

BALLUFF

BTL5-T1 ___-M____-P-S103

User's Guide



PROFI[®]
BUS

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Notes to the user

1.1 Validity

This guide describes the construction, function and setup options for the BTL magnetostrictive linear position sensor with Profibus DP interface. It applies to models **BTL5-T1__-M____-P-S103** (see Type code on page 19).

The guide is intended for qualified technical personnel. Read this guide before installing and operating the BTL.

1.2 Symbols and conventions

Individual **actions** are indicated by a preceding triangle.

- ▶ Instruction 1

Action sequences are numbered consecutively:

1. Instruction 1
2. Instruction 2



Note, tip

This symbol indicates general notes.

1.3 Scope of delivery

- BTL
- Mounting clamps with insulating sleeves and screws
- Condensed guide



The magnets are available in various models and must be ordered separately.

1.4 Software

GSD file via download on the Internet at www.balluff.com or e-mail to service@balluff.de.

1.5 Approvals and markings



UL approval
File No.
E227256

US Patent 5 923 164

The US patent was awarded in connection with this product.



The CE Mark verifies that our products meet the requirements of the current EMC Directive.

The BTL meets the requirements of the following product standard:

- EN 61326-2-3 (noise immunity and emission)

Emission tests:

- RF emission EN 55011

Noise immunity tests:

- Static electricity (ESD)
EN 61000-4-2 Severity level 3
- Electromagnetic fields (RFI)
EN 61000-4-3 Severity level 3
- Electrical fast transients (burst)
EN 61000-4-4 Severity level 3
- Surge
EN 61000-4-5 Severity level 2
- Conducted interference induced by high-frequency fields
EN 61000-4-6 Severity level 3
- Magnetic fields
EN 61000-4-8 Severity level 4



More detailed information on the guidelines, approvals, and standards is included in the declaration of conformity.

2

Safety

2.1 Intended use

The BTL magnetostrictive linear position sensor, together with a Profibus master (e.g. PLC), comprises a position measuring system. It is intended to be installed into a machine or system and used in the industrial sector. Flawless function in accordance with the specifications in the technical data is ensured only when using original Balluff accessories. Use of any other components will void the warranty.

Opening the BTL or non-approved use are not permitted and will result in the loss of warranty and liability claims against the manufacturer.

2.2 General safety notes

Installation and **startup** may only be performed by trained specialists with basic electrical knowledge.

Qualified personnel are persons whose technical training, knowledge and experience as well as knowledge of the relevant regulations allows him to assess the work assigned to him, recognize possible hazards and take appropriate safety measures.

The **operator** is responsible for ensuring that local safety regulations are observed. In particular, the operator must take steps to ensure that a defect in the BTL will not result in hazards to persons or equipment. If defects and unresolvable faults occur in the BTL, take it out of service and secure against unauthorized use.


2.3 Explanation of the warnings

Always observe the warnings in these instructions and the measures described to avoid hazards.

The warnings used here contain various signal words and are structured as follows:

SIGNAL WORD
<p>Type and source of the hazard Consequences if not complied with ► Measures to avoid hazards</p>

The individual signal words mean:

NOTICE
Identifies a danger that could damage or destroy the product.
 DANGER
The general warning symbol in conjunction with the signal word DANGER identifies a hazard which, if not avoided, will certainly result in death or serious injury .

2.4 Disposal

- Observe the national regulations for disposal.

BTL5-T1__-M____-P-S103

Magnetostrictive Linear Position Sensor – Profile Style

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Construction and function

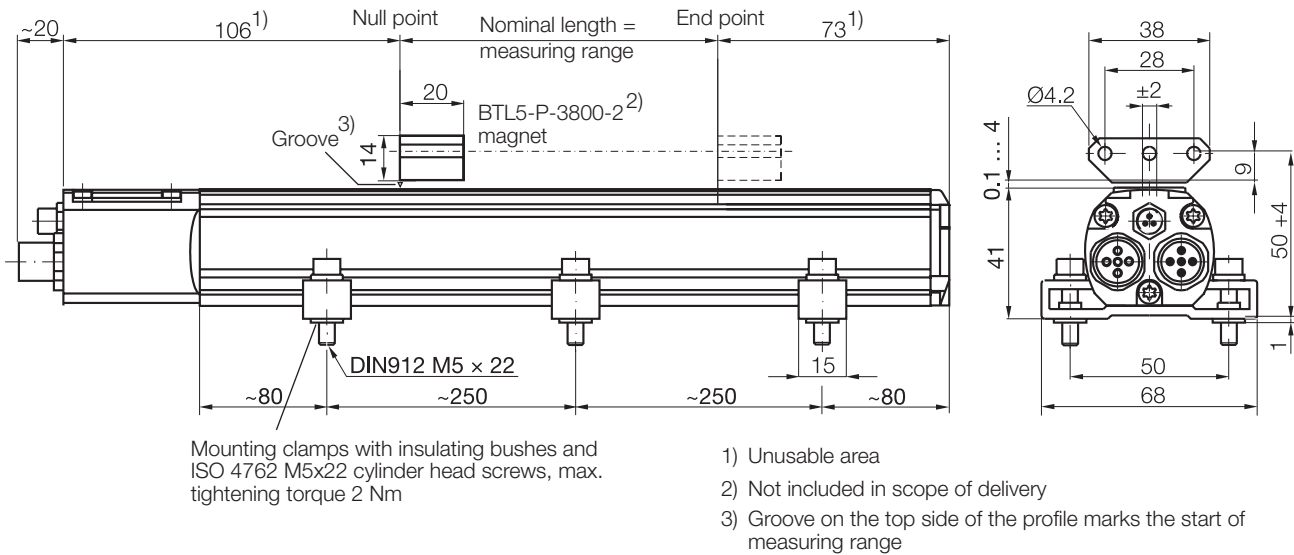


Fig. 3-1: BTL5..., construction

3.1 Construction

Electrical connection: The electrical connection is made via a cable (see Type code on page 19).

