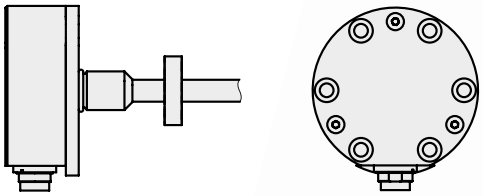
BALLUFF

BTL7-A/C/E/G5_ _-M_ _ _ _-K(8)-NEX-SR32/K_ _ _

User's Guide



II 3 G Ex nA IIC T4 X
II 2 D Ex tb IIIC T135 °C X IP6x

english

www.balluff.com

1 Notes to the user

1.1 Validity

This guide describes the construction, function and setup options for the BTL7 Micropulse Transducer with analog interface. It applies to types
BTL7-A/C/E/G5_ _-M_ _ _ _-K(8)-NEX-SR32/K_ _
(see Type code breakdown on page 25).

Section 2 “ATEX safety notes” contains important information on and requirements for using the transducer in explosive areas. The other sections in this user’s guide include additional information that must be taken into account for areas not classified as explosive zones as well.

1.2 Scope of delivery

- BTL7 transducer
- 6 mounting screws
- User’s guide (incl. declaration of conformity)

> **i** You can find the declaration of conformity for your specific device in the download area at **www.balluff.com**. Please enter the type designation or the ordering code in the search field.

> **i** Connectors and magnets are available in various models, which is why they must be ordered separately (see Accessories from page 23).

1.3 Qualified personnel

This user’s guide is intended for technical personnel who have the appropriate knowledge for proper selection, installation, and operation.

1.4 Languages

The original user’s guide was written in German. Versions in other languages are translations of the original user’s guide. The information in the original user’s guide will apply if the contents of the translated versions are not clear or the information is contradictory.

Do not start up the transducer if you do not have a user’s guide in the language of the country where the product will be used. In such cases, please contact BALLUFF.

1.5 Symbols and conventions

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

► Instruction 1

Action sequences are numbered consecutively:

1. Instruction 1
2. Instruction 2

> **i** **Note, tip**
> This symbol indicates general notes.

1.6 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
Hazard type and source Consequences if not complied with ► Measures to avoid hazards

The individual signal words mean:

NOTICE
Identifies a hazard 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**.

1.7 Disposal

► Observe the national regulations for disposal.

2 ATEX safety notes

2.1 Intended use

In line with its identification, this micropulse transducer is suitable as electrical equipment for use in gas and dust explosive areas. When installed in a machine or system, the transducer forms a position measuring system in conjunction with a controller or evaluation unit and may only be used for this purpose.

When selecting the electrical equipment, the person setting up the machine or system is responsible for assessing its suitability for the planned area of application. The information in the user’s guide and other applicable safety regulations and provisions must be observed during set-up. Flawless function is ensured only when using original BALLUFF accessories. Use of any other components will void the warranty.

The operator of the machine or system must ensure that the transducer is applied under the permissible operating conditions in line with the information in this user’s guide and in compliance with the applicable safety regulations and provisions.

Unauthorized interventions, non-permissible use, or application outside the permissible operating conditions will result in the loss of warranty and liability claims against the manufacturer.

2.2 Safety measures

The persons setting up and operating the machine or system must take steps to ensure that a malfunction in the transducer will not result in hazards to persons or equipment. If there are any indications of damage or malfunctions, the transducer must be immediately taken out of operation and secured against unauthorized use. Even with correct explosion protection, residual risks remain that could pose a hazard to persons and systems when the device is correctly operated or if there are any fault states.

2.3 Approvals, standards, and conformity

CE

The CE Mark verifies that our products meet the requirements of the current EMC Directive as well as the ATEX Directive. Compliance is confirmed with the enclosed declaration of conformity from the manufacturer.

The transducer 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

The transducer with identification ⟨Ex⟩ **II 3 G Ex nA IIC T4 X** and ⟨Ex⟩ **II 2 D Ex tb IIIC T135 °C X IP6x** fulfills the requirements for electrical equipment for explosive areas in accordance with the following standards:

– EN 60079-0: General requirements
– EN 60079-15: Ignition protection “n”
– EN 60079-31: Ignition protection “t”

IECEx

In addition to the ATEX requirements, the transducer has been authenticated under certificate number **IECEx EPS 13.0004 X**.

The current status of the certificate and further information can be found under www.iecex.com in the “Certified Equipment Scheme” section. The certificate number is indicated on the part label.

Further applicable safety regulations and standard requirements must be observed during selection, set-up, and operation:

– Special conditions for safe operation (“X” symbol)
– Requirements for occupational safety
– Requirements for explosion protection
– Electrical installations erection in explosive atmospheres (DIN EN 60079-14)
– Further regulations

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

2 ATEX safety notes (continued)

2.4 Use and inspection

2.4.1 Device category and suitability

The transducer has been classified as electrical equipment in device group **II**, i.e. it is suitable for all explosive areas, with the exception of fire damp-prone mines. It may be used in gas and dust explosive areas in accordance with the following descriptions.

Gas explosion protection

Device category **II 3 G** covers devices that have been designed to ensure a normal level of safety during normal operation within the operational parameters stated by the manufacturer. Devices in the category may be used in zone 2, i.e. in areas in which an explosive atmosphere caused by gases, vapors, or mist is not expected. If such an atmosphere develops, this is very likely to occur only seldom and for a short period.

The ignition protection type **nA** ensures that the electrical equipment is unable to ignite a surrounding explosive atmosphere during normal operation and under specific abnormal conditions.
The risk of sparks is minimized.

Gas group **IIC** indicates that the transducer can be used in all gases in compliance with the temperature class.

Temperature class **T4** indicates that the outer surface temperature of the transducer is below 135°C, even if the permissible operating conditions are unfavorable. As a result, an explosive gas atmosphere with an ignition temperature of over 135°C cannot be ignited.

Dust explosion protection

Device category **II 2 D** covers devices that have been designed to ensure the required amount of safety, even in case of frequent device malfunctions or error states which are generally to be expected. Devices in this category may be used in zone 21 in which an explosive atmosphere caused by dust/air mixtures may occasionally occur.

