VDE 0140) for supply with PELV (Protective Extra-Low Voltage).

NOTICE

Make sure that potential equalization is provided!

The functional earth (FE) and the shielding of the data lines must not be used as the sole potential equalization between the switch cabinet and the FBPS 600i mounted on machine parts.

In accordance with IEC 60364 (DIN VDE 0100), a separate potential equalization cable must be laid between the switch cabinet and machine parts.

The switch cabinet potential of the functional earth (FE) and the shielding connection must always correspond to the earth potential of the machine parts.

19.5.2 SSI interfaces

SSI interface, X1 SSI1, 5-pin M12 connector plug, B-coded

Tab. 19.6: M12 connection X1 SSI1

Pin 1: SSI interface - data	DATA+
Pin 2: SSI interface - data	DATA-
Pin 3: SSI interface - clock	CLK+
Pin 4: SSI interface - clock	CLK-
Pin 5: Functional earth FE	Earth potential
M12 thread: SSI interface - shielding connection	M12 thread is conductively connected (0 Ω) to the FBPS housing
SSI clock frequency	Standard: 80 kHz … 800 kHz Configurable: 50 kHz … 79 kHz

SSI interface, X2 SSI2, 5-pin M12 connector plug, B-coded

Tab. 19.7: M12 connection X2 SSI2

Pin 1: SSI interface - data	DATA+
Pin 2: SSI interface - data	DATA-
Pin 3: SSI interface - clock	CLK+
Pin 4: SSI interface - clock	CLK-
Pin 5: Functional earth FE	Earth potential
M12 thread: SSI interface - shielding connection	M12 thread is conductively connected (0 Ω) to the FBPS housing
SSI clock frequency	Standard: 80 kHz … 800 kHz Configurable: 50 kHz … 79 kHz

NOTICE
Data format of the SSI interface: - Device model FBPS 607i 07 SM 1x0 …: Standard SSI protocol without CRC checksum - Device model FBPS 617i 17 SM 1x0 …: Extended SSI protocol with CRC checksum

19.5.3 USB interface

Tab. 19.8: Mini-B USB 2.0 socket

USB interface	Mini-B type USB 2.0 socket
Function	Connection for webConfig tool
Transmission rate	≤ 12 Mbit/s
Cable length	≤ 5 m

19.5.4 Controls and indicators

Tab. 19.9: Controls and indicators

FBPS devices	
LEDs	3 LEDs (1 x PWR; 1 x SSI1; 1 x SSI2)
Display (version FBPS 6xxi … D)	Monochromatic graphical display, 128 x 32 pixel with LED background lighting
Keyboard (version FBPS 6xxi … D)	Two membrane keyboards
Integrated webConfig tool	
Standard IP address	192.168.61.100

19.6 Mechanical data

Tab. 19.10: General mechanical data for the FBPS 600i

Housing	Diecast aluminum
Connections	3 x M12 (PWR; SSI1; SSI2) 1 x USB 2.0 Mini-B type socket
Degree of protection	IP65 acc. to DIN EN 60529
Weight without packaging	Approx. 540 g

19.7 Environmental data

Tab. 19.11: Environmental data

Ambient temperature (operation)	
Devices without device heating	-5 °C … +60 °C
Devices with device heating	-35 °C … +60 °C
Ambient temperature (storage)	
Devices without/with device heating	-35 °C … +70 °C
Air humidity	Max. 90% rel. humidity, non-condensing
Operating altitude	Max. 3500 meters above sea level

19.8 Startup and warmup times

Tab. 19.12: Startup and warmup times

Warmup time for low-temperature use	At -35°C, approx. 30 minutes after power-on
Boot time between power-on and safe measurement value output at the SSI interfaces	The boot time is dependent on the ambient temperature and the inside temperature at the time of power-on. -5 °C to +60 °C: boot time approx. 10 seconds -35 °C: boot time approx. 30 minutes