Housing: Stainless steel housing containing the processing electronics.

Magnet: Defines the position to be measured on the waveguide. Magnets are available in various models and must be ordered separately (see Accessories on page 15).

Nominal length: To optimally adapt the BTL to the application, nominal lengths from 50 mm to 4000 mm are available.

3.2 Function

The BTL contains the waveguide which is protected by an aluminum housing. A magnet is moved along the waveguide. This magnet is connected to the system part whose position is to be determined.

The magnet defines the position to be measured on the waveguide.

An internally generated INIT pulse interacts with the magnetic field of the magnet to generate a torsional wave in the waveguide which propagates at ultrasonic velocity.

The component of the torsional wave which arrives at the end of the waveguide is absorbed in the damping zone to prevent reflection. The wave generated at position of the magnet returns to the head end of the BTL where a coil converts the wave into an electrical signal. The travel time of the wave is used to calculate the position at a resolution of 5 µm. This is done with high precision and reproducibility within the measuring range designated as the rated length.

The electrical connection between the BTL, evaluation unit/controller, and power supply is established via several cables that are connected via connectors.

3.3 Number of magnets

Up to 4 magnets can be used. The distance (L) between the magnets must be at least 65 mm.

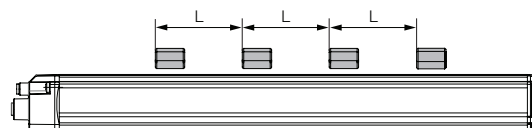


Fig. 3-2: Distance between the magnets

4 Installation and connection

4.1 Installing the BTL

NOTICE
<p>Improper installation Improper installation can compromise the function of the transducer and result in damage.</p> <ul style="list-style-type: none"> ▶ Ensure that no strong electrical or magnetic fields are present in the direct vicinity of the BTL. ▶ Be sure to maintain the specified distances and separations.

Any orientation is permitted. Mount the BTL on a level surface of the machine using the provided mounting clamps and cylinder-head screws. A sufficient number of mounting clamps is supplied.

i In order to avoid the development of resonant frequencies from vibration loads, we recommend arranging the mounting clamps at irregular intervals.

The BTL is electrically isolated from the machine with the supplied insulating bushes (see Fig. 3-1).

1. Guide the BTL into the mounting clamps.
2. Attach the BTL to the base using mounting screws (tighten screws in the clamps with max. 2 Nm).
3. Installing magnet (accessory). When using multiple magnets see chapter 3.3.

i The BTL in profile housing is suitable both for floating, i.e. non-contacting magnets (see Fig. 4-4 to Fig. 4-8) and for captive magnets (see Fig. 4-1 to Fig. 4-3).

4.2 Captive magnets

Note when installing the magnet:

- Avoid lateral forces.
- Connect the magnet to the machine member with a joint rod (see Accessories on page 15).

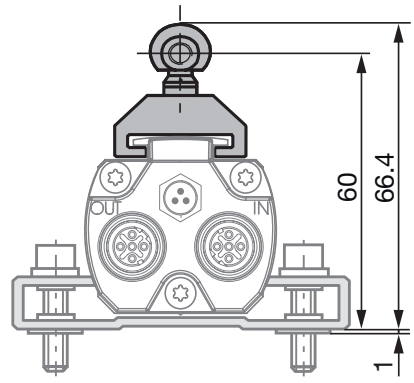


Fig. 4-1: Dimensions and spacing with magnet BTL5-F-2814-1S

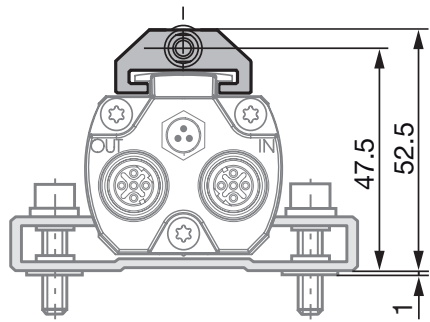


Fig. 4-2: Dimensions and spacing with magnet BTL5-T-2814-1S

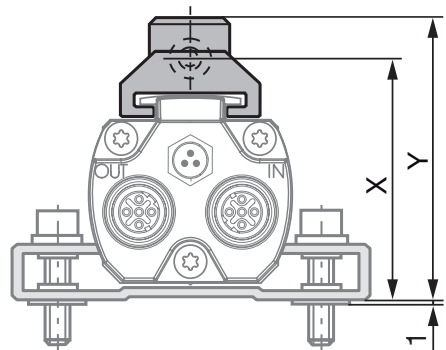


Fig. 4-3: Dimensions and spacing with magnet BTL5-M/N-2814-1S

	BTL5-M-2814-1S	BTL5-N-2814-1S
Distance X	48.5 mm	57 mm
Distance Y	51 mm	59.5 mm

Tab. 4-1: Distances with BTL5-M/N-2814-1S magnet

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Installation and connection (continued)

4.3 Floating magnets

Note when installing the magnet:

- To ensure the accuracy of the linear position sensor, the magnet is attached to the moving member of the machine using non-magnetizable screws (stainless steel, brass, aluminum).
- The moving member must guide the magnet on a parallel line to the BTL.
- Distance A between the magnet and parts made of magnetizable material must be kept to at least 10 mm (see Fig. 4-4 to Fig. 4-8).
- For distance B between the magnet and the BTL and for the center offset C (see Fig. 4-4 to Fig. 4-8) the following values must be maintained:

Magnet type	Distance B ¹⁾	Offset C
BTL5-P-3800-2	0.1...4 mm	± 2 mm
BTL5-P-5500-2	5...15 mm	± 15 mm
BTL5-P-4500-1	0.1...2 mm	± 2 mm
BTL6-A-3800-2	4...8 mm ²⁾	± 5 mm
BTL6-A-3801-2	4...8 mm ²⁾	± 5 mm

¹⁾ The selected distance must remain constant over the entire stroke length.