The ignition protection type **tb** indicates that the electrical equipment is protected against dust entry by housing.

Dust group **IIIC** covers possible use in all areas with an explosive dust atmosphere, both with conductive and non-conductive dusts and flammable fibers.

The temperature specification **T135°C** indicates that the external surface temperature of the transducer is below 135°C under all conditions of the device category.

IP6x confirms the dust resistance of the housing.

2.4.2 Special conditions (“X” symbol)

The “X” symbol indicates special conditions that must be noted for safe operation:

– The permissible ambient temperature is limited to –40°C to +60°C.
– The impact resistance test was done in accordance with a low degree of mechanical risk.
– Cable and line inlets were tested with reduced tensile force in accordance with EN 60079-0. This is why the connection cable must be routed in a permanent location and protected against tension and rotary loads using an additional clamp. Drag chains may not be used.

2.4.3 Operator documents

Zone classification in the system is the responsibility of the operator and must be documented in an explosion protection document. This document must also contain the hazard analysis and assessment, proof of training, maintenance plans and other documents as required under Directive 1999/92/EC.

We expressly recommend including the user’s guide in the operator’s documentation. For safety reasons, it must be taken over completely and without any changes.

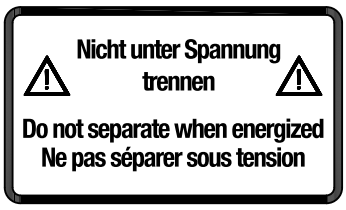
2.5 Assembly, installation, and setup

Assembly, installation, and setup of the transducer must not be done in an explosive atmosphere.
Protect the transducer from damage and wear. In addition to mechanical protection, this also includes precautions to prevent non-permissible operating conditions and damage due to environmental influences.

Note that the position measuring system must be connected to the potential compensation system in accordance with the requirements in EN 60079-14. The external connection for the transducer is accomplished by means of metallic conducting installation in a grounded area. The flange and housing are mechanically fixed with electrically conductive connections, so that no potential differences can occur between them. The cable shield is connected to the housing and must be connected to the potential of the system’s control cabinet.

2 ATEX safety notes (continued)

Do not disconnect the BKS-S_ _ _ connector of the transducer in explosive areas if it is under voltage! This is why the following warning label is affixed to transducers with plug connections.



The connection cable must be routed in a permanent location and protected against tension and rotary loads using an additional clamp. Drag chains may not be used.

The open line ends are to be connected outside the classified zones or inside an approved housing.

The transducer’s IP protection must also be maintained when unplugged. If dust or water accumulates, a suitable protective cap must be attached to the connector.

The calibration box is not approved for gas-explosive areas. As a result, the transducer may not be adjusted in a potentially explosive atmosphere. The calibration box must be removed from the installation for operation.

2.6 Connectors and magnets

Permissible connectors and magnets are listed in section 11 “Accessories”.
For transducers with plug connections, only the following connectors with cables that have been preassembled at the factory are tested and approved:

– BKS-S 32M-_ _
– BKS-S 33M-_ _

Only the magnet versions listed in section 11 “Accessories” may be used.

If another connector, cable, or magnet is used, the operator must ensure compliance with the explosion protection requirements.

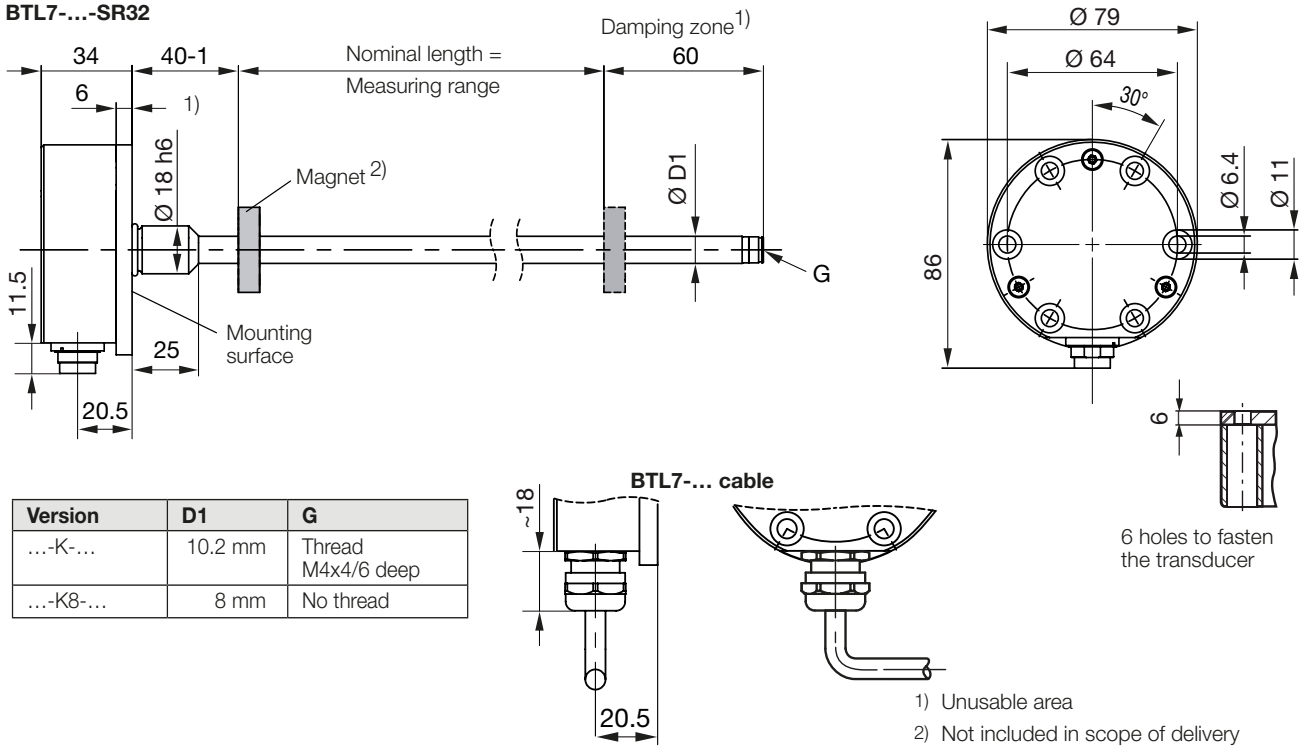
2.7 Maintenance, inspection, repair

The measuring principle used in this transducer is maintenance-free and wear-free. The operator must regularly inspect the transducer for signs of damage or malfunctions in line with the operating conditions and environmental influences. If any damage or wear is found, the transducer must be immediately taken out of operation.

