1 Notes to the user 5
  1.1 Validity 5
  1.2 Symbols and conventions 5
  1.3 Scope of delivery 5
  1.4 Approvals and markings 5

2 Safety 6
  2.1 Intended use 6
  2.2 General safety notes for the position measuring system 6
  2.3 Explanation of the warnings 6
  2.4 Disposal 6

3 Construction and function 7
  3.1 Construction 7
  3.2 Function 8
  3.3 LED display 8

4 Installation and connection 9
  4.1 Installation guidelines 9
  4.2 Preparing for installation 9
  4.3 Installing the transducer 10
    4.3.1 Installation recommendation for hydraulic cylinders 10
  4.4 Electrical connection 11
    4.4.1 Connector type S32/cable connection 11
    4.4.2 Connector type S115 11
    4.4.3 Connector type S135 12
    4.4.4 Connector type S140 12
  4.5 Shielding and cable routing 13

5 Startup 14
  5.1 Starting up the system 14
  5.2 Operating notes 14

6 Calibration procedure 15
  6.1 Calibration device (not for BTL7-...-S140) 15
  6.2 Programming inputs (not for BTL7-...-S135) 15
  6.3 Calibration procedure overview 15
    6.3.1 Teach-in 15
    6.3.2 Adjusting 16
    6.3.3 Online setting 16
    6.3.4 Reset 16
  6.4 Selecting the calibration procedure 16
  6.5 Calibration procedure notes 17
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Calibration using teach-in</td>
</tr>
<tr>
<td>8</td>
<td>Calibration using adjustment</td>
</tr>
<tr>
<td>9</td>
<td>Calibration using online setting</td>
</tr>
<tr>
<td>10</td>
<td>Resetting all values (reset)</td>
</tr>
<tr>
<td>11</td>
<td>Technical data</td>
</tr>
<tr>
<td>11.1</td>
<td>Accuracy</td>
</tr>
<tr>
<td>11.2</td>
<td>Ambient conditions</td>
</tr>
<tr>
<td>11.3</td>
<td>Supply voltage (external)</td>
</tr>
<tr>
<td>11.4</td>
<td>Output</td>
</tr>
<tr>
<td>11.5</td>
<td>Input</td>
</tr>
<tr>
<td>11.6</td>
<td>Dimensions, weights</td>
</tr>
<tr>
<td>12</td>
<td>Accessories</td>
</tr>
<tr>
<td>12.1</td>
<td>Magnets</td>
</tr>
<tr>
<td>12.2</td>
<td>Mounting nut</td>
</tr>
<tr>
<td>12.3</td>
<td>Connectors and cables</td>
</tr>
<tr>
<td>12.3.1</td>
<td>BKS-S32/S33M-00, freely configurable</td>
</tr>
<tr>
<td>12.3.2</td>
<td>BKS-S232/S233-PU-_, preassembled</td>
</tr>
<tr>
<td>12.3.3</td>
<td>BKS-S115/S116-PU-_, preassembled</td>
</tr>
<tr>
<td>12.3.4</td>
<td>BKS-S135/S136M-00, freely configurable</td>
</tr>
<tr>
<td>12.3.5</td>
<td>BKS-S140-23-00, freely configurable</td>
</tr>
<tr>
<td>12.3.6</td>
<td>Plug-in system, 8-pin</td>
</tr>
<tr>
<td>13</td>
<td>Ordering code</td>
</tr>
<tr>
<td>14</td>
<td>Appendix</td>
</tr>
<tr>
<td>14.1</td>
<td>Converting units of length</td>
</tr>
<tr>
<td>14.2</td>
<td>Part label</td>
</tr>
</tbody>
</table>
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/G_ _ _-M_ _ _ _-A/B/Y/Z(8)-S32/S115/S135/S140/KA_ _/FA_ _

(see Ordering code on page 29).

