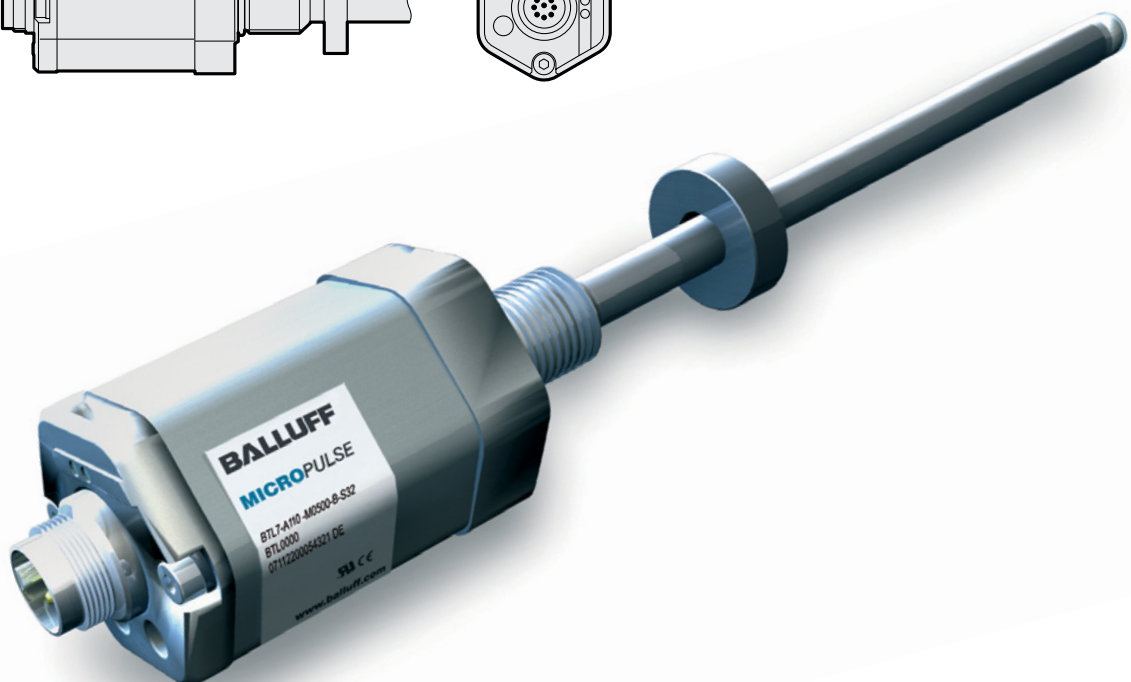
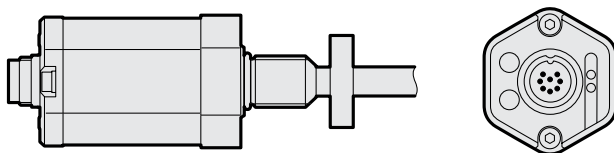


BTL7-A/C/E/G1 _ _ -M _ _ _ -A/B/Y/Z(8)-S32/S115/S135/KA _ _

User's Guide



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1 Notes to the user

1.1 Validity

This guide describes the construction, function and setting possibilities for the BTL7 Micropulse Transducer with analog interface. It applies to models **BTL7-A/C/E/G1 _ _-M _ _ _ -A/B/Y/Z(8)-S32/S115/S135/KA _ _** (see part numbering code on page 25).

The guide is intended for qualified technical personnel. Read this guide before installing the transducer and placing it in operation.

1.2 Symbols and conventions

Enumerations are shown in list form with bullet points.

Action instructions are indicated by a preceding triangle.

The result of an action is indicated by an arrow.

- ▶ Action instruction 1.
- ⇒ Action result.

Cross-references indicate where additional information on the topic can be found (see "Technical data" on page 22).



Note, tip

This symbol indicates general notes.



These symbols indicate the buttons on the calibration device.



Symbols of this type indicate the LED indicators.

1.3 Scope of delivery

- BTL7 transducer,
- calibration device,
- condensed guide.



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

1.4 Approvals and markings



UL authorization
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 EC Directive 2004/108/EG (EMC Directive).

The transducer meets the requirements of the following Generic Standards:

- EN 61000-6-2 (noise immunity)
- EN 61000-6-4 (Emission)

Emission tests:

- RF emission
EN 55011 Group 1, Class A and B

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 |

2

Safety

2.1 Intended use

The BTL7 Micropulse Transducer together with a machine controller (PLC) comprises a displacement measurement system. It is fitted into a machine or piece of equipment for its application. Flawless function in accordance with the specifications in the technical data is ensured only when using original BALLUFF accessories, and use of any other components will void the warranty.

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

2.2 General safety notes for the transducer system

Installation and startup are to be performed only by trained specialists.

The **operator** is responsible for ensuring that local safety regulations are observed.

In particular, the operator must take measures ensure that a defect in the displacement measurement system will not result in hazards to persons or equipment.

When defects and non-clearable faults in the transducer occur, take it out of service and secure against unauthorized use.

2.3 Meaning of the warnings



Note!

The pictogram used with the word "Caution" warns of a possible hazardous situation affecting the health of persons or equipment damage. Ignoring these warnings can result in injury or equipment damage.

- Always observe the described measures for preventing this danger.
-

BTL7-A/C/E/G1 _ _-M _ _ _-A/B/Y/Z(8)-S32/S115/S135/KA _ _ Micropulse Linear Transducer - Rod-Style

3

Construction and Function

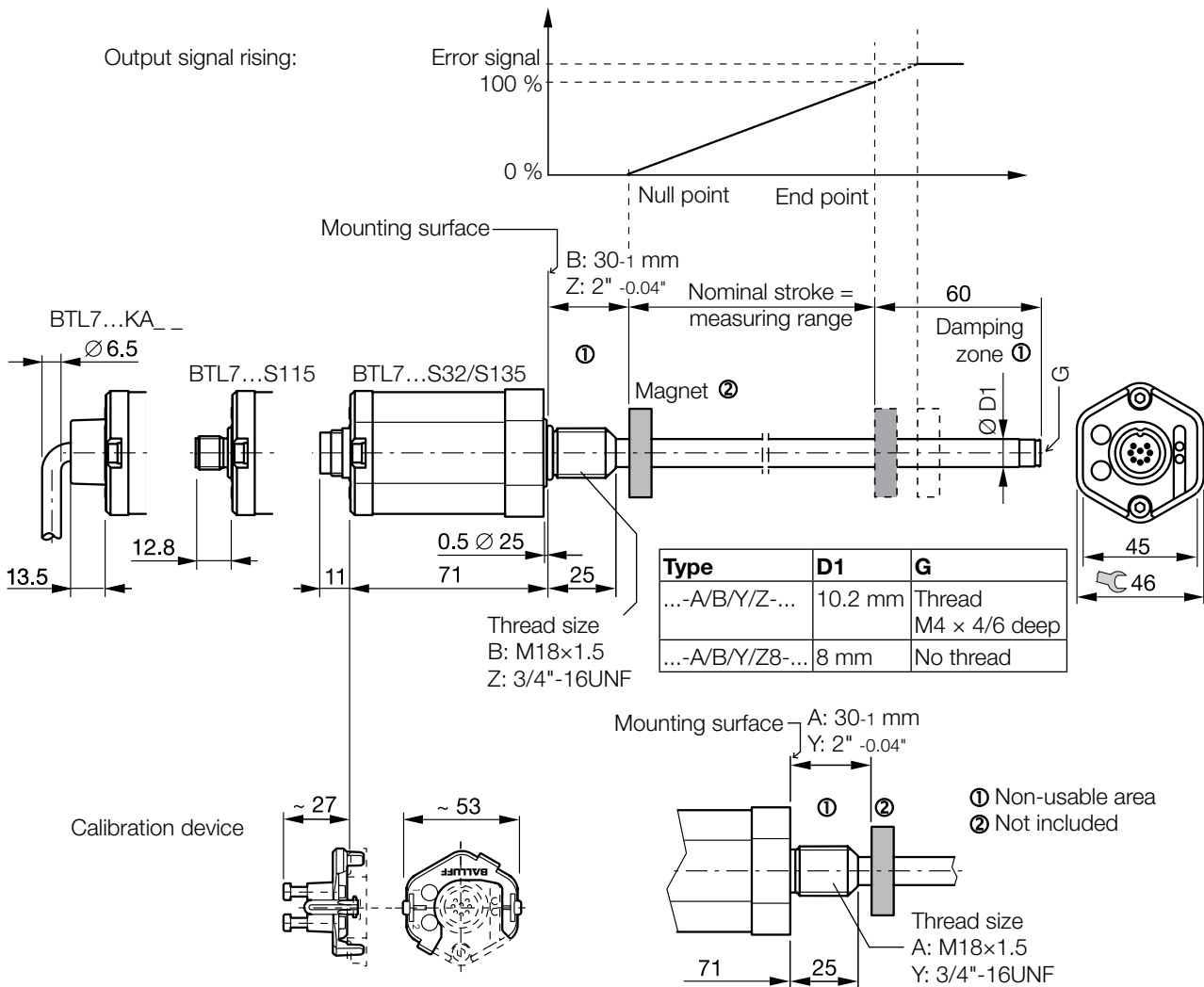


Fig. 3-1: BTL7 Transducer... construction and function

3.1 Construction

Electrical connection: Depending on the version the electrical connection is made via a cable or a connector (see part numbering code on page 25).