19.9 Bar code tape

Bar code tape materials

Tab. 19.13: Bar code tape materials

Base material	Polyester film, without silicone
Surface protection	Polyester, matt
Adhesive	Acrylate adhesive
Strength of adhesive	0.1 mm
Adhesive strength (average values)	• On steel: 25 N/25 mm • On polypropylene: 20 N/25 mm

Print data

Tab. 19.14: Print data

Bar code	Code 128 character set C, 6 digits (increasing in increments of 3)
Length tolerance of the bar code tape	±1 mm/m
Module	0.33 mm
Ratio	1:2:3:4
Contrast	≥ 95 %

Environmental data

Tab. 19.15: Environmental data

Recommended processing temperature	+10°C up to +25°C
Processing temperature	0 °C … +45 °C
Ambient temperature	-40 °C to +120 °C
Dimensional stability	Tested in accordance with DIN 30646:2006-12 • Performance indicator 05 • Bar code tape affixed to polished steel 1.4301 • 168 h / 23 °C / 50% rel. humidity / no shrinkage • 168 h / 120 °C / shrinkage 0.63% • 1 min / 160 °C / no shrinkage
Curing	Final curing after 72 hours The FBPS can detect the position immediately after the BCB is affixed.
Weathering resistance	• UV light resistance in accordance with ISO 4892-2 Method A • Humidity
Chemical resistance In its affixed state, the bar code tape is resistant to chemicals at its front surface (i.e. the side of the bar code that is read). The rear side is not resistant to chemicals.	• Diesel oil: 6 h / 21 °C • White spirit: 1 h / 21 °C • Heptane: 1 h / 21 °C • Cold cleaner: 24 h / 21 °C • Antifreeze: 24 h / 21 °C • Ethylene glycol: no resistance
Behavior in fire	Not self-extinguishing, does not drip
Mounting surface	Grease-free, dry, clean, smooth

Bar code tape variants

Information about the bar code tapes:

- Standard tapes
- Special tapes
- TWIN tapes
- Repair tapes

see chapter 9.5 "Types of bar code tapes"

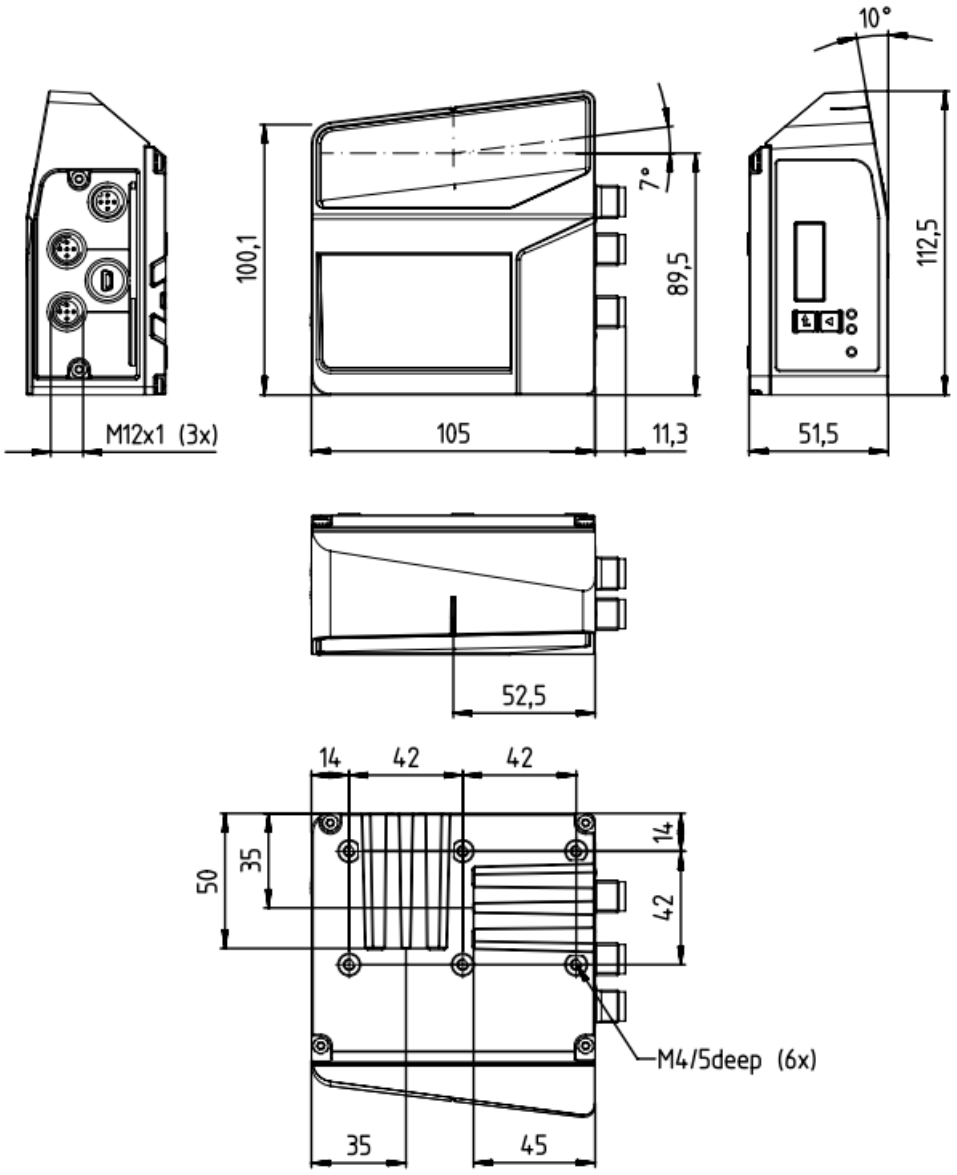
Information about the MVS control bar code see chapter 9.6 "MVS label control bar code".