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

1.2 Symbols and conventions
Individual handling instructions are indicated by a preceding triangle.

► Handling instruction 1

Handling sequences are numbered consecutively:
1. Handling instruction 1
2. Handling instruction 2

Note, tip
This symbol indicates general notes.

These symbols indicate the buttons on the calibration device.

Symbols of this type indicate the LED displays.

1.3 Scope of delivery
– BTL7 transducer
– Calibration device (not for BTL7-…-S140)
– Condensed guide

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

1.4 Approvals and markings

UL approval\(^1\)
File no.
E227256

\(^1\) Not for BTL7-…-S140

US Patent 5 923 164
The US patent was awarded in connection with this product.


The transducer meets the requirements of the following generic standards:
– EN 61000-6-1 (noise immunity)
– EN 61000-6-2 (noise immunity)
– EN 61000-6-3 (emission)
– EN 61000-6-4 (emission)
and the following product standard:
– EN 61326-2-3

Emission tests:
– RF emission
  EN 55016-2-3 (industrial and residential areas)

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.

By using the GL symbol\(^1\), we confirm that the marked products were type tested according to the guidelines of Germanischer Lloyd.

The type approval is authenticated with a certificate.

The verified test requirements cover the environmental category “D” (closed environments with increased heat and vibration requirements).

Therefore, the marked products can be used according to the specifications of the certificate on ocean-going and inland vessels and on offshore operations in systems subject to mandatory type-testing.

Maximum length:
– BTL7-…-A/B/Y/Z(8)-…: 300 mm (500 mm when supported at the end of the rod using slide bush BAM PC-TL-001-D10,4-4 in bore with a diameter of max. 13 mm)

\(^1\) Not for BTL7-…-S140
2 Safety

2.1 Intended use
The BTL7 Micropulse Transducer, together with a machine controller (e.g. PLC), comprises a position measuring system. It is intended to be installed into a machine or system. 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 transducer 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 for the position measuring system
Installation and startup may only be performed by trained specialists with basic electrical knowledge. Qualified personnel are those who can recognize possible hazards and institute the appropriate safety measures due to their professional training, knowledge, and experience, as well as their understanding of the relevant regulations pertaining to the work to be done.

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 position measuring system will not result in hazards to persons or equipment. If defects and unresolvable faults occur in the transducer, it should be taken out of service and secured 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:

<table>
<thead>
<tr>
<th>SIGNAL WORD</th>
<th>Hazard type and source</th>
<th>Consequences if not complied with</th>
<th>Measures to avoid hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOTICE!</td>
<td>Identifies a hazard that could damage or destroy the product.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DANGER</td>
<td>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.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The individual signal words mean:

2.4 Disposal
Observe the national regulations for disposal.
### Construction and Function

#### Electrical Connection

The electrical connection is made via a cable or a connector (see Ordering code on page 29).

#### BTL Housing

Aluminum housing containing the processing electronics.

#### Mounting Thread

We recommend assembling this transducer on the mounting thread:
- BTL7-...-A/B: M18×1.5
- BTL7-...-Y/Z: 3/4"-16UNF

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 25).

#### Nominal Length

Defines the available measuring range.

Rods with various nominal lengths from 25 mm to 7620 mm are available depending on the version:
- Ø 10.2 mm: Nominal length from 25 mm to 7620 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.

#### Calibration Device

Additional device for calibrating the transducer (not for BTL7-...-S140).
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.

3.3 LED display

![LED display diagram]

Fig. 3-2: Position of the BTL7 LED displays

In normal operation LED 1 indicates the operating states of the transducer. Both LEDs together are used for displaying additional information in programming mode (see page 18 ff).

<table>
<thead>
<tr>
<th>LED 1</th>
<th>LED 2</th>
<th>Operating state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Off</td>
<td>Normal function</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Magnet is within the limits.</td>
</tr>
<tr>
<td>Red</td>
<td></td>
<td>Error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No magnet or magnet outside the limits.</td>
</tr>
</tbody>
</table>

Tab. 3-1: LED displays in normal operation
4.1 Installation guidelines

Non-magnetizable material

If using non-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).