BTL housing: Aluminum housing containing the processing electronics.

Mounting thread: It is recommended that the transducer be installed using its mounting threads.

- BTL7-...-A/B: M18x1.5,
- BTL7-...-Y/Z: 3/4"-16UNF.

The transducers having Ø 10.2 mm include an additional thread at the rod end to be used for support with long stroke lengths.

Magnet: Defines the position to be measured on the waveguide. Magnets are available in various form factors and must be ordered separately (see accessories on page 23).

Nominal stroke length: Defines the travel/length area available. Rods with various nominal stroke lengths are available depending on the model:

- Ø 10.2 mm: Nominal stroke length from 25 mm to 7600 mm
- Ø 8 mm: Nominal stroke length from 25 mm to 1016 mm.

Damping zone: Unusable zone at the end of the rod which may not be entered without generating a spurious signal.

Calibration device: Additional device for calibrating the transducer.

3 Construction and function (cont.)

3.2 Function

The BTL7 transducer contains the waveguide which is protected by an outer stainless steel tube (rod). A magnet is moved along the waveguide. This magnet is attached to the moving member of the equipment whose position is being determined.

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

An internally generated INIT pulse together with the magnetic field from the magnet generates a torsional wave in the waveguide through the magnetostrictive effect which propagates along the waveguide 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 component of the torsional wave which arrives at the beginning of the waveguide is converted by a coil into an electrical signal. The travel time of the wave is used to calculate the position. Depending on the BTL7 version, this information is made available as a voltage or current with rising or falling gradient.

3.3 LED indicator

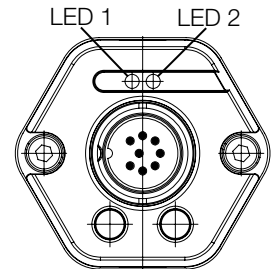


Fig. 3-2: BTL7 LED indicators

i In normal operation only LED 1 indicates the operating states of the transducer. Both LED's together are used for displaying additional information in programming mode (see page 17 ff).

LED 1	LED 2	Operating status
green	off	Normal function (magnet is within the measuring range)
Red flashing		Measuring range left (magnet is outside the measuring range)
red		Error (no magnet or magnet outside the limits)

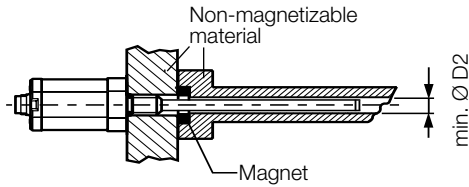
Tab. 3-1: LED indicators in normal operation

4

Installation

4.1 Installation variants

Non-magnetizable material

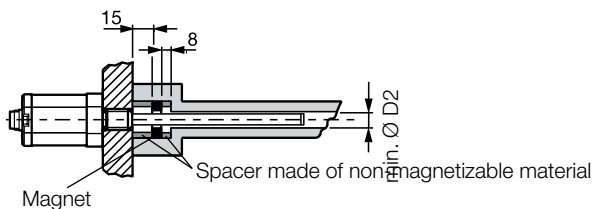
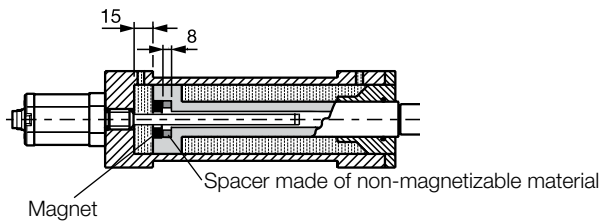


min. Ø D2: Minimum hole diameter

Fig. 4-1: Installation variants in non-magnetizable material

Magnetizable material

When using magnetizable material, the transducer must be protected from magnetic disturbances by suitable means (e.g. spacer ring made of non-magnetizable material, sufficient distance from strong external magnetic fields).



min. Ø D2: Minimum hole diameter

Fig. 4-2: Installation variants in magnetizable material

Tube diameter	Hole diameter D2
10.2 mm	minimum 13 mm
8 mm	minimum 11 mm

Tab. 4-1: Hole diameter for installation in a hydraulic cylinder

4.2 Preparing for installation

Installation variant: For holding the transducer and magnet we recommend non-magnetizable material.

Horizontal mounting: For horizontal mounting with nominal stroke lengths > 500 mm we recommend fastening the tube at its end (only possible for Ø 10.2 mm tube) or supporting it.

Hydraulic cylinders: When installing in a hydraulic cylinder, be sure to keep the minimum value for the hole diameter of the piston (see Tab. 4-1).

Threaded hole: The transducer comes with an M18×1.5 (ISO) or 3/4"-16UNF (SAE) mounting thread. Depending on the model, the threaded hole must be prepared before installation.

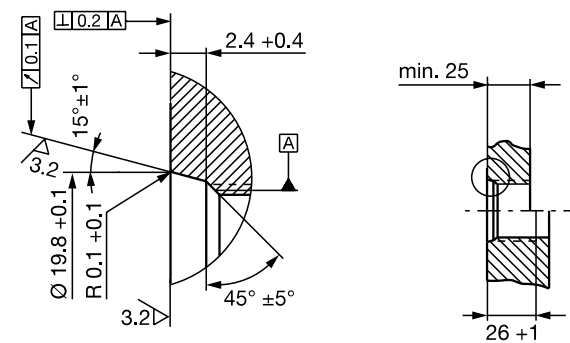


Fig. 4-3: Threaded hole M18×1.5 per ISO 6149, O-Ring 15.4×2.1

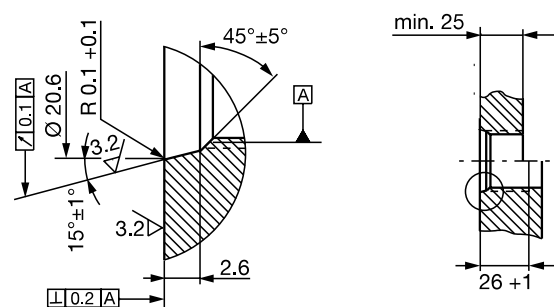


Fig. 4-4: Threaded hole 3/4"-16UNF per SAE J475, O-ring 15.3×2.4

Magnets: Various magnets are available for the BTL7 transducer (see accessories on page 23).

4 Installation (continued)

4.3 Installing the transducer



Note!

Improper installation can compromise the function of the transducer and result in increased wear.

- ▶ The flange surface of the transducer must make full contact with the mounting surface.
- ▶ The hole must be perfectly sealed (O-ring/flange gasket).

- ▶ Construct threaded hole (and, if needed, recess for the O-ring) as per Fig. 4-3 and Fig. 4-4.
- ▶ Thread the transducer into the threaded hold (max. tightening torque 100 Nm).
- ▶ Install magnet (accessory).
- ▶ Nominal stroke length 500 mm or longer: Fasten rod at its end (only possible for 10.2 mm rod) or support it.



Appropriate nuts for the mounting thread are available as accessories (see page 23).

4.3.1 Installation recommendation for hydraulic cylinders

When sealing the hole using a flat gasket, the max. operating pressure is reduced based on the larger surface subjected to pressure

For horizontal installation in hydraulic cylinders (nominal stroke lengths > 500 mm) we recommend using a slide element.



Detailed dimensioning is the responsibility of the cylinder manufacturer.

The slide element material must be matched to the load situation, the medium used and the relevant temperatures. Possible materials include Torlon, Teflon or bronze.

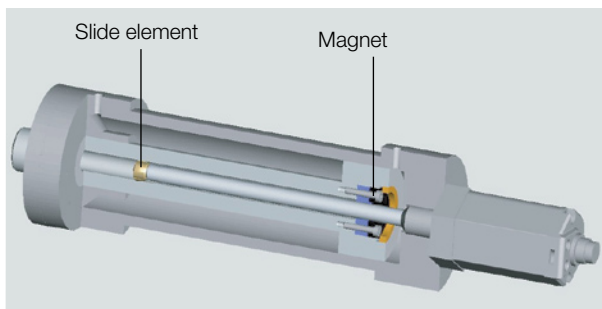


Fig. 4-5: Installation in a hydraulic cylinder

The slide element may be threaded or glued on.