²⁾ For optimal measuring results a distance B of 6...8 mm is recommended.

Tab. 4-2: Distance and offset for floating magnets

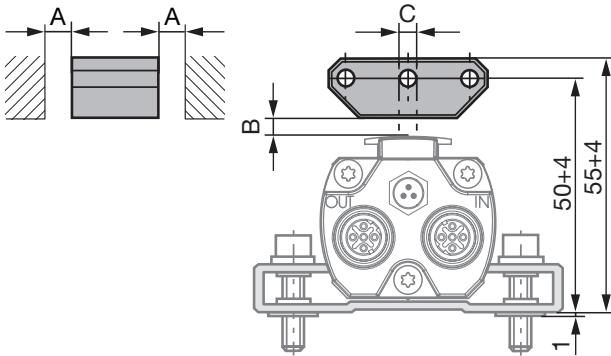


Fig. 4-4: Dimensions and spacing with magnet BTL5-P-3800-2

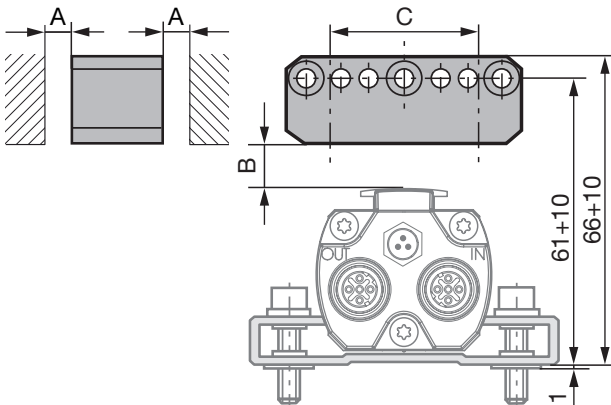


Fig. 4-5: Dimensions and spacing with magnet BTL5-P-5500-2

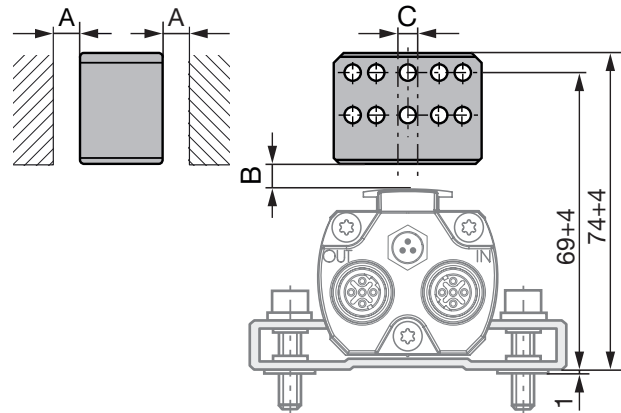


Fig. 4-6: Dimensions and spacing with magnet BTL6-A-3800-2

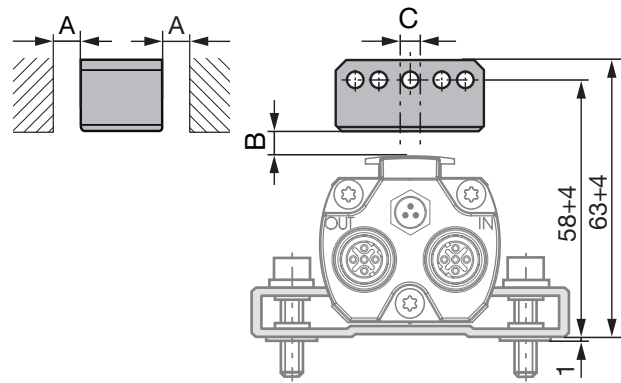


Fig. 4-7: Dimensions and spacing with magnet BTL6-A-3801-2

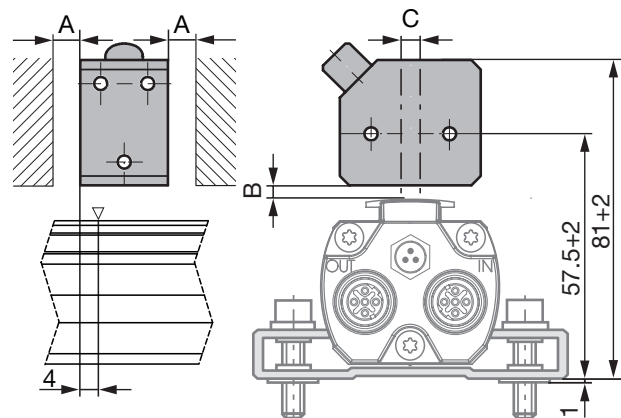


Fig. 4-8: Dimensions and spacing with BTL5-P-4500-1 electromagnet (24 V/100 mA)



The measuring range is offset by 4 mm towards the BTL plug (see Fig. 4-8).

4 Installation and connection (continued)

4.4 Shielding and cable routing

i **Defined ground!**
 The BTL and the control cabinet must be at the same ground potential.

Shielding

To ensure electromagnetic compatibility (EMC), observe the following:

- Connect BTL and controller using a shielded cable. Shielding: Braided copper shield with minimum 85% coverage.
- Shield is internally connected to connector housing.

Magnetic fields

The position measuring system is a magnetostrictive system. Ensure that there is sufficient distance between the BTL and the strong, external magnetic fields.