Magnetizable material

Horizontal assembly: If installing horizontally with nominal lengths > 500 mm, we recommend tightening the outer rod at the end (only possible with Ø 10.2 mm) or supporting it.

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).

Mounting hole: The transducer comes with an M18x1.5 (ISO) or 3/4"-16UNF (SAE) mounting thread. Depending on the version, a mounting hole must be made before assembly.

Magnet: Various magnets are available for the BTL7 transducer (see Accessories on page 25).

4.2 Preparing for installation

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

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

<table>
<thead>
<tr>
<th>Tube diameter</th>
<th>Bore diameter D2</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2 mm</td>
<td>At least 13 mm</td>
</tr>
<tr>
<td>8 mm</td>
<td>At least 11 mm</td>
</tr>
</tbody>
</table>

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

Fig. 4-2: Installation in magnetizable material

Fig. 4-3: Mounting hole M18x1.5 per ISO 6149 O-ring 15.4x2.1

Fig. 4-4: Mounting hole 3/4" 16UNF per SAE J475 O-ring 15.3x2.4
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).

► Make a mounting hole with thread (possibly with countersink for the O-ring) acc. to Fig. 4-3 or Fig. 4-4.
► Screw the transducer with mounting thread into the mounting hole (max. torque 100 Nm).
► Install the magnet (accessories).
► For nominal lengths > 500 mm: Tighten the rod at the end (only possible with Ø 10.2 mm) or support it.

Suitable nuts for the mounting thread are available as accessories (see page 25).

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 sliding element to protect the rod end from wear.

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

The sliding 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.

The sliding element can be screwed on or bonded.
► Secure the screws so they cannot be loosened or lost.
► Select a suitable adhesive.

Fig. 4-6: Detailed view and top view of sliding element

There must be a gap between the sliding 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)

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 sliding element.

Fig. 4-7: Fixing the magnet

An example of how to install the transducer with a supporting rod is shown in Fig. 4-8 on page 11.
4 Installation and connection (continued)

4.4 Electrical connection

Depending on the model, the electrical connection is made using a cable or a connector. The connection or pin assignments for the respective version can be found in Tab. 4-2 to Tab. 4-5.

Note the information on shielding and cable routing on page 13.

---

Fig. 4-8: Example 2, transducer installed with supporting rod

### 4.4.1 Connector type S32/cable connection

<table>
<thead>
<tr>
<th>S32 Pin</th>
<th>Cable color</th>
<th>-A.10</th>
<th>-G.10</th>
<th>-C.00</th>
<th>-C.70</th>
<th>-E.00</th>
<th>-E.70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YE yellow</td>
<td>Not used(1)</td>
<td>0 to 20 mA</td>
<td>20 to 0 mA</td>
<td>4 to 20 mA</td>
<td>20 to 4 mA</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>GY gray</td>
<td>0 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PK pink</td>
<td>10 to 0 V</td>
<td>10 to −10 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>RD red</td>
<td>Lb (programming input)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>GN green</td>
<td>0 to 10 V</td>
<td>−10 to 10 V</td>
<td>Not used(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>WH white</td>
<td>Lb (programming input)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BU blue</td>
<td>GND(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>BN brown</td>
<td>20 to 28 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Fig. 4-9: Pin assignment of S32 (view of connector pins of transducer), 8-pin M16 circular plug

(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.

Tab. 4-2: Connection assignment BTL7...-S32

---

### 4.4.2 Connector type S115

<table>
<thead>
<tr>
<th>S115 Pin</th>
<th>-A.10</th>
<th>-G.10</th>
<th>-C.00</th>
<th>-C.70</th>
<th>-E.00</th>
<th>-E.70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 V (pin 3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0 V (pin 5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10 to 0 V</td>
<td>10 to −10 V</td>
<td>Not used(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Lb (programming input)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0 to 10 V</td>
<td>−10 to 10 V</td>
<td>0 to 20 mA</td>
<td>20 to 0 mA</td>
<td>4 to 20 mA</td>
<td>20 to 4 mA</td>
</tr>
<tr>
<td>8</td>
<td>Lb (programming input)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>GND(2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>20 to 28 V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Fig. 4-10: Pin assignment of S115 (view of connector pins of transducer), 8-pin M12 circular plug

(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.