- ▶ Secure the screw from loosening or becoming detached.
- ▶ Use a suitable glue.

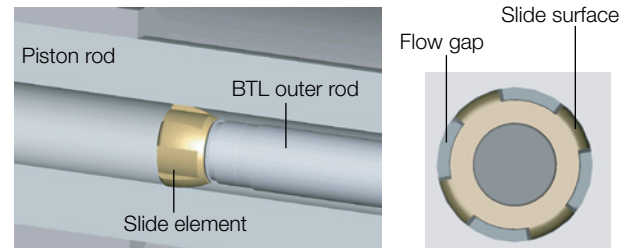


Fig. 4-6: Detail view and top view of slide element

There must be a sufficient gap between the slide element and the piston hole to allow for the flow of hydraulic fluid.

Methods of attaching the magnet:

- Screws
- Threaded ring
- Press-in
- Indentation (center punching)

The hole in the spacer must be matched to the slide element for optimal guiding of the protective tube.

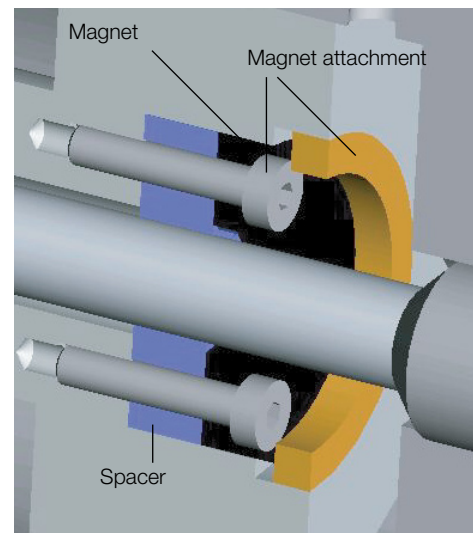


Fig. 4-7: Magnet attachment

BTL7-A/C/E/G1 _ _-M _ _ _-A/B/Y/Z(8)-S32/S115/S135/KA_ _ Micropulse Linear Transducer - Rod-Style

5 Startup

5.1 Electrical connection

Depending on the model, the electrical connection is made using a cable (KA_ _) or a connector (S32, S115 or S135). The wire assignments or pinout depends on the respective model (see Tab. 5-1, 5-2, 5-3, 5-4).

5.1.1 Connector type S32

PIN	Interface BTL7-...					
	-A110	-G110	-C100	-C170	-E100	-E170
1	not used ¹⁾		0...20 mA	20...0 mA	4...20 mA	20...4 mA
2	0 V					
3	10...0 V	10...-10 V	not used ¹⁾			
4	La (programming input)					
5	0...10 V	-10...10 V	not used ¹⁾			
6	GND ²⁾					
7	+24 V					
8	Lb (programming input)					

Tab. 5-1: Pinout for S32 connector

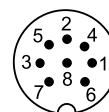


Fig. 5-1: Pinout for S32 connector (topview of connector on transducer)

5.1.2 Connector type S115

PIN	Interface BTL7-...					
	-A110	-G110	-C100	-C170	-E100	-E170
1	0 V (Pin 3)					
2	0 V (Pin 5)					
3	10...0 V	10...-10 V	not used ¹⁾			
4	La (programming input)					
5	0...10 V	-10...10 V	0...20 mA	20...0 mA	4...20 mA	20...4 mA
6	GND ²⁾					
7	+24 V					
8	Lb (programming input)					

Tab. 5-2: Pinout for S115 connector

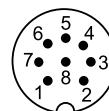


Fig. 5-2: Pinout for S115 connector (topview of connector on transducer)

1) Unused wires may be connected to GND on the controller side, but not to the shield.

2) Reference potential for supply voltage and EMC GND.

BTL7-A/C/E/G1 _ _ -M _ _ _ -A/B/Y/Z(8)-S32/S115/S135/KA _ _ Micropulse Linear Transducer - Rod-Style

5 Startup (cont.)

5.1.3 Connector type S135

PIN	Interface BTL7-...					
	-A110	-G110	-C100	-C170	-E100	-E170
1	0...10 V	-10...10 V	0...20 mA	20...0 mA	4...20 mA	20...4 mA
2	0 V (Pin 1)					
3	10...0 V	10...-10 V	not used ¹⁾			
4	0 V (Pin 3)		not used ¹⁾			
5	+24 V					
6	GND ²⁾					

Tab. 5-3: Pinout for S135 connector

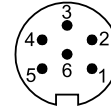


Fig. 5-3: Pinout for S135 connector (topview of connector on transducer)

5.1.4 Cable connection KA _ _

Cable color	Interface BTL7-...					
	-A110	-G110	-C100	-C170	-E100	-E170
YE yellow	not used ¹⁾		0...20 mA	20...0 mA	4...20 mA	20...4 mA
GY gray	0 V					
PK pink	10...0 V	10...-10 V	not used ¹⁾			
RD red	La (programming input)					
GN green	0...10 V	-10...10 V	not used ¹⁾			
BU blue	GND ²⁾					
BN brown	+24 V					
WH white	Lb (programming input)					

Tab. 5-4: Cable connection assignments

- 1) Unused wires may be connected to GND on the controller side, but not to the shield.
2) Reference potential for supply voltage and EMC GND.

5 Startup (cont.)

5.2 Shielding and cable routing



Defined ground!

The transducer and the control cabinet must be at the same ground potential.

Shielding

To ensure electromagnetic compatibility (EMC) observe the following:

- Connect transducer and controller using a shielded cable.
Shield: Braided copper shield with minimum 80% coverage.
- Connector version: Area connection of shield in connector with the connector body.
- Cable version: Connect cable shield to housing on transducer side.
Ground cable shield on controller side (connect to protection ground).

Magnetic Fields

The transducer system is a magnetostrictive system. Ensure that there is sufficient distance between the transducer and between the holding cylinder and strong, external magnetic fields.

Cable routing

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

Bending radius for fixed cable

The bending radius for fixed cable must be at least twice the cable diameter.

Cable length

Linear Transducer	Maximum cable length ¹⁾	Cable diameter
BTL7-A/G	30 m	6 - 8 mm
BTL7-C/E	100 m	

Tab. 5-5: Cable lengths

1) Prerequisite: Construction, shielding and routing preclude the effect of any external noise fields.

5.3 Starting up the system



Note!

When starting up and if the displacement measurement system is part of a closed loop system whose parameters are not yet set, the system may exhibit uncontrolled movements. This could result in personal injury and equipment damage.

- ▶ Startup should be performed only by trained technical personnel.
- ▶ Observe 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.
Especially after replacing the transducer or after repair by the manufacturer, check for correct null point and end point values. If necessary recalibrate the transducer (see page 14 ff).

5.4 Operating notes

- Check the function of the transducer and all associated components on a regular basis.
- Take the displacement measurement system out of operation whenever there is a malfunction. Secure the system against unauthorized use.

6 Calibration procedure

6.1 Calibration device

The calibration device is an ancillary device for setting up the transducer.

- ▶ Before calibrating: Place the calibration device on the connection side of the transducer.
- ▶ When finished: Remove the calibration device to prevent changes.
- ▶ Keep the calibration device for later use.



Automatic deactivation!

If the buttons on the calibration device are not pressed for approx. 10 min., the Programming mode is automatically quit.

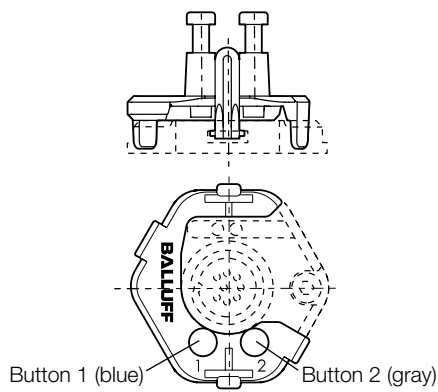


Fig. 6-1: Calibration device in place

6.2 Programming inputs (not for BTL7-...-S135)

Instead of the calibration device, the programming inputs may also be used for setup.

- La corresponds to button 1,
- Lb corresponds to button 2,
- Programming input at +24V (high active) corresponds to button depressed.



Automatic deactivation!

If no signals are sent over the programming inputs for approx. 10 min., Programming mode is automatically ended.

6.3 Calibration procedure overview

6.3.1 Teach-in

The factory set null and end point is replaced by a new null and end point.