Cable routing

The Profibus bus line must be routed according to *Technical Guideline 2.111, Installation Guidelines for Profibus-DP/FMS*.

Do not route the cable between the BTL, controller, and power supply near high voltage cables (inductive stray noise is possible).

The cable must be routed tension-free.

Inductive stray noise from AC harmonics (e.g. from phase angle controls) are especially critical and the cable shield offers very little protection against this.

The signal is transmitted to the controller via the Profibus DP interface.

Cable twisted in pairs, shielded.

Maximum length of the entire field bus cable: 1200 m

The transfer rate depends on the length of the cable. In accordance with EN 50170, the values named in Tab. 4-3 apply.

Cable length	Baud rate [kbit/s]
< 100 m	12000
< 200 m	1500
< 400 m	500
< 1000 m	187.5
< 1200 m	93.7/19.2/9.6

Tab. 4-3: Baud rate depending on cable length

The bus must be terminated at both ends in accordance with EN 50170 (see Fig. 4-10).

i The BTL can be assigned a station address via DIP switches. In addition, the BTL can internally terminate the bus via DIP switches. For further information see chapter Presettings on page 12.

Noise elimination

To avoid equipotential bonding (current flow) through the cable shield, please note the following:

- Use insulating bushes.
- Put the control cabinet and the system in which the BTL is located to the same ground potential.

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4 Installation and connection (continued)

4.5 Electrical Connection

The BTL is attached via connectors.

i Note the information on shielding and cable routing on page 10.

4.5.1 Connecting the supply voltage, control and data signals

The connection assignments are shown in Fig. 4-9, Tab. 4-4 and Tab. 4-5.

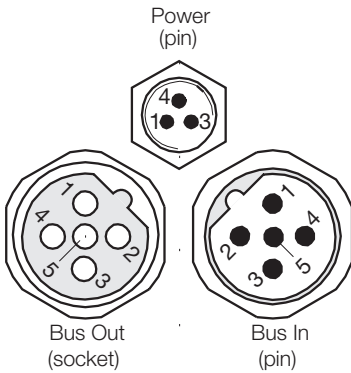


Fig. 4-9: BKS pin assignment, BTL...-S103 connector, view on the plug/socket side of the BTL

Pin	Control and data signals	
	BUS IN	BUS OUT
1	VP +5 V (output)	
2	RxD / TxD-N (A)	
3	Data GND	
4	RxD / TxD-P (B)	
5	Shield	

Tab. 4-4: Control and data signals connection assignment

Pin	Supply voltage (external)	
	Power	
1	+24 V	
3	0 V (GND)	
4	Shield	

Tab. 4-5: Supply voltage connection assignment

4.5.2 Connection example

i In this version the connections for power supply, Bus In and Bus Out are located on separate connectors.

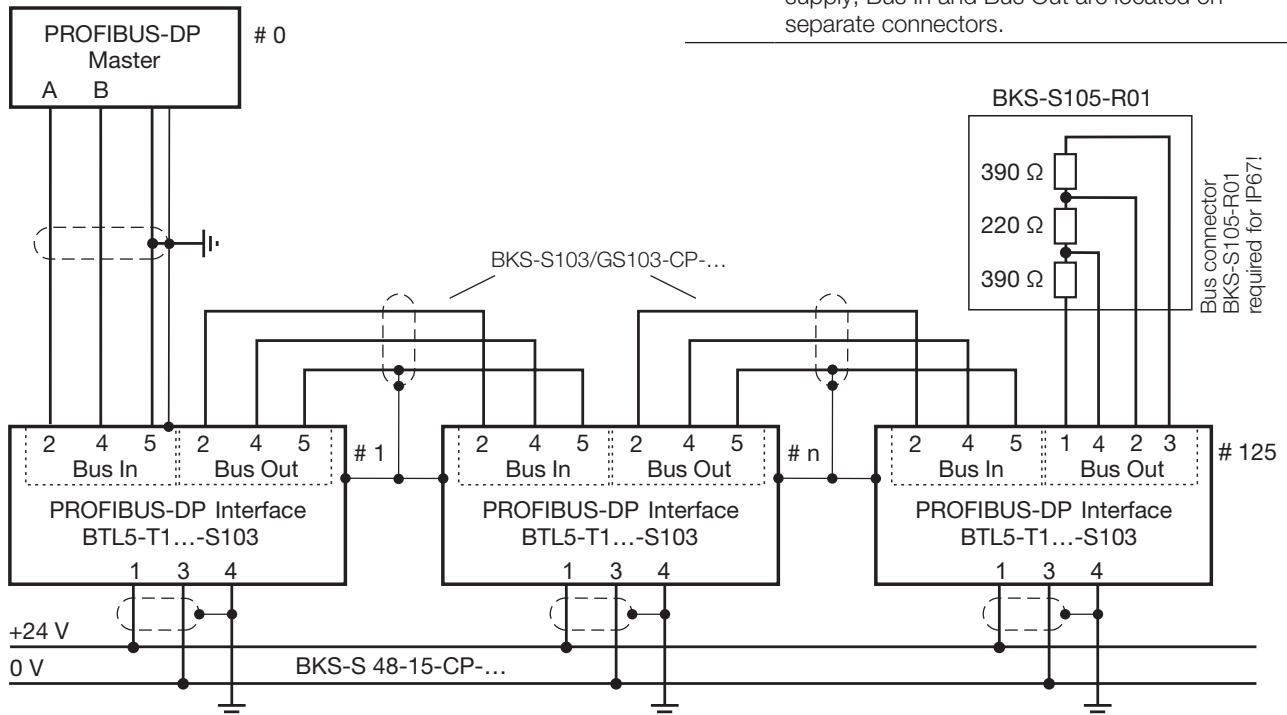


Fig. 4-10: BTL5-T1...-S103 with master, connection example

5

Startup

5.1 Starting up the system

⚠ DANGER

Uncontrolled system movement

When starting up, if the position measuring system is part of a closed loop system whose parameters have not yet been set, the system may perform uncontrolled movements. This could result in personal injury and equipment damage.