Tab. 4-3: Connection assignment BTL7...-S115

---
4.4.3 Connector type S135

<table>
<thead>
<tr>
<th>S135 Pin</th>
<th>-A.10</th>
<th>-G.10</th>
<th>-C.00</th>
<th>-C.70</th>
<th>-E.00</th>
<th>-E.70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 to 10 V</td>
<td>–10 to 10 V</td>
<td>0 to 20 mA</td>
<td>20 to 0 mA</td>
<td>4 to 20 mA</td>
<td>20 to 4 mA</td>
</tr>
<tr>
<td>2</td>
<td>0 V (pin 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10 to 0 V</td>
<td>10 to –10 V</td>
<td></td>
<td>Not used(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0 V (pin 3)</td>
<td></td>
<td></td>
<td>Not used(1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>BTL7–1__–...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>BTL7–5__–...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tab. 4-4: Connection assignment BTL7...-S135

Fig. 4-11: Pin assignment of S135 (view of connector pins of transducer), 6-pin M16 circular plug

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.

4.4.4 Connector type S140

<table>
<thead>
<tr>
<th>S140 Pin</th>
<th>Interface BTL7–...</th>
</tr>
</thead>
<tbody>
<tr>
<td>-A.10</td>
<td></td>
</tr>
<tr>
<td>-G.10</td>
<td></td>
</tr>
<tr>
<td>-C.00</td>
<td></td>
</tr>
<tr>
<td>-C.70</td>
<td></td>
</tr>
<tr>
<td>-E.00</td>
<td></td>
</tr>
<tr>
<td>-E.70</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>0 V</td>
</tr>
<tr>
<td>B</td>
<td>Not used(1)</td>
</tr>
<tr>
<td>C</td>
<td>10 to 0 V</td>
</tr>
<tr>
<td>F</td>
<td>GND(2)</td>
</tr>
<tr>
<td>G</td>
<td>La (programming input)</td>
</tr>
<tr>
<td>H</td>
<td>Lb (programming input)</td>
</tr>
<tr>
<td>J</td>
<td>0 to 10 V</td>
</tr>
<tr>
<td>K / E</td>
<td>Not used(1)</td>
</tr>
<tr>
<td>D</td>
<td>BTL7–1__–...</td>
</tr>
<tr>
<td></td>
<td>BTL7–5__–...</td>
</tr>
</tbody>
</table>

Tab. 4-5: Connection assignment BTL7...-S140

Fig. 4-12: Pin assignment of S140 (view of connector pins of transducer), 10-pin circular plug

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.
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 the transducer and controller using a shielded cable.
  Shielding: Copper filament braided, at least 85% coverage.
- 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 position measuring system is a magnetostrictive system. It is important to maintain adequate distance between the transducer 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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTL7-A/G</td>
<td>Max. 30 m$^{1}$</td>
</tr>
<tr>
<td>BTL7-C/E</td>
<td>Max. 100 m$^{1}$</td>
</tr>
</tbody>
</table>

Tab. 4-6: Cable lengths BTL7

$^{1}$ Prerequisite: Construction, shielding and routing preclude the effect of any external noise fields.
5

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.

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 transducer and all associated components on a regular basis.
- Take the position measuring system out of operation whenever there is a malfunction.
- Secure the system against unauthorized use.
6 Calibration procedure

6.1 Calibration device (not for BTL7---S140)
The calibration device is an additional device for calibrating the transducer.
► Before calibrating: Place the calibration device on the connection side of the transducer.
► When finished with calibration: 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., programming mode is automatically ended.