Only service technicians from BALLUFF GmbH may repair defective transducers. Intervention in the product by the operator is not permitted due to safety reasons.

The transducer’s housing may not be opened or loosened! This is why the following warning label is affixed over a gap in the housing.

3 Construction and function



Version	D1	G
…-K-…	10.2 mm	Thread M4x4/6 deep
…-K8-…	8 mm	No thread

Fig. 3-1: Transducer BTL7-…-K(8)-… transducer, construction and function

3.1 Construction

Electrical connection: The electrical connection is made via a cable or a connector (see Type code breakdown on page 25).

Housing: Housing containing the processing electronics.

Fastening: For secure fastening, tighten the transducer with cylinder screws (ISO 4762, M6 × 16 - A2-70) at all 6 mounting holes (see Figure 3-1). All screws must be tightened with 3.5 Nm.
The transducers with Ø 10.2 mm have an additional thread at the end of the rod to support larger nominal lengths.

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 23).

Nominal length: Defines the available measuring range. Rods with various nominal lengths from 25 mm to 5500 mm are available depending on the version:
– Ø 10.2 mm: Nominal length from 25 mm to 5500 mm
– Ø 8 mm: Nominal length from 25 mm to 1016 mm

Damping zone: Area at the end of the rod that cannot be used for measurements, but which may be passed over.

3.2 Function

The Micropulse Transducer contains the waveguide which is protected by an outer stainless steel tube (rod). 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.

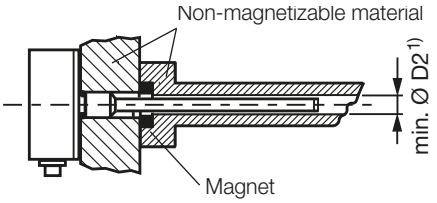
An internally generated INIT pulse interacts with the magnetic field of the magnet to generate a torsional wave in the waveguide which propagates at ultrasonic speed.

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 version, this information is made available as a voltage or current output with a rising or falling gradient.

4 Installation and connection

4.1 Installation guidelines

Non-magnetizable material

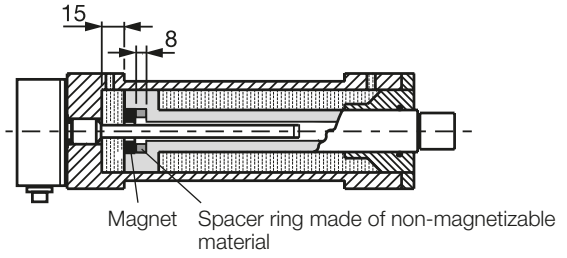


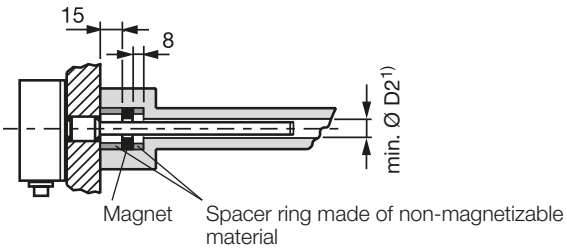
1) Min. Ø D2 = Minimum diameter of the bore (see Tab. 4-1)

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

Magnetizable material

If using magnetizable material, the transducer must be protected against magnetic interference through suitable measures (e.g. spacer ring made of non-magnetizable material, a suitable distance from strong external magnetic fields).





1) Min. Ø D2 = Minimum diameter of the bore (see Tab. 4-1)

Fig. 4-2: Installation in magnetizable material

Rod diameter	Bore diameter D2
10.2 mm	At least 13 mm
8 mm	At least 11 mm

Tab. 4-1: Bore diameter if installed in a hydraulic cylinder

4.2 Preparing for installation

Installation note: We recommend using non-magnetizable material to mount the transducer and magnet.

Horizontal assembly: For horizontal assembly with nominal lengths > 500 mm, support the rod and tighten it at the end if necessary (only possible with a diameter of 10.2 mm).

Hydraulic cylinder: If installed in a hydraulic cylinder, ensure that the minimum value for the bore diameter of the support piston is complied with (see Tab. 4-1).

Fitting bore: The mounting surface of the BTL housing must make full contact with the supporting surface. A suitable O-ring must completely seal the bore, i.e. the countersink for the O-ring must be produced in accordance with Figure 4-3.

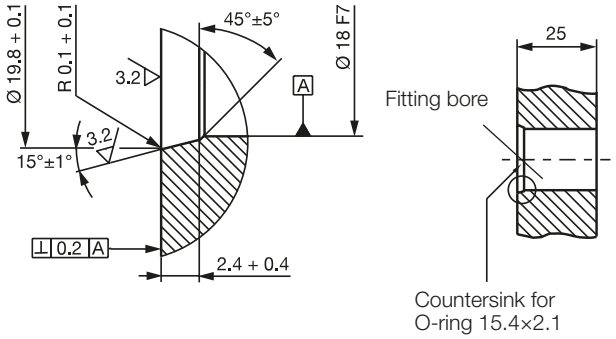


Fig. 4-3: Fitting bore for installing the BTL with O-ring

Magnet: Various magnets are available for the BTL7 transducer (See Accessories on page 23).

4 Installation and connection (continued)

4.3 Installing the transducer

NOTICE

Interference in function

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

- ► The mounting surface of the transducer must make full contact with the supporting surface.
- ► The bore must be perfectly sealed (O-ring/flat seal).