- ▶ Persons must keep away from the system's hazardous zones.
- ▶ Startup must be performed only by trained technical personnel.
- ▶ Observe the safety instructions of the equipment or system manufacturer.

1. Check connections for tightness and correct polarity. Replace damaged connections.
2. Turn on the system.
3. Check measured values and adjustable parameters and readjust the BTL if necessary.

i Check for the correct values, especially after replacing the BTL or after repair by the manufacturer.

5.2 Operating notes

- Regularly check function of the BTL and all associated components.
- Take the BTL out of operation whenever there is a malfunction.
- Secure the system against unauthorized use.

5.3 Default setting

The BTL is delivered with the following default settings:

- Station address: 126
- Resolution: position 5 µm, velocity 0.1 mm/s
- Maximum working/useful range

5.4 Presettings

The station address can be configured through the Set_Slave_Address service. This service requires a class 2 DP master. The linear position sensor's GSD file is used for configuration. The GSD file provides all setup option information. The COM Profibus from Siemens, for example, can be used for configuration.

NOTICE

Device damage

Particles, dirt or dust entering the housing can affect the functioning of the BTL and damage it.

- ▶ When opening the housing, make sure that no particles can get into the device.
- ▶ When closing the cover, make sure that there is enough pressure on the seal. Tightening torque: 0.8 Nm

For use in standard Profibus systems, the station address and the terminating resistor are set via the integrated S1 DIP switch before startup (see Fig. 5-1 and Fig. 5-2).

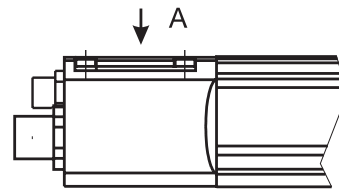


Fig. 5-1: Position of the S1 DIP switch

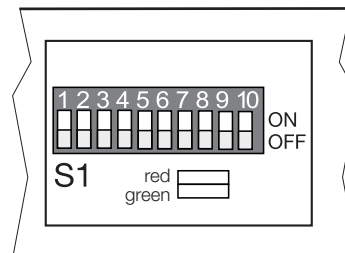


Fig. 5-2: View A, S1 DIP switch for setting the station address and terminating resistor

5

Startup (continued)

5.4.1 Station address

Values from 0 to 125 can be set for the station address. Every address may only be assigned once in a network! For the value 126, the address 126 or the address most recently set by the Set_Slave_Address service is used. With the value 127, the BTL can be reset to factory settings. As the value 127 is not a valid address, no operation on the bus is possible.

S1.1	S1.2	S1.3	S1.4	S1.5	S1.6	S1.7
2 ⁰	2 ¹	2 ²	2 ³	2 ⁴	2 ⁵	2 ⁶
LSB						MSB
1	2	4	8	16	32	64

Tab. 5-1: Station address

All address setting are applied by the BTL after a re-start. Thus, changes that are made while supply voltage is present do not have an immediate effect.

5.4.2 Bus termination

For a safe quiescent level, the bus must be terminated at both ends in accordance with Fig. 4-10. The BTL allows for internal bus termination by setting DIP switches S1.9 and S1.10 to ON (see Fig. 5-2). For IP67, the bus termination resistance suggested in Fig. 4-10 on page 11 must be used. Then, the internal bus termination must not be activated (S1.9 and S1.10 set to OFF)! If possible, stubs are to be avoided.

5.4.3 LED display for Profibus encoder profile

LED red (BF) ¹⁾	LED green	Meaning	Cause
Off	Off	No supply voltage	
On	On	No connection to another participant (no Data_Exchange)	– Bus not connected – Master unavailable/off
On	Flash-ing ²⁾	Parameter error, no Data_Exchange	– Slave is not configured or configured incorrectly – Incorrect station address assigned (within the permissible range) – Incorrect PRM or CFG telegram received
Flash-ing ²⁾	Flash-ing ²⁾	Position error	No magnet in the valid measuring range or number of magnets is incorrect
Off	On	Data_Exchange Slave and function O.K.	BTL functions, everything O.K.

¹⁾ BF = bus error

²⁾ Flashing frequency 0.5 Hz

Tab. 5-2: LED display for Profibus encoder profile

If multiple malfunctions are present at the same time, the malfunction with the highest priority is displayed.



Detailed configuration instructions can be requested on the Internet at www.balluff.com or via email at service@balluff.de.

BTL5-T1 __ -M ___ -P-S103

Magnetostrictive Linear Position Sensor – Profile Style

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Technical data

6.1 Accuracy

The specifications are typical values for BTL5-T... at 24 V DC, and room temperature, with a nominal length of 500 mm in conjunction with the BTL5-P-3800-2, BTL5-P-4500-1, BTL5-P-5500-2¹⁾ BTL6-A-3800-2¹⁾, BTL6-A-3801-2¹⁾, BTL5-F-2814-1S, BTL5-T-2814-1S, BTL5-M-2814-1S or BTL5-N-2814-1S magnet. The BTL is fully operational immediately, with full accuracy after warm-up.



For special versions, other technical data may apply. Special versions are indicated by the suffix -SA on the part label.