6.2 Programming inputs (not for BTL7---S135)
Instead of the calibration device, the programming inputs may also be used for setting:
– La corresponds to button 1,
– Lb corresponds to button 2,
– Programming input at 20 to 28 V (BTL7---1---...) or 10 to 30 V (BTL7---5---...) corresponds to button depressed (high active).

► 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 point and end point is replaced by a new null point and end point.

► The detailed procedure for teach-in is described on page 18.

Steps:
► Move magnet to the new zero position.
► Read new null point by pressing the buttons.

Fig. 6-1: Calibration device in place

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

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

The detailed procedure for adjustment is described on page 19 ff.

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

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

![Fig. 6-5: Adjusting new end position (changing the output gradient)](image)

6.3.3 Online setting

The detailed procedure for online setting is described on page 21.

Setting start and end values while the system is running.

6.3.4 Reset

The detailed procedure for the reset is described on page 22.

Restoring the transducer to its factory settings.

6.4 Selecting the calibration procedure

![Fig. 6-6: Selecting the calibration procedure](image)
6 Calibration procedure (continued)

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 zero and end point
- Any desired position of the magnet can be used as the zero or end point. However, the zero and end points may not be reversed.
- The absolute zero 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.

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

Value table for teach-in and adjustment

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

<table>
<thead>
<tr>
<th>Output gradient</th>
<th>Linear transducer</th>
<th>Unit</th>
<th>Min. value</th>
<th>Null value</th>
<th>Identification for adjustment</th>
<th>Identification for teach-in</th>
<th>End value</th>
<th>Max. value</th>
<th>Error value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising</td>
<td>BTL7-A…</td>
<td>V</td>
<td>–0.5</td>
<td>0</td>
<td>2.0</td>
<td>4.0</td>
<td>+10.0</td>
<td>+10.5</td>
<td>+10.5</td>
</tr>
<tr>
<td></td>
<td>BTL7-G…</td>
<td>V</td>
<td>–10.5</td>
<td>–10.0</td>
<td>2.0</td>
<td>4.0</td>
<td>+10.0</td>
<td>+10.5</td>
<td>+10.5</td>
</tr>
<tr>
<td></td>
<td>BTL7-C…</td>
<td>mA</td>
<td>0</td>
<td>0</td>
<td>6.0</td>
<td>12.0</td>
<td>20.0</td>
<td>20.4</td>
<td>20.4</td>
</tr>
<tr>
<td></td>
<td>BTL7-E…</td>
<td>mA</td>
<td>3.6</td>
<td>4.0</td>
<td>6.0</td>
<td>12.0</td>
<td>20.0</td>
<td>20.4</td>
<td>3.6</td>
</tr>
<tr>
<td>Falling</td>
<td>BTL7-A…</td>
<td>V</td>
<td>+10.5</td>
<td>+10.0</td>
<td>8.0</td>
<td>6.0</td>
<td>0</td>
<td>–0.5</td>
<td>–0.5</td>
</tr>
<tr>
<td></td>
<td>BTL7-G…</td>
<td>V</td>
<td>+10.5</td>
<td>+10.0</td>
<td>–2.0</td>
<td>–4.0</td>
<td>–10.0</td>
<td>–10.5</td>
<td>–10.5</td>
</tr>
<tr>
<td></td>
<td>BTL7-C…</td>
<td>mA</td>
<td>20.4</td>
<td>20.0</td>
<td>14.0</td>
<td>8.0</td>
<td>0</td>
<td>0</td>
<td>20.4</td>
</tr>
<tr>
<td></td>
<td>BTL7-E…</td>
<td>mA</td>
<td>20.4</td>
<td>20.0</td>
<td>14.0</td>
<td>8.0</td>
<td>4.0</td>
<td>3.6</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Tab. 6-1: Value table for teach-in and adjustment
7 Calibration using teach-in

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

Initial situation:
– Transducer with magnet within measuring range

1. Activate buttons
► Hold down any button for at least 3 s.
► Release button.
► Within 1 s, hold down ● and ● simultaneously for at least 3 s.
⇒ Output indicates error value.
⇒ Buttons are activated.