- ► For secure fastening, tighten the transducer with cylinder screws (ISO 4762, M6 × 16 - A2-70) at all 6 mounting holes.
- ► All screws must be tightened with 3.5 Nm.
- ► Install the magnet (accessories).
- ► From 500 mm nominal length: support the rod and tighten it at the end if necessary (only possible with a diameter of 10.2 mm).

4.3.1 Installation recommendation for hydraulic cylinders

If you seal the hole with a flat seal, the max. operating pressure will be reduced in accordance with the larger pressurized surface.
If installing horizontally in a hydraulic cylinder (nominal lengths > 500 mm), we recommend affixing a slide element to protect the rod end from wear.

i Dimensioning of the detailed solutions is the responsibility of the cylinder manufacturer.

The slide element material must be suitable for the appropriate load case, medium used, and application temperatures. E.g. Torlon, Teflon or bronze are all possible materials.

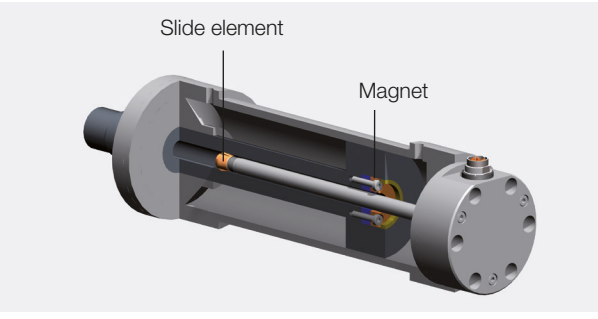


Fig. 4-4: Example 1, transducer installed with slide element

The slide element can be screwed on or bonded.

- ► Secure the screws so they cannot be loosened or lost.
- ► Select a suitable adhesive.

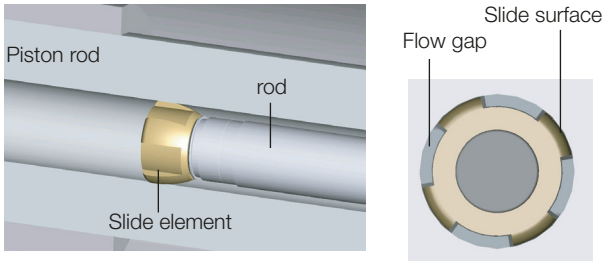


Fig. 4-5: Detailed view and top view of slide element

There must be a gap between the slide element and piston bore that is sufficiently large for the hydraulic oil to flow through.

Options for fixing the magnet:

- – Screws
- – Threaded ring
- – Press fitting
- – Notches (center punching)

i If installed in a hydraulic cylinder, the magnet should not make contact with the rod.

The hole in the spacer ring must ensure optimum guidance of the rod by the slide element.

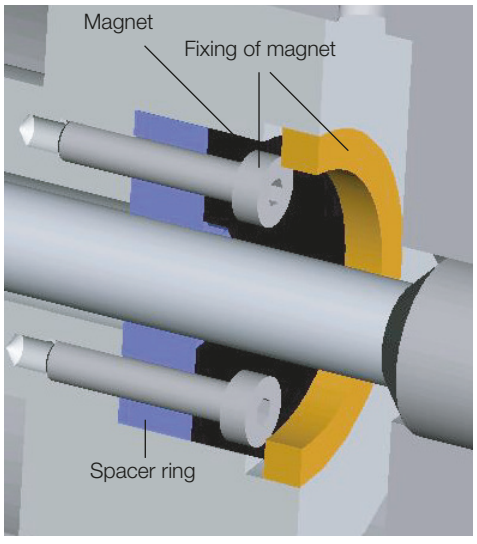


Fig. 4-6: Fixing of magnet

An example of how to install the transducer with a supporting rod is shown in Fig. 4-7 on page 12.

4 Installation and connection (continued)

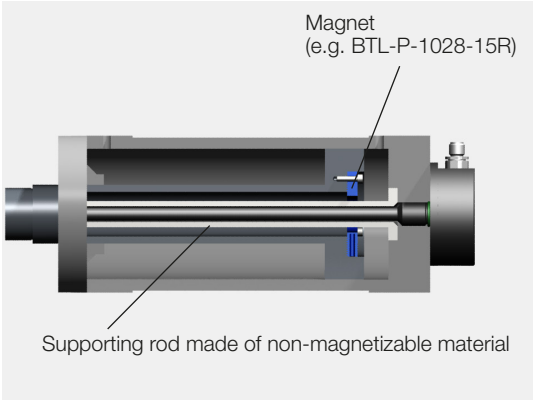


Fig. 4-7: Example 2, transducer installed with supporting rod

4.4 Electrical connection

Depending on the model, the electrical connection is made using a cable (BTL7-…-K) or a connector (BTL7-…-SR32). The connection or pin assignments for the respective version can be found in Table 4-2.

Note the information on shielding and cable routing.

4.4.1 Connector SR32/cable connection K_ _

Pin	Cable color	-A_10	-G_10	-C_00	-C_70	-E_00	-E_70
1	YE yellow	Not used[1]		0…20 mA	20…0 mA	4…20 mA	20…4 mA
2	GY gray	0 V					
3	PK pink	10…0 V	10…–10 V	10…0 V[3]			
4	RD red	La (programming input)					
5	GN green	0…10 V	–10…10 V	0…10 V[3]			
6	BU blue	GND[2]					
7	BN brown	10…30 V					
8	WH white	Lb (programming input)					

1) Unassigned leads can be connected to the GND on the controller side but not to the shield.

2) Reference potential for supply voltage and EMC-GND.

3) The voltage outputs may exhibit a minimal offset to the harmonized current output.

Tab. 4-2: Connection assignment BTL7-…-SR32/K_ _

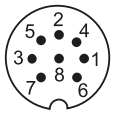


Fig. 4-8: Pin assignment of SR32 (view of connector pins of transducer), 8-pin M16 circular plug

4.5 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.
  Shielding: Braided copper shield with minimum 85%.
- Connector version: Shield is internally connected to connector housing.
- Cable version: On the transducer side, the cable shielding is connected to the housing.
  Ground the cable shielding on the controller side (connect with the protective earth conductor).