Position resolution	5 µm
Non-linearity	±30 µm
Hysteresis	≤ 1 LSB
Reproducibility	≤ 2 LSB
Temperature coefficient ²⁾	≤ (6 µm + 5 ppm × nominal length)/K
Velocity resolution	0.1 mm/s
Velocity detectable max.	10 m/s

6.2 Ambient conditions³⁾

Ambient temperature	-40 °C...+85 °C
Storage temperature	-40 °C...+100 °C
Relative humidity	< 90%, non-condensing
Shock rating	100 g/6 ms
Continuous shock per EN 60068-2-27 ⁴⁾ , ⁵⁾	100 g/2 ms
Vibration per EN 60068-2-6 ⁴⁾ , ⁵⁾	12 g, 10...2000 Hz
Degree of protection per IEC 60529 when threaded together	IP67

6.3 Supply voltage (external)

Stabilized voltage ⁶⁾	20...28 V DC
Residual ripple	≤ 0.5 V _{PP}
Current draw (at 24 V DC) ⁷⁾	≤ 130 mA
Inrush current	≤ 3 A
Reverse polarity protection	yes
Overvoltage protection	Transzorb protection diodes
Dielectric strength (GND to housing)	500 V DC

6.4 Control signals

RxD/TxD-N, RxD/TxD-P, Data GND per EN 50170

6.5 Magnet

Max. number of magnets	4 ⁸⁾
------------------------	-----------------

6.6 Dimensions, weights


Nominal length	50...4000 mm
Weight (depends on length)	Approx. 1.4 kg/m
Housing material	Aluminum

6.7 Connection to the evaluation unit

Maximum length of the entire field bus cable is 1200 m. Cable twisted in pairs, shielded see Fig. 4-10.


¹⁾ In the position range 0 to 20 mm, the specified linearity limit can be exceeded by ±100 µm.

²⁾ Nominal length 500 mm, magnet in the middle of the measuring range

³⁾ For : Use in enclosed spaces and up to a height of 2000 m above sea level.

⁴⁾ Individual specifications as per Balluff factory standard

⁵⁾ Resonant frequencies excluded

⁶⁾ For : The BTL must be externally connected via a limited-energy circuit as defined in UL 61010-1, a low-power source as defined in UL 60950-1 or a class 2 power supply as defined in UL 1310 or UL 1585.

⁷⁾ Depending on the load on VP (repeater, bus termination)

⁸⁾ Number dependent on nominal length (see section 3.3)

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7

Accessories

7.1 Captive magnets

BTL5-M/N-2814-1S

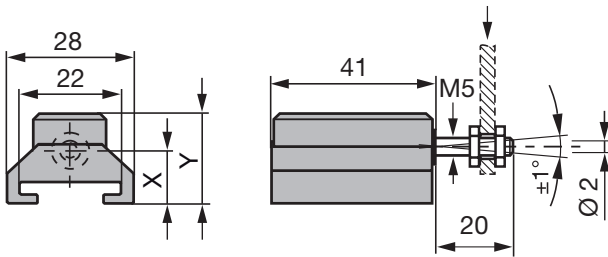


Fig. 7-1: Installation dimensions of BTL5-M/N-2814-1S magnet

	BTL5-M-2814-1S	BTL5-N-2814-1S
Distance X	12.5 mm	15 mm
Distance Y	21 mm	23.5 mm
Weight:	Approx. 32 g	Approx. 35 g
Housing:	Aluminum	Aluminum
Slide surface:	Plastic	Plastic

BTL5-F-2814-1S

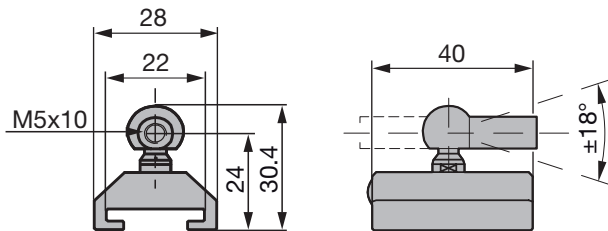


Fig. 7-2: Installation dimensions of BTL5-F-2814-1S magnet

Weight:	Approx. 28 g
Housing:	Aluminum
Slide surface:	Plastic

BTL5-T-2814-1S

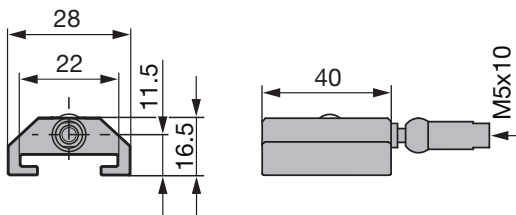


Fig. 7-3: Installation dimensions of BTL5-T-2814-1S magnet

Weight:	Approx. 28 g
Housing:	Aluminum
Slide surface:	Plastic

7.2 BTL2-GS10-____-A joint rod

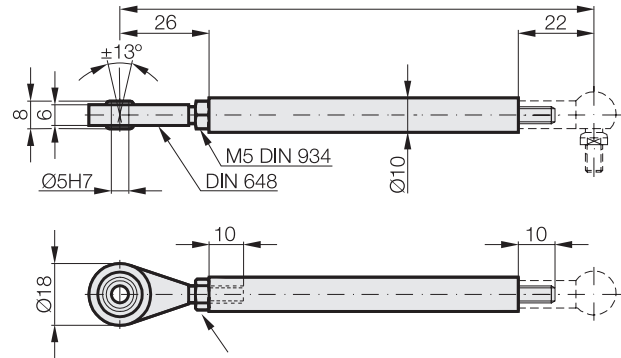


Fig. 7-4: BTL2-GS10-____-A joint rod

Weight:	ca. 150 g/m
Material:	Aluminum

¹⁾ State the nominal length when ordering

Example: BTL2-GS10-**0100**-A (nominal length = 100 mm)

7

Accessories (continued)