19.10 Dimensioned drawings

19.10.1 Dimensioned drawings FBPS 607i/617i … SM 100 … (side plug outlet)

Tab. 19.16: Dimensions of FBPS 607i/617i … SM 100 … (side plug outlet)

Dimensions (H x W x D)	112.5 mm x 116.3 mm x 51.5 mm



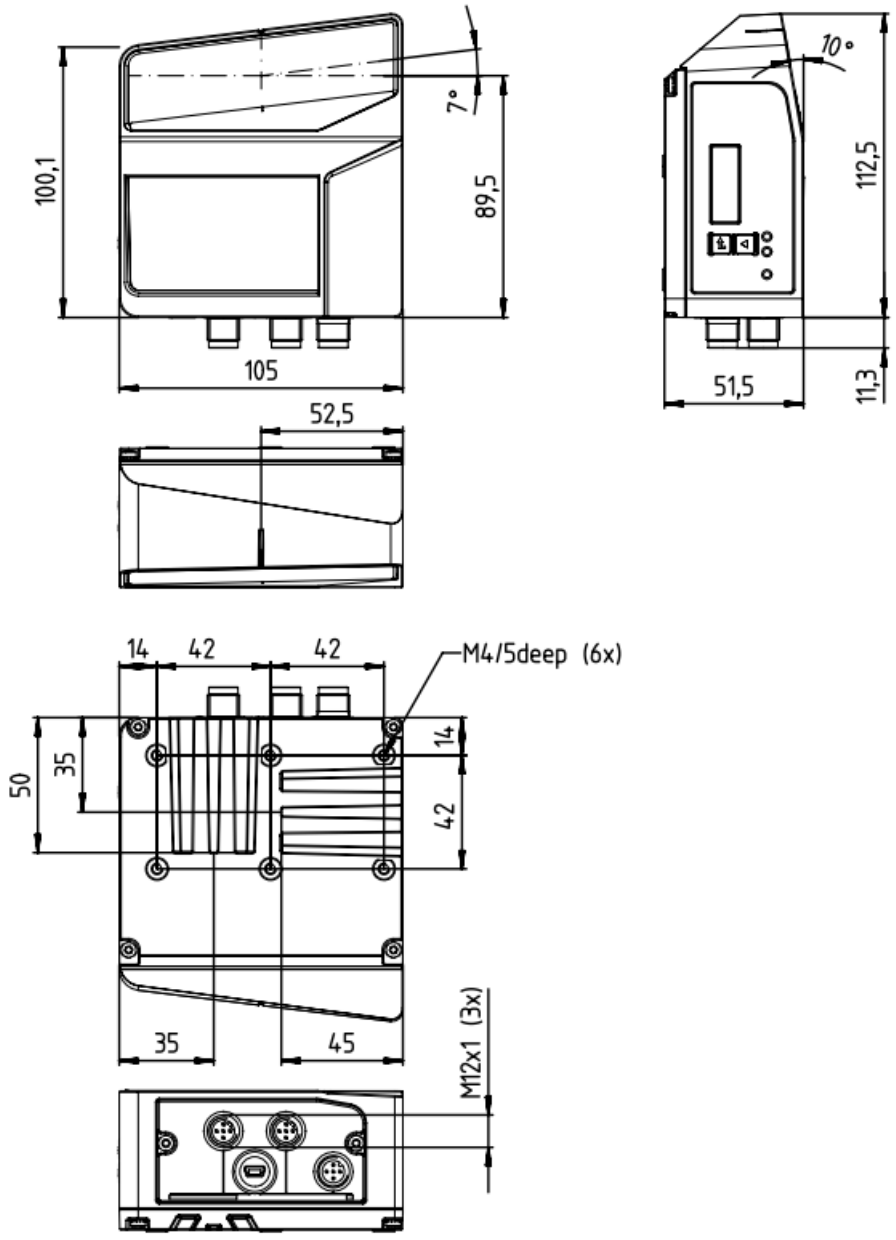
All dimensions in mm

Fig. 19.2: Dimensioned drawing of FBPS with side connector