Magnetic fields

The linear encoder is a magnetostrictive system. It is important to maintain adequate distance between the transducer/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).
The cable must be routed tension-free.

Bending radius for fixed cable

The bending radius for a fixed cable must be at least five times the cable diameter.

Cable length

BTL7-A/G	Max. 30 m[1]
BTL7-C/E	Max. 100 m[1]

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

Tab. 4-3: Cable lengths BTL7

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.

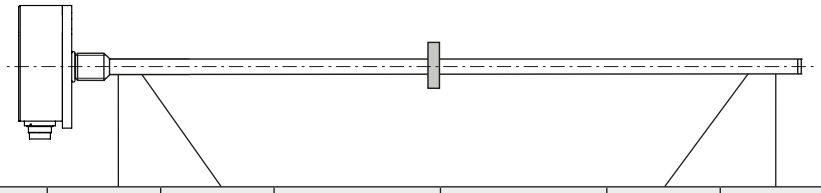
1. Check connections for tightness and correct polarity. Replace damaged connections.
2. Turn on the system.
3. Check measured values and adjustable parameters and readjust the transducer, if necessary.

i Check for the correct values at the null point and end point, especially after replacing the transducer or after repair by the manufacturer.

5.2 Operating notes

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

6 Calibration procedure



Output gradient	Linear transducer	Unit	Min. value	Null value	Indication for adjustment	Indication 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	2.0	4.0	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	6.0	12.0	0	0	20.4
	BTL7-E…	mA	20.4	20.0	6.0	12.0	4.0	3.6	3.6

Tab. 6-1: Value table for teach-in and inverting

6.1 Programming inputs

Programming inputs La and Lb must be used in order to make settings. A programming input at 10 to 30 V corresponds to activation (high active).
The Balluff BTL7-A-CB02-… calibration box can be used for this (see Accessories on page 24).

Automatic deactivation!
If no signals are transmitted via the programming inputs for approx. 10 min, programming mode is automatically ended.

6.2 Calibration procedure notes

Prerequisites

- 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, the system control or the calibration box).

Values for null and end point

- Any desired position of the magnet can be used as the null or end point. However, the null and end points may not be reversed.
- The absolute null and end points must lie within the minimum or maximum range of what can be output (see value table).

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

Value table for teach-in and inverting

The following examples refer to transducers with 0 to 10 V or 4 to 20 mA output.

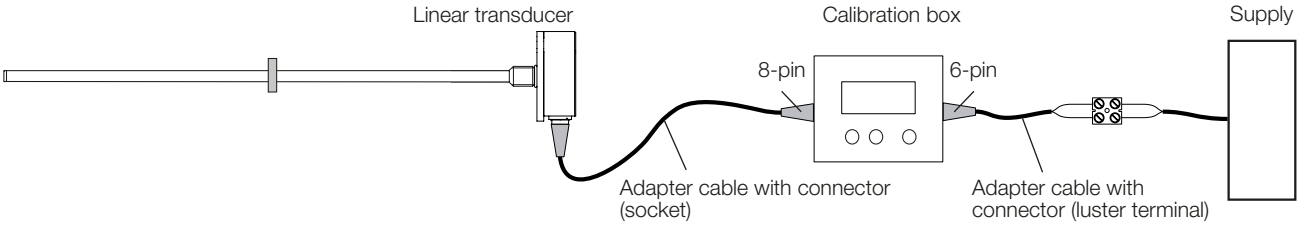


Fig. 6-1: Connecting the BTL7-A-CB02-S… calibration box

6 Calibration procedure (continued)

6.3 Calibration procedure overview

6.3.1 Teach-in

The factory set null point and end point is replaced by a new null point and end point. The null point and end point can be set separately, the output gradient changes.

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

Steps:

- ► Move magnet to the new null position.
- ► Read new null point by activating the programming inputs.
  ⇒ The current end point remains the same.

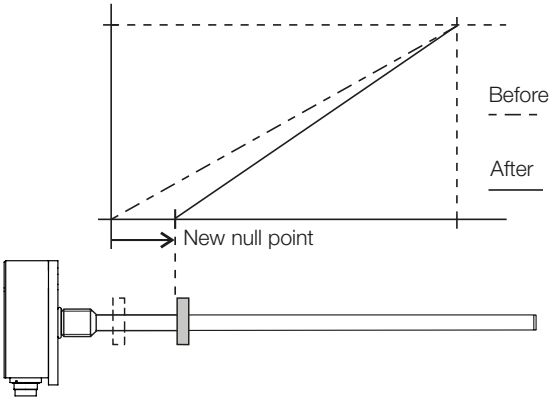


Fig. 6-2: Reading new null point

- ► Move magnet to the new end position.
- ► Read new end point by activating the programming inputs.
  ⇒ The current null point remains the same.

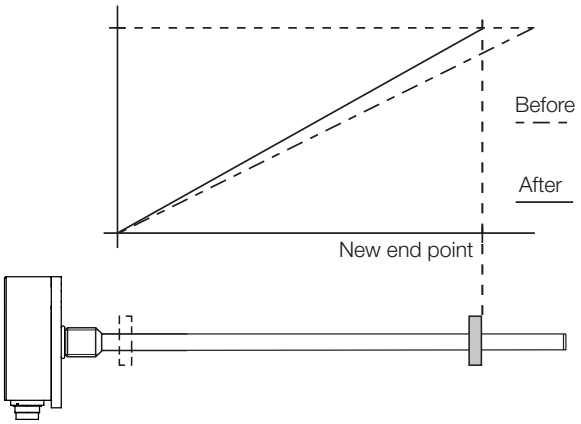


Fig. 6-3: Reading new end point

Only with BTL7-C/E…:

- ► The gradient of the current output can be inverted by activating the programming inputs.
  ⇒ For example, a rising output gradient is changed to a falling gradient. The voltage outputs are not inverted.

6 Calibration procedure (continued)

6.3.2 Adjusting

The detailed procedure for adjusting is described on page 18 ff.