7.3 Floating magnets

BTL5-P-3800-2

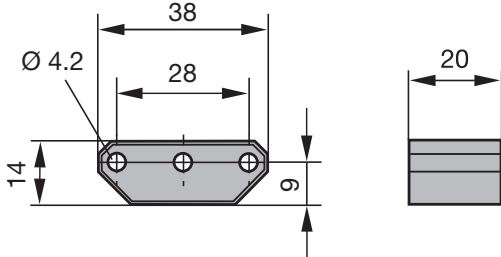


Fig. 7-5: Installation dimensions of BTL5-P-3800-2 magnet

Weight: Approx. 12 g
 Housing: Plastic

BTL5-P-5500-2

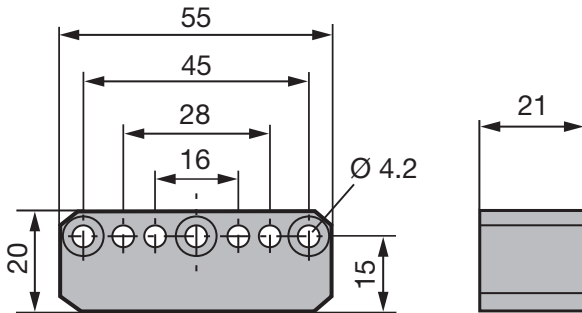


Fig. 7-6: Installation dimensions of BTL5-P-5500-2 magnet

Weight: Approx. 40 g
 Housing: Plastic

BTL6-A-3800-2

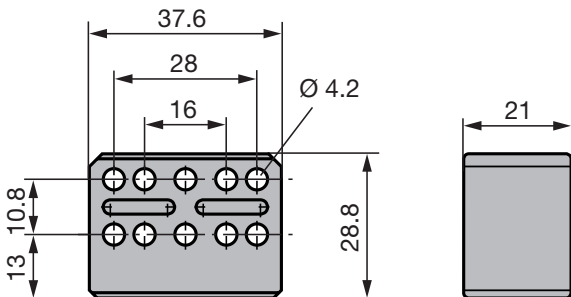


Fig. 7-7: Installation dimensions for BTL6-A-3800-2

Weight: Approx. 30 g
 Housing: Plastic

BTL6-A-3801-2

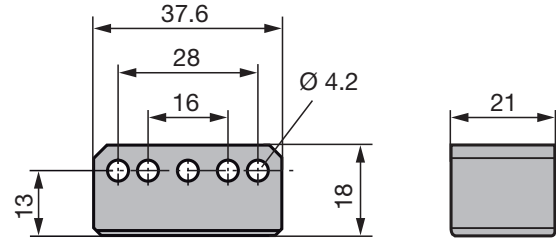


Fig. 7-8: Installation dimensions for BTL6-A-3801-2

Weight: Approx. 25 g
 Housing: Plastic

BTL5-P-4500-1

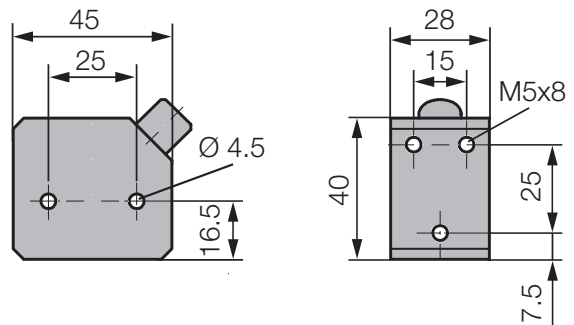


Fig. 7-9: Installation dimensions of BTL5-P-4500-1 magnet

Weight: Approx. 90 g
 Housing: Plastic
 Ambient temperature: -40 °C...+60 °C

Special advantage of the BTL5-P-4500-1 magnet: Several magnets on the same BTL can be separately switched on and off electrically (actuation with a PLC signal).

BTL5-T1__-M____-P-S103 Magnetostrictive Linear Position Sensor – Profile Style

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Accessories (continued)

7.4 Connectors and cables

7.4.1 Connector, freely configurable

BKS-S103-00

Straight connector, freely configurable
M12, 5-pole
Cable feed-through (pinch ring PG 9)

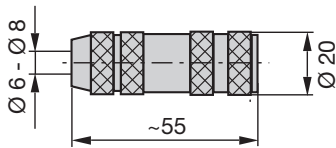


Fig. 7-10: Connector BKS-S103-00 (socket) for BUS IN

BKS-S104-00

Angled connector, freely configurable
M12, 5-pole
Cable feed-through (pinch ring PG 9)

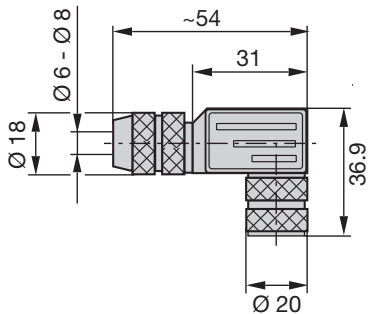


Fig. 7-11: Connector BKS-S104-00 (socket) for BUS IN

BKS-S105-00

Straight connector, freely configurable
M12, 5-pole
Cable feed-through (pinch ring PG 9)

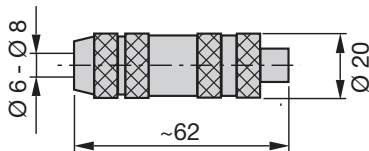


Fig. 7-12: Connector BKS-S105-00 (pin) for BUS OUT

BKS-S106-00

Angled connector, freely configurable
M12, 5-pole
Cable feed-through (pinch ring PG 9)

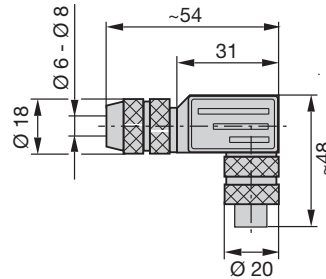


Fig. 7-13: Connector BKS-S106-00 (pin) for BUS OUT

7.4.2 Connector, preassembled

BKS-S 48-15-CP-...