19.10.2 Dimensioned drawings FBPS 607i/617i … SM 110 … (bottom plug outlet)

Tab. 19.17: Dimensions of FBPS 607i/617i … SM 110 … (bottom plug outlet)

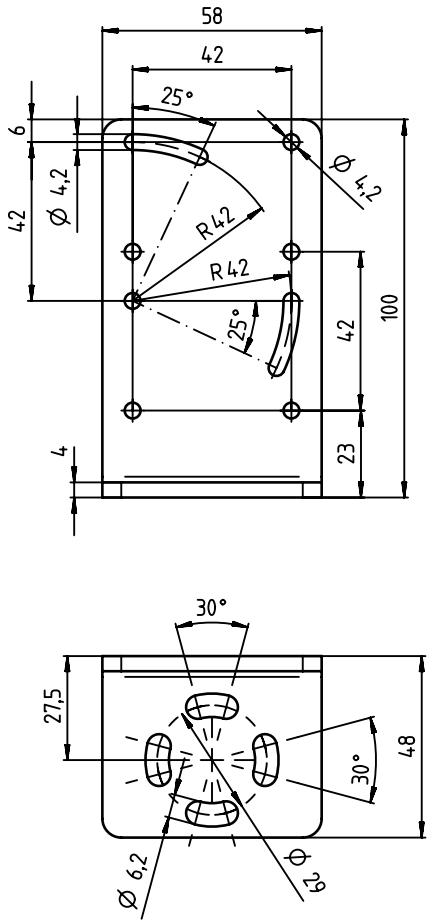
Dimensions (H x W x D)	123.8 mm x 105.0 mm x 51.5 mm



All dimensions in mm

Fig. 19.3: Dimensioned drawing of FBPS with bottom connector

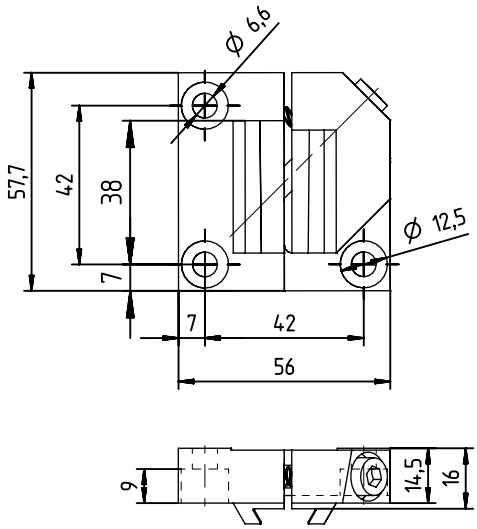
19.10.3 Dimensioned drawing BT 300-W mounting system