The detailed procedure for teach-in is described on page 17.

Steps:

- ▶ Move magnet to the new null position.
- ▶ Read null point by pressing the buttons.

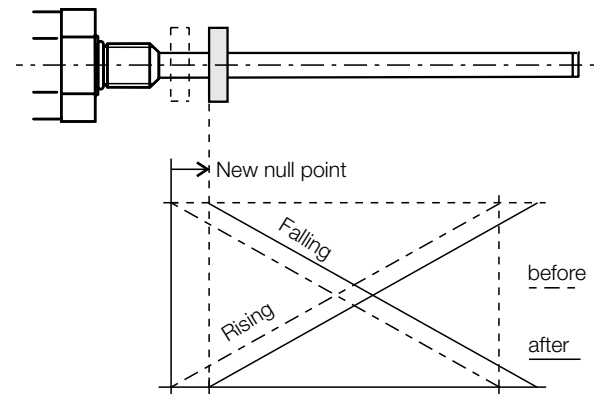


Fig. 6-2: Reading new null point (offset shift)

- ▶ Move magnet to the new end position.
- ▶ Read end point by pressing the buttons.

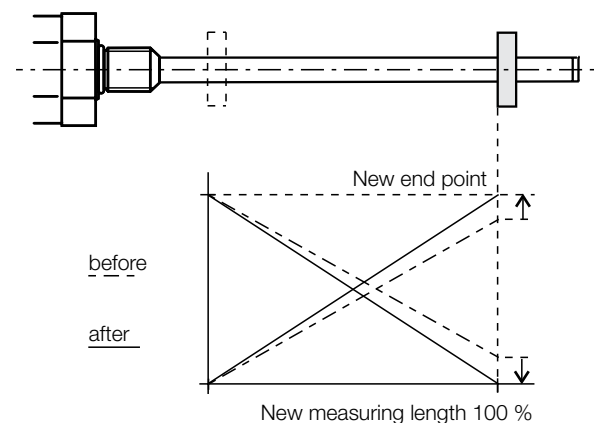


Fig. 6-3: Reading new end point (changing the output gradient)

6 Calibration procedure (cont.)

6.3.2 Adjusting

i The detailed procedure for adjustment is described starting page 18.

A new start and/or end value is adjusted. This is recommended when the magnet cannot be brought to the null or zero point.

Steps:

- Move magnet to the new start position.
- Set the new start value by pressing the buttons.

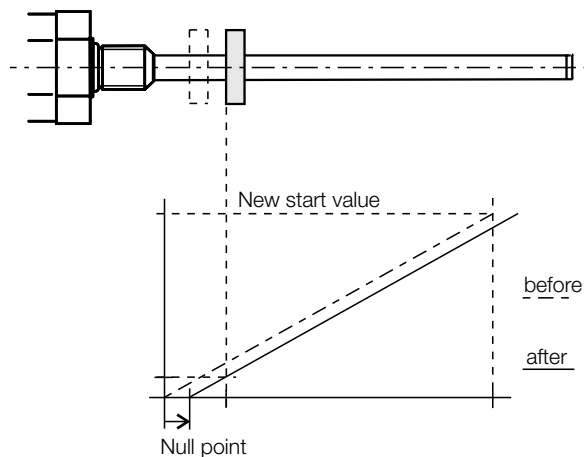


Fig. 6-4: Adjusting new start position (offset shift)

- Move magnet to the new end position.
- Set the new end value by pressing the buttons.

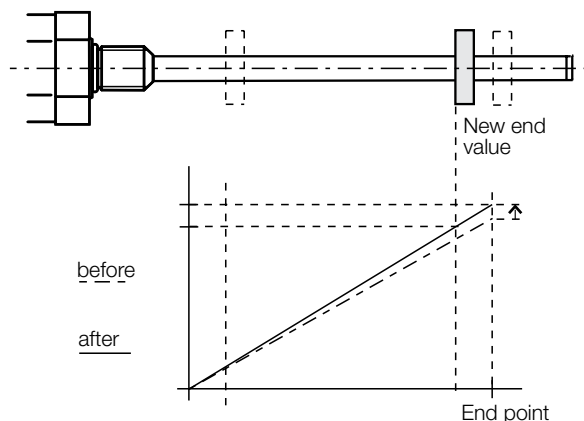


Fig. 6-5: Reading new end position (changing the output gradient)

6.3.3 Online setting

i The detailed procedure for online setting is described on page 20.

Setting start and end values while the system is running.

6.3.4 Reset

i The detailed procedure for the reset is described on page 21.

Restoring the transducer to its factory settings.

6.4 Selecting the calibration procedure

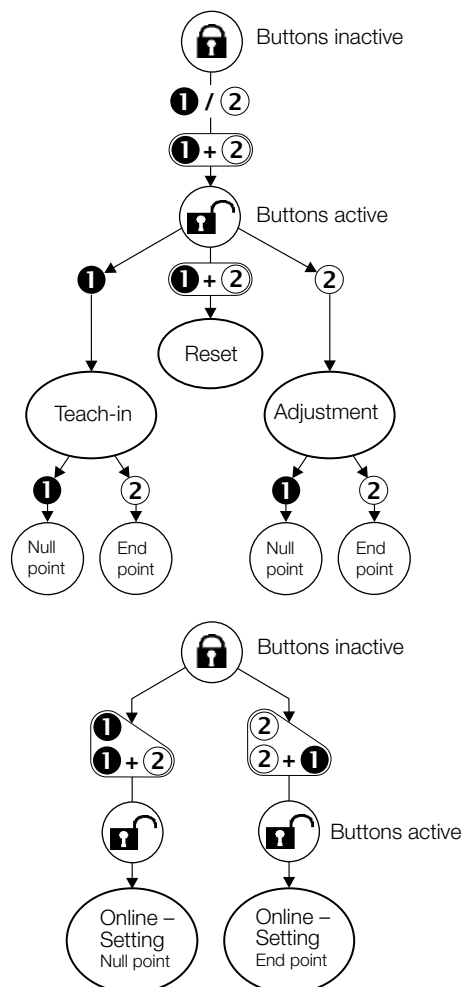


Fig. 6-6: Selecting the calibration procedure

6 Calibration procedure (cont.)

6.5 Calibration procedure notes

Prerequisites

- The calibration device is in place or the programming inputs are connected.
- The transducer is connected to the system controller.
- Voltage or current values from the transducer can be read (using a multimeter or the system controller).

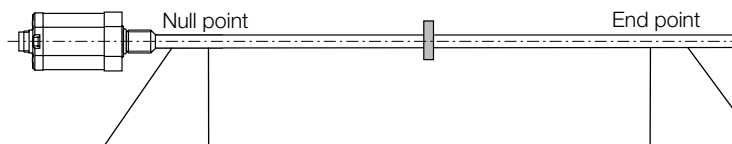
Values for null and end point

- Any desired position of the magnet can be used as the null or end point. The null and end points may not however be reversed.
- The absolute null and end points must lie within the minimum or maximum limits of what can be output (see value table).
- The distance between the null point and end point must be at least 4 mm.

i The last set values are always saved, regardless of whether the setting was made using the buttons, the programming inputs or automatically after 10 min. have expired.

Value table for teach-in and adjustment

i The following examples refer to transducers with 0...10 V or 4...20 mA output. For all other versions, use the values in the value table below.



Output gradient	Linear Transducer	Unit	Min. value	Null value	Identifier for adjustment	Identifier for Teach-in	End value	Max. value	Error value
Rising	BTL7-A...	V	-0.5	0	2.0	4.0	+10.0	+10.5	+10.5
	BTL7-G...	V	-10.5	-10.0	2.0	4.0	+10.0	+10.5	+10.5
	BTL7-C...	mA	0	0	6.0	12.0	20.0	20.4	20.4
	BTL7-E...	mA	3.6	4.0	6.0	12.0	20.0	20.4	3.6
Falling	BTL7-A...	V	+10.5	+10.0	8.0	6.0	0	-0.5	-0.5
	BTL7-G...	V	+10.5	+10.0	-2.0	-4.0	-10.0	-10.5	-10.5
	BTL7-C...	mA	20.4	20.0	14.0	8.0	0	0	20.4
	BTL7-E...	mA	20.4	20.0	14.0	8.0	4.0	3.6	3.6

Tab. 6-1: Value table for Teach-in and adjustment

7

Calibration using Teach-in



Note!

Teach-in while the system is running may result in malfunctions.
 ► Stop the system before performing teach-in.

Output:

- Transducer with magnet within measuring range

1. Activate buttons

- Hold down any button for at least 3 s.
- Release button.
- Within 1 s ① and ② at the same time hold down for at least 3 s.
 - ⇒ Output indicates error value.
 - ⇒ Buttons are activated.