Straight connector, molded, preassembled
M8, 3-pole
Various cable lengths can be ordered,
e.g. BKS-S48-15-CP-05: Cable length 5 m

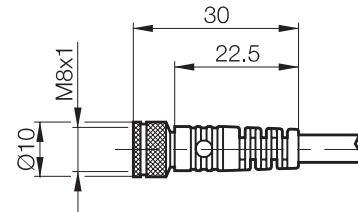


Fig. 7-14: Connector BKS-S48-15-CP-...

BTL5-T1 __ -M __ -P-S103 Magnetostrictive Linear Position Sensor – Profile Style

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Accessories (continued)

7.4.3 Connecting cable, preassembled

BKS-S103/GS103-CP-...

Connecting cable, preassembled
M12, 5-pole
Various cable lengths can be ordered, e.g. BKS-S103/
GS103-CP-05: Cable length 5 m

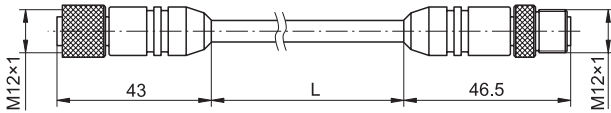


Fig. 7-15: Connecting cable BSK-S103/GS203-CP-...

BKS-S103-CP-...

Connecting cable, preassembled
M12, 5-pole
Various cable lengths can be ordered,
e.g. BKS-S103-CP-05: Cable length 5 m

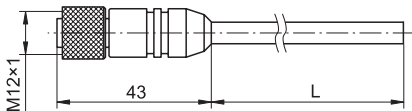


Fig. 7-16: Connecting cable BKS-S103-CP-...

BKS-S105-CP-...

Connecting cable, preassembled
M12, 5-pole
Various cable lengths can be ordered,
e.g. BKS-S105-CP-05: Cable length 5 m

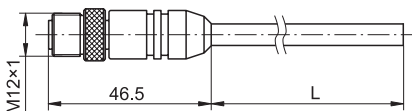


Fig. 7-17: Connecting cable BKS-S105-CP-...

7.4.4 Bus termination resistance, freely configurable

BKS-S105-R01

Bus termination resistance, freely configurable
M12, 5-pole
Installed resistors

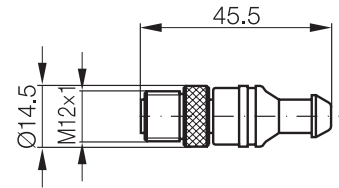


Fig. 7-18: Bus termination resistance BKS-S105-R01

7.4.5 Transparent cover

BTL5-A-CP01-K

Transparent cover, metric, M16x1.5

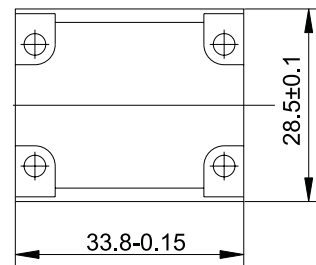


Fig. 7-19: Transparent cover, metric M16x1.5

7.4.6 Screw plugs

BKS 12-CS-01

Screw plug, brass, M12x1

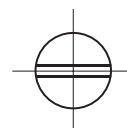
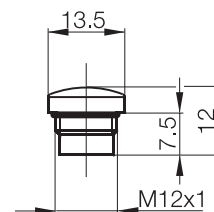


Fig. 7-20: Closing cap BKS 12-CS-01 for BUS OUT

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Type code

BTL5 - T110 - M0500 - P - S103

Interface: _____

T = PROFIBUS DP

Supply voltage: _____

1 = 20... 28 V DC

Number of magnets: _____

1 = 1 - 4, can be selected via GSD

Nominal length (4-digit): _____

M0500 = Measurements in mm, nominal length 500 mm (M0050...M4000)

Construction: _____

P = profile housing

Electrical connection: _____

S103 = 1 x 3-pin male

1 x 5-pin male

1 x 5-pin female

BTL5-T1__-M____-P-S103

Magnetostrictive Linear Position Sensor – Profile Style

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Appendix

9.1 Converting units of length

1 mm = 0.0393700787 inches

mm	inch
1	0.03937008
2	0.07874016
3	0.11811024
4	0.15748031
5	0.19685039
6	0.23622047
7	0.27559055
8	0.31496063
9	0.35433071
10	0.393700787

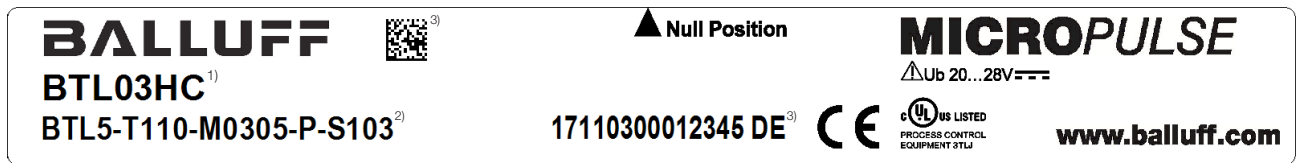
Tab. 9-1: Conversion table mm to inches

1 inch = 25.4 mm

inch	mm
1	25.4
2	50.8
3	76.2
4	101.6
5	127
6	152.4
7	177.8
8	203.2
9	228.6
10	254

Tab. 9-2: Conversion table inches to mm

9.2 Part label



- ¹⁾ Order code
- ²⁾ Type
- ³⁾ Serial number

Fig. 9-1: BTL5 part label (example)