All dimensions in mm

Fig. 19.4: Dimensioned drawing of BT 300-W

19.10.4 Dimensioned drawing BTU 0300M-W mounting system



All dimensions in mm

Fig. 19.5: Dimensioned drawing of BTU 0300M-W

20 Order guide and accessories

20.1 Part number code

FBPS 6xxi SM 1x0 x

Example: FBPS 607i 07 SM 110

FBPS	Fail-safe bar code positioning system
6	Series: FBPS 600i
xx	Interface: 07: 2-channel standard SSI 17: 2-channel SSI with CRC
i	i: Integrated fieldbus technology
S	Scanning principle: S: Line scanner
M	Optics: M: Medium distance (medium density)
1x0	Plug outlet: 100: side 110: bottom
x	Options: -: Device without additional options D: Display H: Heating

NOTICE

A list with all available device types can be found on the Leuze website **www.leuze.com**.

20.2 Type overview

Tab. 20.1: Type overview FBPS 600i

Part no.	Part designation	Description
50140954	FBPS 607i 07 SM 100	2-channel standard SSI, side plug outlet
50140955	FBPS 607i 07 SM 100 D	2-channel standard SSI, side plug outlet, display
50140956	FBPS 607i 07 SM 100 H	2-channel standard SSI, side plug outlet, heating
50140957	FBPS 607i 07 SM 110	2-channel standard SSI, bottom plug outlet
50140958	FBPS 607i 07 SM 110 D	2-channel standard SSI, bottom plug outlet, display
50140959	FBPS 607i 07 SM 110 H	2-channel standard SSI, bottom plug outlet, heating
50144059	FBPS 617i 17 SM 100	2-channel SSI with CRC, side plug outlet
50144060	FBPS 617i 17 SM 100 D	2-channel SSI with CRC, side plug outlet, display
50144061	FBPS 617i 17 SM 100 H	2-channel SSI with CRC, side plug outlet, heating
50144062	FBPS 617i 17 SM 110	2-channel SSI with CRC, bottom plug outlet
50144063	FBPS 617i 17 SM 110 D	2-channel SSI with CRC, bottom plug outlet, display
50144064	FBPS 617i 17 SM 110 H	2-channel SSI with CRC, bottom plug outlet, heating

20.3 Accessories – connection technology

Tab. 20.2: Power connection cables

Part no.	Type designation	Description
50133839	KD U-M12-5A-P1-20	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 2 m • Unshielded • Ambient temperature, operation: -25 °C to +80 °C
50133840	KD U-M12-5A-P1-30	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 3 m • Unshielded • Ambient temperature, operation: -25 °C to +80 °C
50133841	KD U-M12-5A-P1-50	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 5 m • Unshielded • Ambient temperature, operation: -25 °C to +80 °C
50132534	KD U-M12-5A-P1-100	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 10 m • Unshielded • Ambient temperature, operation: -25 °C to +80 °C
50133859	KD S-M12-5A-P1-20	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 2 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50133860	KD S-M12-5A-P1-50	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 5 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50133861	KD S-M12-5A-P1-100	PWR connection cable, PUR, M12 socket, A-coded, axial plug outlet, open cable end, UL approval • Cable length 10 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C

Tab. 20.3: SSI connection cables

Part no.	Type designation	Description
50104172	KB SSI/IBS-2000-BA	SSI connection cable, PUR, M12 socket, B-coded, axial plug outlet, open cable end • Cable length 2 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50104171	KB SSI/IBS-5000-BA	SSI connection cable, PUR, M12 socket, B-coded, axial plug outlet, open cable end • Cable length 5 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50104170	KB SSI/IBS-10000-BA	SSI connection cable, PUR, M12 socket, B-coded, axial plug outlet, open cable end • Cable length 10 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50104169	KB SSI/IBS-15000-BA	SSI connection cable, PUR, M12 socket, B-coded, axial plug outlet, open cable end • Cable length 15 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C
50108446	KB SSI/IBS-30000-BA	SSI connection cable, PUR, M12 socket, B-coded, axial plug outlet, open cable end • Cable length 30 m • Shielded • Ambient temperature, operation: -25 °C to +80 °C