If an error occurs or an interruption while activating the buttons, allow a wait time of **12 s** before retrying.

2. Select Teach-in

- ① Hold down for at least 2 s.
 - ⇒ Indication for "Teach-in" is displayed.
- ① Release.
 - ⇒ Current position value is displayed.

3. Set null point

- Bring magnet to the new null point.
- ① Hold down for at least 2 s.
 - ⇒ The new null point is set.

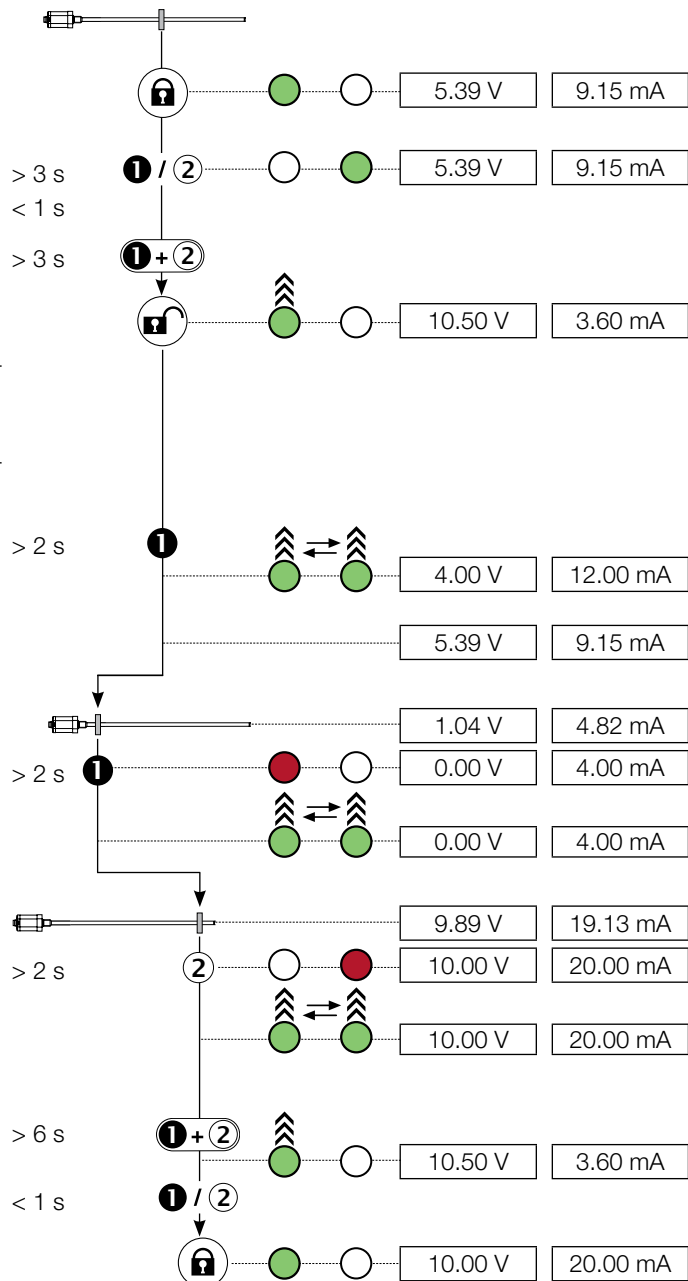
4. Set end point

- Bring magnet to the new end point.
- ② Hold down for at least 2 s.
 - ⇒ The new end point is set.

5. Quit Teach-in and deactivate buttons

- ① and ② hold down simultaneously for at least 6 s.
 - ⇒ Output indicates error value.
- ① or ② press briefly (< 1 s).
 - ⇒ Buttons are deactivated.
 - ⇒ Current position value is displayed.

LED indicator Displayed values (example)
 LED1 LED2 at 0...10 V at 4...20 mA



LED legend:

○ LED not on

● LED green solid on

● LED red



LED green flashing



LED 1 and LED 2 flashing green-green in alternation

8

Calibration using adjustment



Note!

Adjustment while the system is running may result in malfunctions.

- Stop the system before performing adjustment.

Output:

- Transducer with magnet within measuring range

1. Activate buttons

- Hold down any button for at least 3 s.
- Release button.
- Within 1 s ① and ② at the same time hold down for at least 3 s.
 - ⇒ Output indicates error value.
 - ⇒ Buttons are activated.



If an error occurs or an interruption while activating the buttons, allow a wait time of **12 s** before retrying.

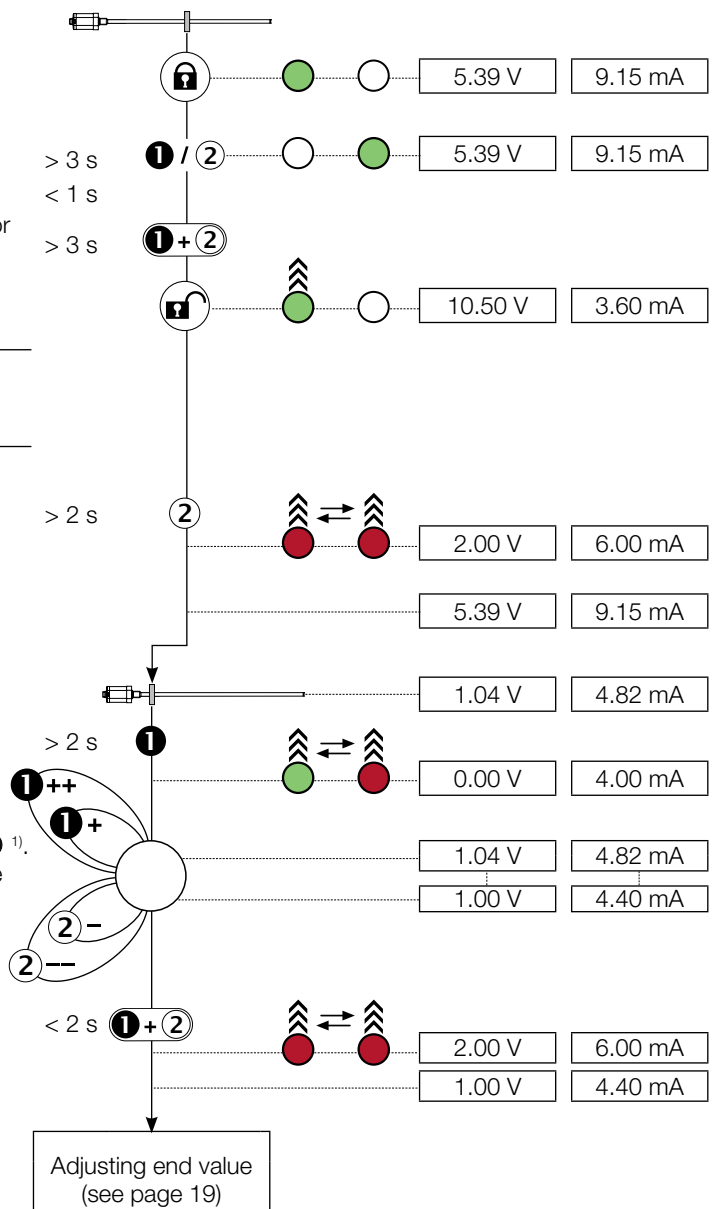
2. Select Adjustment

- ② Hold down for at least 2 s.
 - ⇒ Indication for "Adjustment" is displayed.
- ② Release.
 - ⇒ Current position value is displayed.

3. Adjust start value

- Bring magnet to start position.
- ① Hold down for at least 2 s.
 - ⇒ Indication for "Adjust start value" is displayed.
- Adjust start value.
 - ⇒ The start value can be changed using ① and ② ¹⁾. The gradient of the output remains constant (see page 15).
- Quit calibration procedure: Press ① and ② for no more than 2 s.
 - ⇒ Indication for "Adjustment" is displayed.
 - ⇒ Set position value is saved..

LED indicator Displayed values (example)
 LED1 LED2 at 0...10 V at 4...20 mA



1) Press button briefly: Current value is increased or decreased by approx. 1 mV or 1 µA. If a button is held down longer than 1 s, the step interval is increased.

LED legend:	○ LED not on	⬆⬆⬆ LED 1 and LED 2 flashing green-red in alternation
	● LED green solid on	⬆⬆⬆ LED 1 and LED 2 flashing red-red in alternation
	⬆ LED green flashing	

8

Calibration using adjustment (cont.)