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

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

3. Set null point
► Bring magnet to the new null point.
► Hold down ● for at least 2 s.
⇒ The new null point is set.

4. Set end point
► Bring magnet to the new end point.
► Hold down ● for at least 2 s.
⇒ The new end point is set.

5. Exit teach-in and deactivate buttons
► Hold down ● and ● simultaneously for at least 6 s.
⇒ Output indicates error value.
► Briefly press ● or ● (< 1 s).
⇒ Buttons are deactivated.
⇒ Current position value is displayed.

LED display Displayed values (example)
LED1 LED2 At 0 to 10 V At 4 to 20 mA

<table>
<thead>
<tr>
<th>LED1</th>
<th>LED2</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.39</td>
<td>9.15</td>
<td>V</td>
<td>mA</td>
</tr>
<tr>
<td>10.50</td>
<td>3.60</td>
<td>V</td>
<td>mA</td>
</tr>
<tr>
<td>4.00</td>
<td>12.00</td>
<td>V</td>
<td>mA</td>
</tr>
<tr>
<td>1.04</td>
<td>4.82</td>
<td>V</td>
<td>mA</td>
</tr>
<tr>
<td>9.89</td>
<td>19.13</td>
<td>V</td>
<td>mA</td>
</tr>
<tr>
<td>10.00</td>
<td>20.00</td>
<td>V</td>
<td>mA</td>
</tr>
</tbody>
</table>

LED legend:
- LED not on
- LED flashing green
- LED green
- LED red
- LED 1 and LED 2 flashing green-green in alternation

BTL7-A/C/E/G_ _ _-M_ _ _ _-A/B/Y/Z(8)-S32/S115/S135/S140/KA_ _/FA_ _
Micropulse Transducer - Rod Style
**NOTICE!**

**Interference in function**
Adjustment while the system is running may result in malfunctions.

▶ Stop the system before performing adjustment.

**Initial situation:**
- Transducer with magnet within measuring range

1. **Activate buttons**
   ▶ Hold down any button for at least 3 s.
   ▶ Release button.
   ▶ Within 1 s, hold down 1 and 2 simultaneously for at least 3 s.
     ⇒ Output indicates error value.
     ⇒ Buttons are activated.

   ![LED display Displayed values (example)]
   LED1 | LED2 | At 0 to 10 V | At 4 to 20 mA
   5.39 V | 9.15 mA
   5.39 V | 9.15 mA

   ![LED display Displayed values (example)]
   LED1 | LED2 | At 0 to 10 V | At 4 to 20 mA
   10.50 V | 3.60 mA

2. **Select adjustment**
   ▶ Hold down 2 for at least 2 s.
     ⇒ Indication for “Adjustment” is displayed.
   ▶ Release 2.
     ⇒ Current position value is displayed.

3. **Adjust start value**
   ▶ Bring magnet to start position.
   ▶ Hold down 1 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.
     The gradient of the output remains constant (see page 16).

   ![LED display Displayed values (example)]
   LED1 | LED2 | At 0 to 10 V | At 4 to 20 mA
   1.04 V | 4.82 mA
   1.04 V | 4.82 mA
   1.00 V | 4.40 mA
   1.00 V | 4.40 mA

   ![LED display Displayed values (example)]
   LED1 | LED2 | At 0 to 10 V | At 4 to 20 mA
   2.00 V | 6.00 mA
   2.00 V | 6.00 mA

4. **Exit calibration procedure:** Press 1 and 2 for no more than 2 s.
   ⇒ Indication for “Adjustment” is displayed.
   ⇒ Set position value is saved.