Tab. 20.4: FBPS connectors

Part no.	Type designation	Description
50020501	KD 095-5A	M12 socket, axial, A-coded for XD1 PWR, UL approval • Ambient temperature, operation: -40 °C to +85 °C
50038538	KD 02-5-BA	M12 socket, axial, B-coded for X1 SSI1 / X2 SSI2, UL approval • Shielded • Ambient temperature, operation: -40 °C to +85 °C

Tab. 20.5: USB interconnection cable

Part no.	Type designation	Description
50117011	KB USB A – USB Mini B	USB interconnection cables for webConfig • 1 type A connector • 1 Mini B type connector • Cable length 1.5 m

20.4 Accessories – mounting systems

Tab. 20.6: Mounting systems

Part no.	Type designation	Description
50124941	BTU 0300M-W	Mounting device / quick-change system
50121433	BT 300 W	Mounting bracket

20.5 Bar code tapes

20.5.1 Standard bar code tapes

Leuze offers a wide selection of standardized bar code tapes.

Tab. 20.7: Data for standard bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …)
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 FBPS in the *Accessories* tab.

20.5.2 Special bar code tapes

Special tapes are produced according to customer specifications.

Tab. 20.8: Data for special bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …)
Height	20 mm – 140 mm in millimeter increments
Length	Configurable, maximum 10,000.02 m
Tape start value	Configurable
Tape end value	Configurable, maximum tape end value at 9,999.99 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.

	NOTICE
	On the Leuze website **www.leuze.com** under - **Products > Measuring sensors > Bar code positioning systems > FBPS** – *Accessories* tab and alternatively under - **Products > Accessories > Bar code tapes > Product selector** an entry wizard is available for all types of special, repair and TWIN bar code tapes. 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.

20.5.3 Repair bar code tapes

Repair bar code tapes are produced according to customer specifications.

Tab. 20.9: Data for repair bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …)
Height	47 mm 25 mm
Length	Configurable, maximum 5 m
Tape start value	Configurable
Tape end value	Configurable

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

	NOTICE
	On the Leuze website **www.leuze.com** under - **Products > Measuring sensors > Bar code positioning systems > FBPS** – *Accessories* tab and alternatively under - **Products > Accessories > Bar code tapes > Product selector** an entry wizard is available for all types of special, repair and TWIN bar code tapes. 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.

20.5.4 TWIN bar code tapes

TWIN bar code tapes are special bar code tapes and are manufactured according to customer specifications.

Tab. 20.10: Data for TWIN bar code tapes

Feature	Value
Grid dimensions	30 mm (BCB G30 …)
Height	20 mm – 140 mm in millimeter increments
Length	Configurable, maximum 10,000.02 m
Tape start value	Configurable
Tape end value	Configurable, maximum tape end value at 9,999.99 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 bar code tapes over 300 m in length are wound and delivered on multiple rolls.

	NOTICE
	On the Leuze website **www.leuze.com** under - **Products > Measuring sensors > Bar code positioning systems > FBPS** – *Accessories* tab and alternatively under - **Products > Accessories > Bar code tapes > Product selector** an entry wizard is available for all types of special, repair and TWIN bar code tapes. 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.

20.5.5 MVS control label

Tab. 20.11: MVS control label

Part no.	Type designation	Description
50106476	BCB G30 H47 MVS	MVS control label, packaging unit 10 pieces

21 EC Declaration of Conformity

	NOTICE
	You can download the EC Declaration of Conformity from the Leuze website. ↳ Call up the Leuze website: *www.leuze.com*. ↳ Enter the type designation or part number of the device as the search term. The part number can be found on the name plate of the device under the "Part No." entry. ↳ The documents can be found on the product page for the device under the *Downloads* tab.