4. Adjusting end value

- Bring magnet to end position.
- ② Hold down for at least 2 s.
 - ⇒ Indication for "Adjust end value" is displayed.
- Adjusting end value
 - ⇒ The end value can be changed using ① and ②¹⁾. The gradient of the output is changed, but the null value remains unchanged (see page 15).
- Quit calibration procedure: Press ① and ② for no more than 2 s.
 - ⇒ Indication for "Adjustment" is displayed.
 - ⇒ Set position value is saved.

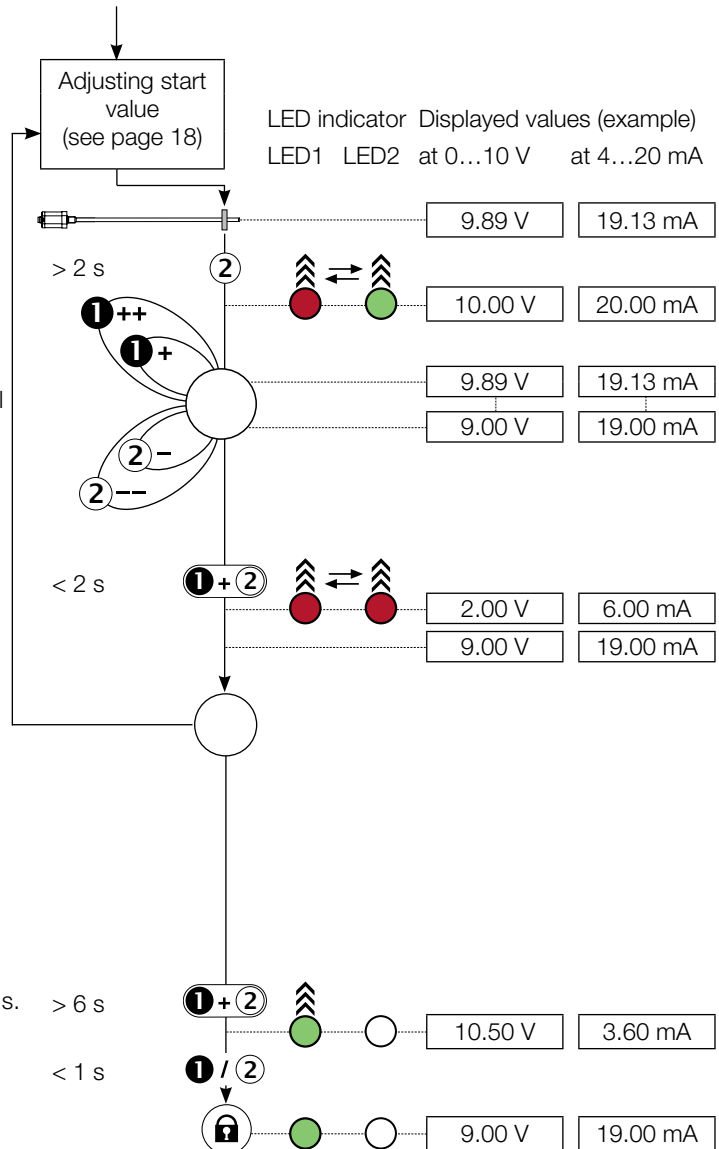


Check values

The settings for the start value and end value have a mutual effect depending on the measuring position. Repeat steps 3 and 4 until the desired values are exactly set.

5. Quit Adjustment and deactivate buttons

- ① and ② hold down simultaneously for at least 6 s.
 - ⇒ Output indicates error value.
- ① or ② press briefly (< 1 s).
 - ⇒ Buttons are deactivated.
 - ⇒ Current position value is displayed.



1) Press button briefly: Current value is increased or decreased by approx. 1 mV or 1 µA. If a button is held down longer than 1 s, the step interval is increased.

LED legend:

○ LED not on

● LED green solid on

⏏ LED green flashing



LED 1 and LED 2 flashing red-green in alternation



LED 1 and LED 2 flashing red-red in alternation

9

Calibration using online setting



Note!

Changing the BTL output signal may result in personal injury and equipment damage if the system is ready to run.

- Persons must stay away from the hazardous areas of the equipment.

In online setting the system is not shut down. The start and end value are set online.

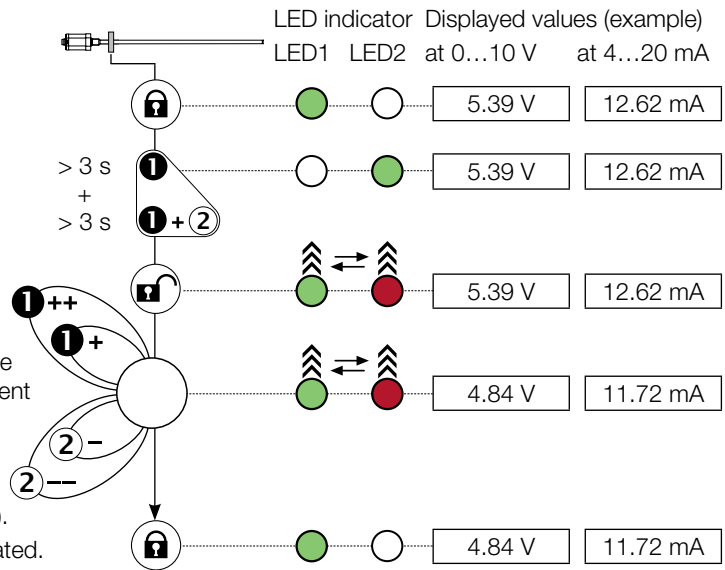
Maximum setting range for each calibration procedure:

Start value: $\pm 25\%$ of present stroke
 End value: $\pm 25\%$ of present output value

If the desired value cannot be attained in the first calibration procedure (max. setting range exceeded), the calibration procedure must be started again.

1. Setting start value online:

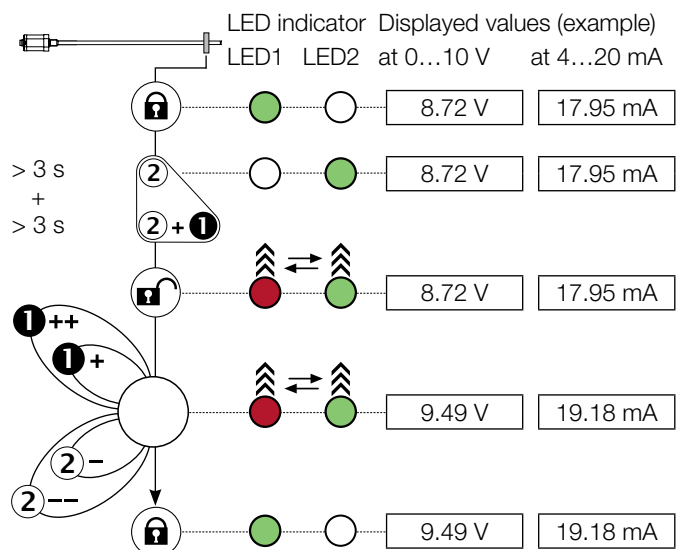
- Move the system so that the magnet is in the start position.
- **1** Hold down for at least 3 s.
- Hold **1** down and press additionally press **2** for at least 3 s.
- ⇒ Buttons are activated.
- Setting the start value.
- ⇒ Using **1** and **2** you can change the start value within the permissible setting range¹⁾. The gradient of the output remains constant (see page 15).
- Quit setting (do not press a button for at least 15 s).
- ⇒ The start value is saved, the buttons are deactivated.



After each calibration procedure you must wait for the lockout time of **15 s**. This also applies to switching between the start value and end value setting.

2. Setting end value online:

- Move the system so that the magnet is in the end position.
- **2** Hold down for at least 3 s.
- Hold **2** down and press additionally press **1** for at least 3 s.
- ⇒ Buttons are activated.
- Set end value.
- ⇒ Using **1** and **2** you can change the end value within the permissible setting range¹⁾. The gradient of the output is changed, but the null value remains unchanged (see page 15).
- Quit setting (do not press a button for at least 15 s).
- ⇒ The end value is saved, the buttons are deactivated.



¹⁾ Press button briefly: Present value is increased or decreased by approx. mV or 1 μ A. If a button is held down longer than 1 s, the step interval is increased.

LED legend:

○ LED not on

● LED green solid on



LED 1 and LED 2 flashing green-red in alternation



LED 1 and LED 2 flashing red-green in alternation

10

Resetting all values (Reset)



Note!

Resetting the values while the system is running may result in malfunctions.

- Stop the system before performing the reset.

The Reset function can be used to restore all the settings to the factory settings. For a Reset the magnet may also be located outside the measuring range.