The factory set null point and end point is replaced by a new start point and end point and the associated output values can be adjusted. The start and end values can be adjusted as you like up to the limits.

Adjustment is possible from serial number 120615000xxxxx xx onwards.

Steps

- ► Move magnet to the new start position.
- ► Read new start point by activating the programming inputs.
- ► Set the desired start value by activating the programming inputs.

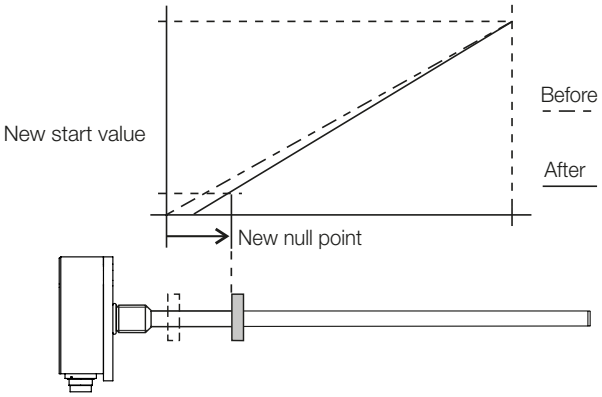


Fig. 6-4: Adjust a new start value

- ► Move magnet to the new end position.
- ► Read new end point by activating the programming inputs.
- ► Set the desired end value by activating the programming inputs.

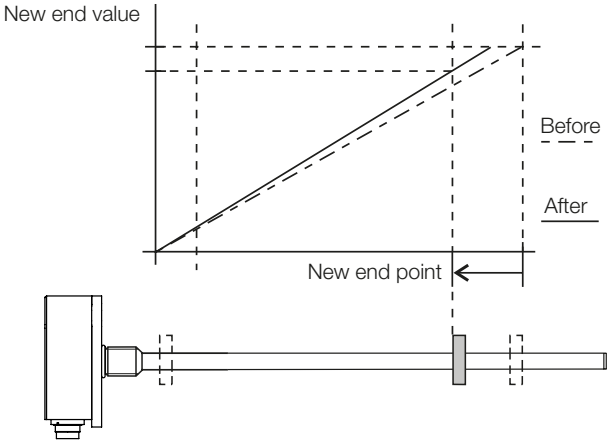


Fig. 6-5: Adjust a new end value

6.3.3 Reset

Restoring the transducer to its factory settings.

The detailed procedure for the reset is described on page 20.

7 Teach-in

NOTICE

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

		Displayed values (example)	
		At 0 to 10 V	At 4 to 20 mA
Initial situation: – Transducer with magnet within measuring range		5.39 V	9.15 mA
Activate teach-in Activate ⓐ for at least 4 s.	> 4 s ⓐ	4.00 V	12.00 mA
⇒ Indication for teach-in is displayed.			
⇒ The current position value is displayed again once the button is released.		5.39 V	9.15 mA
Set null point Bring magnet to the new null point.		1.04 V	4.82 mA
Activate ⓐ for at least 2 s.	> 2 s ⓐ		
⇒ The new null point is set.		0.00 V	4.00 mA
Set end point Bring magnet to the new end point.		9.89 V	19.13 mA
Activate ⓑ for at least 2 s.	> 2 s ⓑ		
⇒ The new end point is set.		10.00 V	20.00 mA
Inverting the characteristic curve (only with BTL7-C/E)			
Simultaneously activate ⓐ and ⓑ for at least 4 s.	> 4 s ⓐ+ⓑ		3.60 mA
⇒ Error value is displayed.			
⇒ The characteristic curve of the output is inverted once released.			14.85 mA
End teach-in			
Briefly activate ⓐ and ⓑ simultaneously (< 1 s).	< 1 s ⓐ+ⓑ	10.50 V	3.60 mA
⇒ The output indicates the error value during activation.			
⇒ Current position value is displayed.		10.00 V	4.00 mA

i Any of the individual steps for settings can be selected. The teach-in process can be ended at any time.

Programming line La = ⓐ
Programming line Lb = ⓑ

8 Adjusting

NOTICE

Interference in function

Adjustment while the system is running may result in malfunctions.

► Stop the system before performing adjustment.

Displayed values (example)

At 0 to 10 V | At 4 to 20 mA

Initial situation:

– Transducer with magnet within measuring range

5.39 V | 9.15 mA

Activate adjusting

► Activate ⓑ for at least 4 s.

> 4 s ⓑ

⇒ Indication for adjustment is displayed.

2.00 V | 6.00 mA

⇒ The current position value is displayed again once the button is released.

5.39 V | 9.15 mA

Set start point

► Bring magnet to the new start point.

1.04 V | 4.82 mA

► Activate ⓐ for at least 2 s.

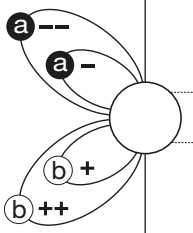
> 2 s ⓐ

⇒ The new start point is set with the last valid start value.

0.00 V | 4.00 mA

Adjust start value

► The start value can be changed using ⓐ and ⓑ. The gradient of the curve changes (see page 16).



0.00 V | 4.00 mA

0.90 V | 7.20 mA

► End calibration procedure: Briefly activate ⓐ and ⓑ simultaneously (< 1 s).

< 1 s ⓐ + ⓑ

2.00 V | 6.00 mA

⇒ Set position value is saved.

0.90 V | 7.20 mA

For setting the end point, adjusting the end value, and ending adjustment, see page 19.

Any of the individual steps for settings can be selected. The adjustment process can be ended at any time.

8 Adjusting (continued)

Displayed values (example)

At 0 to 10 V | At 4 to 20 mA

Set end point

► Bring magnet to the new end point.

9.89 V | 19.13 mA

► Activate ⓑ for at least 2 s.

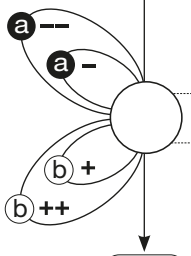
> 2 s

⇒ The new end point is set with the last valid end value.

10.00 V | 20.00 mA

Adjust end value

► The end value can be changed using ⓐ and ⓑ. The gradient of the curve changes (see page 16).



10.00 V | 20.00 mA

8.00 V | 16.80 mA

► End calibration procedure: Briefly activate ⓐ and ⓑ simultaneously (< 1 s).
⇒ Set position value is saved.

< 1 s

2.00 V | 6.00 mA

8.00 V | 16.80 mA

End adjusting

► Briefly activate ⓐ and ⓑ simultaneously (< 1 s).
⇒ The current position value is displayed once the buttons are released.

< 1 s

10.50 V | 3.60 mA

7.63 V | 18.56 mA

i Any of the individual steps for settings can be selected. The adjustment process can be ended at any time.

9 Resetting all values (reset)

NOTICE

Interference in function

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.

			Displayed values (example)	
			At 0 to 10 V	At 4 to 20 mA
			5.39 V	9.15 mA
Activate reset				
► Simultaneously activate ⓐ and ⓑ	for at least 4 s.	> 4 s	10.50 V	3.60 mA
Reset				
► Simultaneously activate ⓐ and ⓑ	for at least 4 s.	> 4 s	0.00 V	4.00 mA
After activation:				
⇒ All values are reset.			9.89 V	19.13 mA
⇒ Current position value is displayed.				
⇒ Reset is deactivated.				

Abort reset

Resetting can be aborted without any changes being saved after the *Activate reset* step.

► Briefly activate ⓐ and ⓑ simultaneously (< 1 s). < 1 s

⇒ Current position value is displayed.

10 Technical data

10.1 Accuracy

The specifications are typical values for the BTL7-A/C/E/G… at 24 V DC and room temperature, with a nominal length of 500 mm in conjunction with the BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R or BTL-P-1014-2R magnet.
The transducer 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.

Repeat accuracy	
Typical	±10 µm
Sampling rate	
Dependent on the nominal length	1 ms…4 ms
At nominal length = 500 mm	1 ms
Non-linearity at	
Nominal length ≤ 500 mm	±50 µm
Nominal length > 500 to ≤ 5500 mm	±0.01% FS
Temperature coefficient[1]	≤ 30 ppm/K
Max. detectable velocity	10 m/s

10.2 Ambient conditions

Operating temperature	–40°C…+60°C
Storage temperature	–40°C…+70°C
Relative humidity	< 90%, non-condensing
Rod pressure rating (when installed in hydraulic cylinders)	
For Ø 8 mm	≤ 250 bar
For Ø 10.2 mm	≤ 600 bar
Shock rating	150 g/6 ms
Continuous shock per EN 60068-2-27[2), 3)]	150 g/2 ms
Vibration per EN 60068-2-6[2), 3)]	20 g, 10…2000 Hz
Degree of protection per IEC 60529	
Connector SR32 (when attached)	IP67
Cable	IP68[2)]

10.3 Supply voltage (external)

Voltage, stabilized:	
BTL7-_5_ _-…	10…30 V DC
Ripple	≤ 0.5 V_{ss}
Current draw (at 24 V DC)	< 120 mA
Inrush current	≤ 500 mA
Reverse polarity protection[4)]	Up to 36 V
Overvoltage protection	Up to 36 V
Dielectric strength (GND to housing)	500 V AC

10.4 Output

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 resistance		Signal cable to 36 V Signal cable to GND

10.5 Input

Programming inputs La, Lb:	High-active
BTL7-_5_ _-…	10…30 V DC
Overvoltage protection	Up to 36 V

1) Nominal length = 500 mm, magnet in the middle of the measuring range
2) Individual specifications as per Balluff factory standard
3) Resonant frequencies excluded
4) A prerequisite is that no current can flow between GND and 0 V in the event of polarity reversal.

10 Technical data (continued)

10.6 Dimensions, weights

Rod diameter	8 mm or 10.2 mm
Nominal length	
For Ø 8 mm	25…1016 mm
For Ø 10.2 mm	25…5500 mm
Weight (depends on length)	Approx. 2 kg/m
Housing material	Stainless steel
Flange material	Stainless steel
Rod material	Stainless steel
Rod wall thickness	
For Ø 8 mm	0.9 mm
For Ø 10.2 mm	2 mm
Housing mounting	Flange with 6 holes

BTL7-…-K_ _

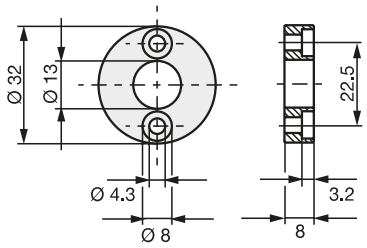
Cable material	PUR
Cable diameter	Max. 7 mm
Permissible bending radius	
Fixed routing	≥ 35 mm

11 Accessories

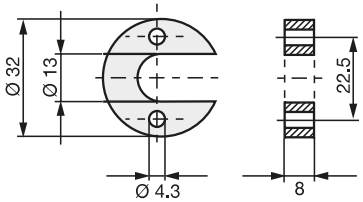
Accessories are not included in the scope of delivery and must be ordered separately.

11.1 Magnets

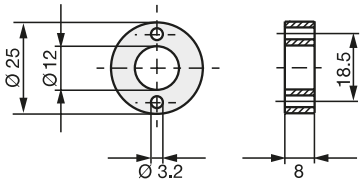
BTL-P-1013-4R



BTL-P-1013-4S



BTL-P-1012-4R



BTL-P-1014-2R

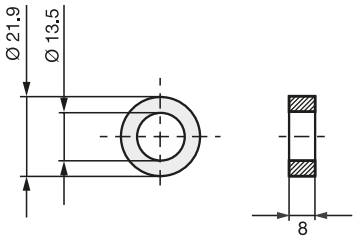


Fig. 11-1: Magnet installation dimensions

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

Weight:	Approx. 10 g
Housing:	Aluminum

Included in the scope of delivery for the BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R:

Spacer:	8 mm, material: polyoxymethylene (POM)

BTL-P-1028-15R (special accessories for applications with a supporting rod):