1. Activate buttons

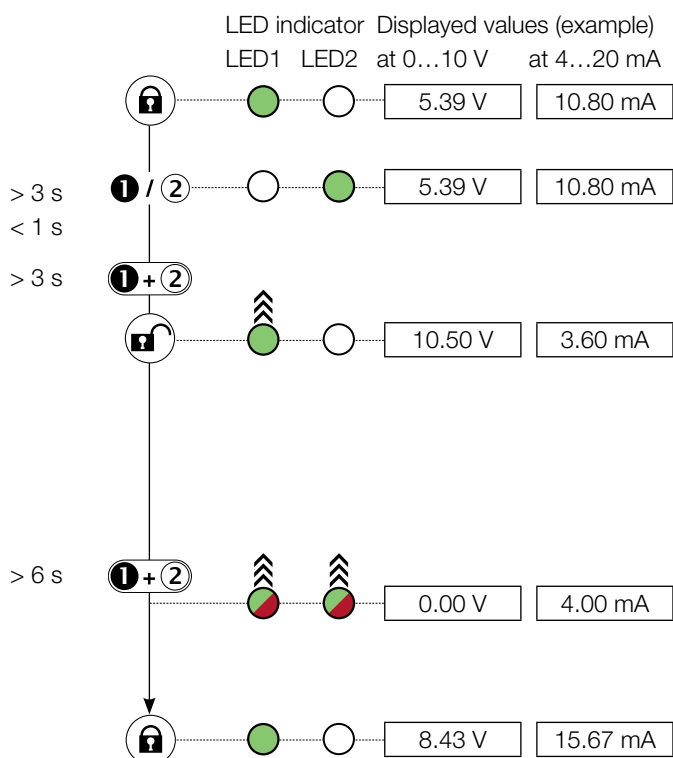
- Hold down any button for at least 3 s.
- Release button.
- Within 1 s ① and ② at the same time hold down for at least 3 s.
 - ⇒ Output indicates error value.
 - ⇒ Buttons are activated.



If an error occurs or an interruption while activating the buttons, allow a wait time of **12 s** before retrying.

2. Reset

- ① and press ② for at least 6 s.
 - ⇒ Output indicates null value.
 - ⇒ All values are reset.
- Release buttons.
 - ⇒ Current position value is displayed.
 - ⇒ Buttons are locked.



LED legend:

LED not on

LED green solid on

LED green flashing

LED 1 and LED 2 flashing green-red together

BTL7-A/C/E/G1 _ _ -M _ _ _ -A/B/Y/Z(8)-S32/S115/S135/KA _ _ Micropulse Linear Transducer - Rod-Style

11

Technical Data

11.1 Accuracy

Typical values at 24 V DC and room temperature. BTL7-A... or BTL7-E..., nominal stroke length BTL = 500 mm. Ready immediately, full accuracy after warmup phase. Together with magnet BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1014-2R, BTL-P-1012-4R or BTL-P-0814-GR-PAF.



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

Repeatability	
Voltage, typical	±10 µm
Current, typical	±5 µm
Sampling rate	
depends on nominal stroke length	250 µs ... 5.4 ms
at nominal stroke length= 500 mm	500 µs
Non-linearity at	
nominal stroke length ≤ 500 mm	±50 µm
nominal stroke length > 500 to ≤ 5500 mm	±0.01 % FS
nominal stroke length > 5500 mm	±0.02 % FS
Temperature coefficient	
(nominal stroke length = 500 mm, magnet in middle of measuring range)	≤ 30 ppm/K

11.2 Ambient conditions

Operating temperature	-40 °C to +85 °C
Storage temperature	-40 °C to +90 °C
Relative humidity	< 90 %, non-condensing
Pressure rating (when installed in hydraulic cylinders),	
at Ø 8 mm	≤ 250 bar
at Ø 10.2 mm	≤ 600 bar
Shock rating per IEC 60068-2-27 ¹⁾	150 g/6 ms
Continuous shock per IEC 60068-2-29 ¹⁾	150 g/2 ms
Vibration per IEC 60068-2-6 ¹⁾ (note resonant frequency of the outer rod)	20 g, 10 – 2000 Hz
Degree of protection per IEC 60529	
Connector S32/S115/S135 (when attached)	IP67
Cable KA _ _	IP68 ¹⁾

11.3 Supply voltage (external)

Voltage, stabilized	20 to 28 V DC
Ripple	≤ 0.5 V _{pp}
Current draw (at 24 V DC)	≤ 150 mA
Inrush	≤ 500 mA/10 ms
Polarity reversal protected	to 36 V
Overvoltage protection	to 36 V
Dielectric strength GND to housing	500 V AC

11.4 Outputs

BTL7-A... Output voltage	0...10 V and 10...0 V
Load current	≤ 5 mA
BTL7-C... Output current	0...20 mA / 20...0 mA
Load resistance	≤ 500 Ohms
BTL7-E... Output current	4...20 mA / 20...4 mA
Load resistance	≤ 500 Ohms
BTL7-G... Output voltage	-10...10 V and 10...-10 V
Load current	≤ 5 mA
Short circuit protected	Signal line to 36 V Signal line to GND

11.5 Inputs

Programming inputs La, Lb	20 to 28 V DC high-active
Overvoltage protection	to 36 V

11.6 Dimensions, weights

Diameter of outer rod	8 mm or 10.2 mm
nominal stroke length for	
Ø 8 mm	≤ 1016 mm
Ø 10.2 mm	≤ 7600 mm
Weight (depends on length)	approx. 2 kg per m
Housing material	Anodized aluminum
Outer rod material	Stainless steel 1.4571
Outer rod wall thickness	
for Ø 8 mm	0.9 mm
for Ø 10.2 mm	2 mm
Young's modulus	approx. 200 kN/mm ²
Mounting thread	M18×1.5 or 3/4"-16UNF

1) Individually determined according to Balluff Factory Standard

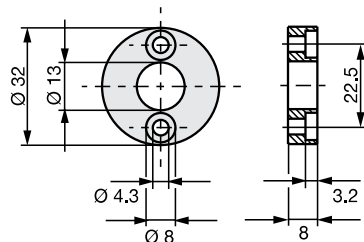
12

Accessories

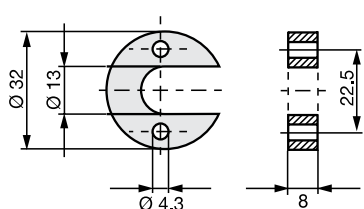
Accessories not included in scope of delivery and must be ordered separately.

12.1 Magnets

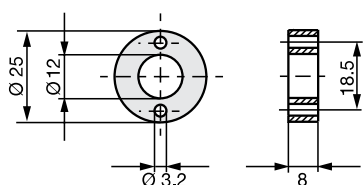
BTL-P-1013-4R



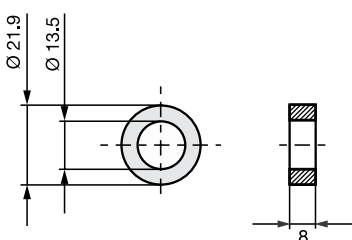
BTL-P-1013-4S



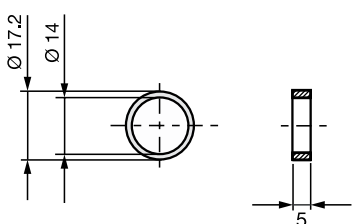
BTL-P-1012-4R



BTL-P-1014-2R



BTL-P-0814-GR-PAF



Magnet

BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R, BTL-P-1014-2R:

Weight: approx. 10 g
 Housing: Anodized aluminum
 Operating temperature: -40 °C to +85 °C

BTL-P-0814-GR-PAF:

Weight: approx. 2 g
 Housing: Ferrite bound in PA
 Operating temperature: -40 °C to +85 °C

Included with BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R magnet:

Spacer: 8 mm, Polyoxymethylene (POM)

Magnet BTL5-P-4500-1:

(electromagnet)

Weight: approx. 90 g
 Housing: Plastic
 Operating temperature: -40 °C to +60 °C

12.2 Mounting nuts

- Mounting nut M18×1.5:
BTL-A-FK01-E-M18×1.5
- Mounting nut 3/4"-16UNF:
BTL-A-FK01-E-3/4"-16UNF

Fig. 12-1: Magnet installation dimensions

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Accessories (cont.)