Weight:	Approx. 68 g
Housing:	Aluminum

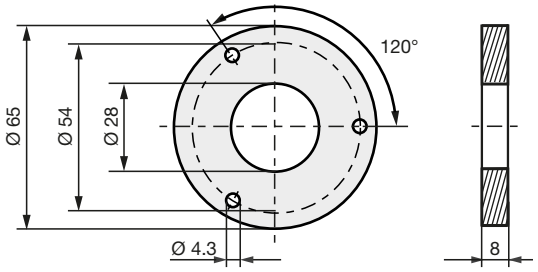


Fig. 11-2: BTL-P-1028-15R special accessories

11 Accessories (continued)

11.2 Connectors and cables

BKS-S 32M-_ _

Straight connector, preassembled
M16 per IEC 130-9, 8-pin
Various cable lengths can be ordered, e.g.
BKS-S 32M-05: Cable length 5 m

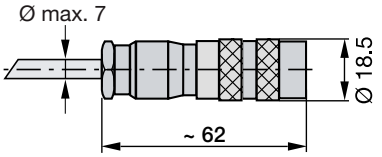


Fig. 11-3: Connector BKS-S 32M-_ _

BKS-S 33M-_ _

Angled connector, preassembled
M16 per IEC 130-9, 8-pin
Various cable lengths can be ordered, e.g.
BKS-S 33M-05: Cable length 5 m

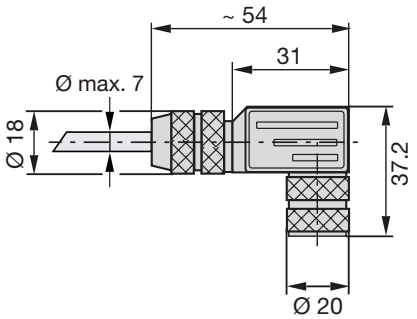


Fig. 11-4: Connector BKS-S 33M-_ _

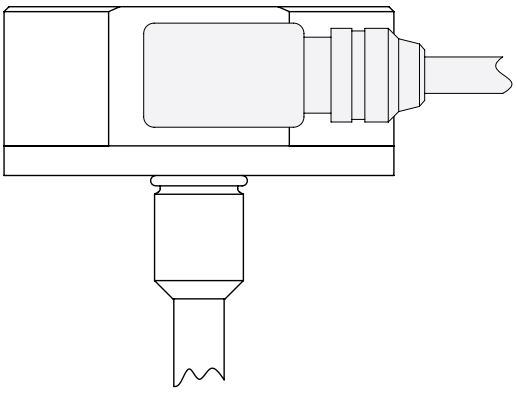


Fig. 11-5: Connector BKS-S 33M-_ _, outlet

Pin	Color
1	YE yellow
2	GY gray
3	PK pink
4	RD red
5	GN green
6	BU blue
7	BN brown
8	WH white

Tab. 11-1: BKS-S 32/33M-_ _ pin assignment

11.3 Calibration box

BTL7-A-CB02-S32

Scope of delivery:
– Calibration box
– 2 adapter cables, each approx. 0.3 m
– Condensed guide

BTL7-A-CB02-K

Scope of delivery:
– Calibration box
– 2 adapter cables, each approx. 0.3 m/0.6 m
– Condensed guide

12 Type code breakdown

BTL7 - E 5 0 0 - M0500 - K - NEX - SR32

Micropulse 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:
5 = 10…30 V DC

Output gradient:
00 = Rising (e.g. C_00 = 0…20 mA); only with BTL7-C/E
10 = Rising + falling (e.g. A_10 = 10…0 V and 0…10 V); only with BTL7-A/G
70 = Falling (e.g. C_70 = 20…0 mA); only with BTL7-C/E

Nominal length (4-digit):
M0500 = Metric specification in mm, nominal length 500 mm
(M0025…M1016: K8)
(M0025…M5500: K)

Rod version, fastening:
K = Flange with 6 holes, O-ring, rod diameter 10.2 mm
K8 = Flange with 6 holes, O-ring, rod diameter 8 mm

Electrical connection, radial:
SR32 = 8-pin, M16 plug per IEC 130-9
K05 = Cable, 5 m (PUR)

13 Appendix

13.1 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

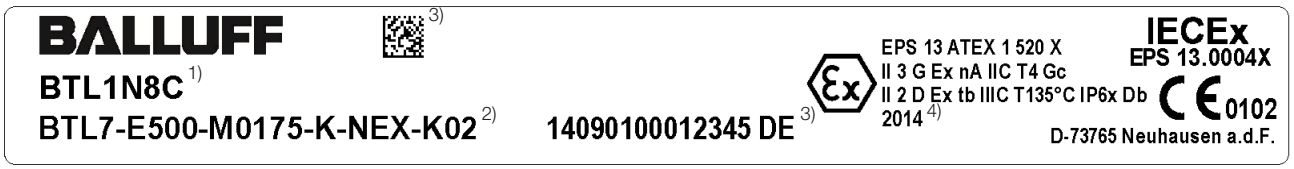
Tab. 13-1: Conversion table mm to inches

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. 13-2: Conversion table inches to mm

13.2 Part label



1) Ordering code
2) Type
3) Serial number YYMMDDSSSSSSSS CC
4) Year of manifacture

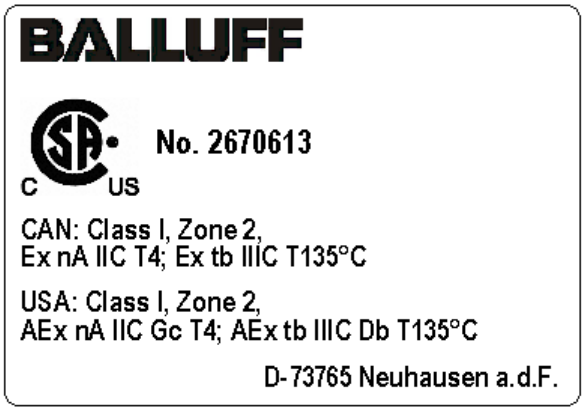


Fig. 13-1: BTL7 part label (example)

No. 897999 EN· G16; subject to modification. Replaces L15.