12.3 Connectors

BKS-S32M-00 and BKS-S135M-00:

- Straight connector, for user assembly
- BKS-S32M-00: M16 per IEC 130-9, 8-pin
- BKS-S135M-00: M16 per IEC 130-9, 6-pin

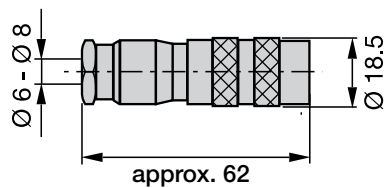


Fig. 12-2: Connectors BKS-S32M-00/BKS-S135M-00

BKS-S33M-00 and BKS-S136M-00:

- Right-angle connector, for user assembly
- BKS-S33M-00: M16 per IEC 130-9, 8-pin
- BKS-S136M-00: M16 per IEC 130-9, 6-pin

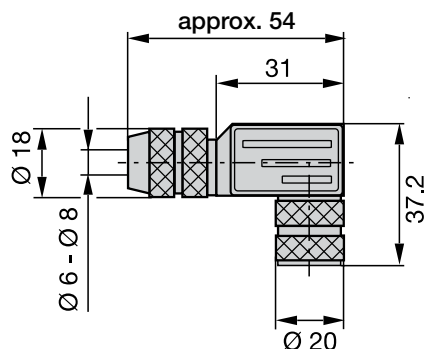


Fig. 12-3: Connectors BKS-S33M-00/BKS-S136M-00

BKS-S115-PU- _ _:

- Straight connector, molded-on cable, preassembled
- M12, 8-pin
- Various cable lengths can be ordered, e.g. BKS-S115-PU-05: Cable length 5 m

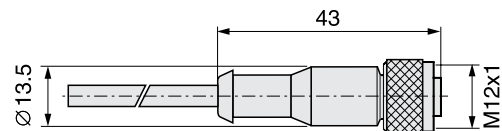


Fig. 12-4: Connector BKS-S115-PU- _ _

BKS-S116-PU- _ _:

- Right-angle connector, molded-on cable, preassembled
- M12, 8-pin
- Various cable lengths can be ordered, e.g. BKS-S116-PU-05: Cable length 5 m

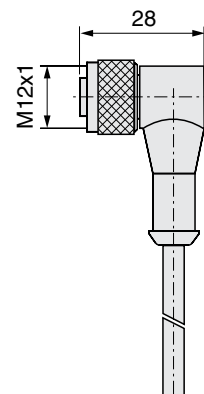


Fig. 12-5: Connector BKS-S116-PU- _ _

BTL7-A/C/E/G1 _ _ -M _ _ _ -A/B/Y/Z(8)-S32/S115/S135/KA _ _ Micropulse Linear Transducer - Rod-Style

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Ordering code

Example:

BTL7 - A 1 1 0 - M0500 - B - S32

Linear Transducer

Interface

- A = Analog interface, voltage output 0...10 V
- G = Analog interface, voltage output -10...10 V
- C = Analog interface, current output 0...20 mA
- E = Analog interface, current output 4...20 mA

Supply voltage

- 1 = 20 to 28 V DC

Output gradient

- 00 = Rising (e.g. C_00 = 0...20 mA)
- 10 = Rising + falling (e.g. A_10 = 10...0 V and 0...10 V)
- 70 = Falling (e.g. C_70 = 20...0 mA)

Nominal stroke

- M0500 = Metric specification in mm, nominal stroke length 500 mm

Construction

- A = Metric mounting thread M18×1.5, rod diameter 10.2 mm
- B = Metric mounting thread M18×1.5, O-ring, rod diameter 10.2 mm
- Y = Inch thread 3/4"-16UNF, rod diameter 10.2 mm
- Z = Inch thread 3/4"-16UNF, O-ring, rod diameter 10.2 mm
- A8 = Metric mounting thread M18×1.5, rod diameter 8 mm
- B8 = Metric mounting thread M18×1.5, O-ring, rod diameter 8 mm
- Y8 = Inch thread 3/4"-16UNF, rod diameter 8 mm
- Z8 = Inch thread 3/4"-16UNF, O-ring, rod diameter 8 mm

Electrical connection

- S32 = Connector S32, M16 per IEC 130-9, 8-pin
- S115 = Connector S115, M12, 8-pin
- S135 = Connector S135, M16 per IEC 130-9, 6-pin
- KA05 = Cable, 5 m

14 Appendix

14.1 Converting units of length

1 mm = 0.0393700787 inch

Conversion table:

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. 14-1: Examples of conversion for mm-inch

1 inch = 25.4 mm

Conversion table:

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. 14-2: Example for converting inch-mm

14.2 Part label

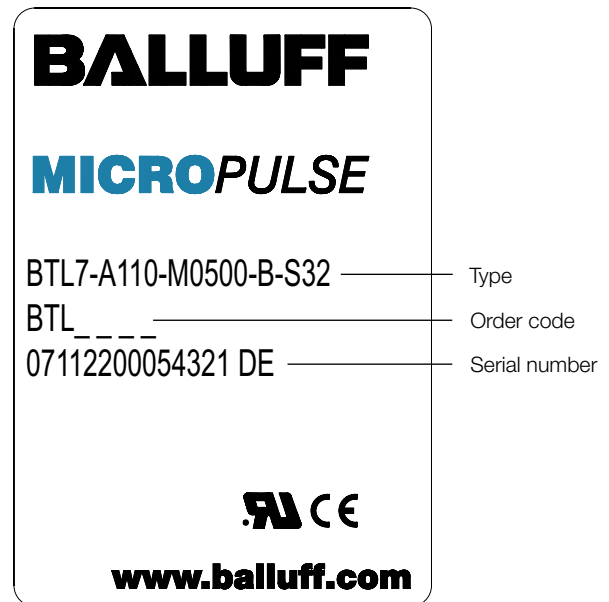


Fig. 14-1: Part label BTL7



World Headquarters

Germany

Balluff GmbH
Schurwaldstrasse 9
73765 Neuhausen a.d.F.
Phone +49 7158 173-0
Fax +49 7158 5010
Service hotline
+49 7158 173-370
service@balluff.de

Subsidiaries

Australia

Balluff-Leuze Pty. Ltd.
Sensors for Automation
2 Rocco Drive
Scoresby VIC 3179
Melbourne
Phone 03/97 64 23 66
Fax 03/97 53 32 62

Austria

Gebhard Balluff
VertriebsgesmbH
Industriestrasse B16
2345 Brunn am Gebirge
Phone 0 22 36/3 25 21-0
Fax 0 22 36/3 25 21 46

Brazil

Balluff Controles
Elétricos Ltda.
Rua Francisco Foga, Nr. 25
Distrito Industrial
de Vinhedo
cep: 13280.000
Sao Paulo
Phone 0 19/3 8 76 56 11
Fax 0 19/3 8 76 27 63

Canada

Balluff Canada Inc.
2840 Argentia RD Unit 2
Mississauga On
L5N 8G4
Phone 9 05/ 8 16-14 94
1-8 00-9 27-96 54
Fax 9 05/8 16-14 11

Czech Republic

Balluff CZ, s.r.o
Pelušková 1400
198 00 Praha 9
Phone/Fax
02/81 94 00 99
Fax 02/81 94 00 66

France

Balluff SAS
ZI Nord De Torcy-Bat 3
Rue des Tanneurs - BP 48
77201 Marne La Vallée
Cedex 1
Phone 01/64 11 19 90
Fax 01/64 11 19 91

Great Britain

Balluff Ltd.
The Automation Centre
Finney Lane, Cheadle,
Cheshire SK8 3DF
Phone 0161 437 1234,
Fax 0161 436 1435

Hungary

Balluff Elektronika Kft
Pápai u. 55
8200 Veszprém
Phone 0 88/42 18 08
Fax 0 88/42 34 39

Balluff Elektronika Kft
Marketing Iroda
Vihar u. 22/4
1221 Budapest XXII
Phone/Fax 1/2 29 20 95

Italy

Balluff Automation s.r.l.
Corso Giambone 63
10134 Torino
Phone 0 11/3 15 07 11
Fax 0 11/3 17 96 65,
3 17 01 40

Japan

Balluff Co. Ltd.
Ishikawa Bldg. 2nd Fl.
1-5-5 Yanagibashi,
Taito-Ku
Tokio 111-0052
Phone +81 03 5833-5440
Fax +81 03 5833-5441

Poland

Balluff Sp. z o.o.
ul. Smolenskigo 4-7
01-698 Warszawa
Phone 22/8 33 15 64,
8 33 15 82, 8 33 58 60
Fax 22/8 33 09 69

Singapore

Balluff Asia Pte. Ltd.
BLK 1004 Toa Payoh
Ind. Park
Lorong 8, #03-1489
Singapore 319076
Phone 62 52 43 84
Fax 62 52 90 60

Switzerland

Balluff Sensortechnik AG
Riedstrasse 6
8953 Dietikon
Phone 043/322 32 40
Fax 043/322 32 41

USA

Balluff Inc.
8125 Holton Drive
Florence,
Kentucky 41042-0937
Phone 8 59/7 27-22 00,
1-8 00-5 43-83 90
Fax 8 59/7 27-48 23
applications@balluff.com