**LED legend:**
- LED not on
- LED green
- LED 1 and LED 2 flashing green-red in alternation
- LED flashing green
- LED 1 and LED 2 flashing red-red in alternation

---

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

---

**Calibration using adjustment**
4. Adjust end value
► Bring magnet to end position.
► Hold down for at least 2 s.
  ⇒ Indication for “Adjust end value” is displayed.
► Adjust end value
  ⇒ The end value can be changed using and . The gradient of the output is changed, but the zero value remains unchanged (see page 16).
► Exit calibration procedure: Press and 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. Exit adjustment and deactivate buttons
► Hold down and simultaneously for at least 6 s.
  ⇒ Output indicates error value.
► Briefly press or (< 1 s).
  ⇒ Buttons are deactivated.
  ⇒ Current position value is displayed.

1) Briefly press button: 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
- LED 1 and LED 2 flashing red-green in alternation
- LED flashing green
- LED 1 and LED 2 flashing red-red in alternation
NOTICE!

Interference in function
Changing the transducer output signal may result in personal injury and equipment damage if the system is ready for operation.
► Persons must keep away from the system’s hazardous zones.

1. Set start value online:
► Move the system so that the magnet is in the start position.

► Hold down for at least 3 s.
► Hold down and additionally press for at least 3 s.

⇒ Buttons are activated.
► Set start value.
⇒ Using and , you can change the start value within the permissible setting range\(^1\). The gradient of the output remains constant (see page 16).

► Exit 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. Set end value online:
► Move the system so that the magnet is in the end position.

► Hold down for at least 3 s.
► Hold down and additionally press for at least 3 s.

⇒ Buttons are activated.
► Set end value.
⇒ Using and , you can change the end value within the permissible setting range\(^1\). The gradient of the output is changed, but the zero value remains unchanged (see page 16).

► Exit setting (do not press a button for at least 15 s).
⇒ The end value is saved, the buttons are deactivated.

\(^1\) Briefly press button: Current value is increased or decreased by approx. 1 mV or 1 mA. If a button is held down longer than 1 s, the step interval is increased.
**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.

### 1. Activate buttons
- Hold down any button for at least 3 s.
- Release button.
- Within 1 s, hold down 1 and 2 simultaneously for at least 3 s.
  - Output indicates error value.
  - Buttons are activated.

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

### 2. Reset
- Hold down 1 and 2 for at least 6 s.
  - Output indicates zero value.
  - All values are reset.
- Release buttons.
  - Current position value is displayed.
  - Buttons are locked.
11.1 Accuracy

The specifications are typical values for 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 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.

Repeat accuracy
Voltage, typical ±10 µm
Current, typical ±5 µm

Sampling rate
Dependent on nominal length 250 µs to 5.7 ms
At nominal length = 500 mm 500 µs

Non-linearity at
Nominal length ≤ 500 mm ±50 µm
Nominal length > 500 to ≤ 5500 mm ±0.01% FS
Nominal length > 5500 mm ±0.02% FS

Temperature coefficient (1)
≤ 30 ppm/K

Max. detectable speed 10 m/s

11.2 Ambient conditions (2)

Operating temperature
−40°C to +85°C

Operating temperature for UL (only BTL-...-KA...)
max. +80°C

Storage temperature
−40°C to +100°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
per EN 60068-2-27(3)

Continuous shock
150 g/2 ms
per EN 60068-2-29(3)

Vibration
20 g, 10 to 2000 Hz
per EN 60068-2-6(5)
(note resonant frequency of the rod)

Degree of protection per IEC 60529
Connector (when attached) IP 67
Cable IP 68(5)

11.3 Supply voltage (external)

Voltage, stabilized(4):
BTL7-1_ _ -... 20 to 28 V DC
BTL7-5_ _ -... 10 to 30 V DC
Ripple
≤ 0.5 V ss

Current draw (at 24 V DC)
≤ 150 mA

Inrush current
≤ 500 mA/10 ms

Reverse polarity protection (5)
Up to 36 V

Overvoltage protection
Up to 36 V

Dielectric strength
500 V AC
(GND to housing)

11.4 Output

BTL7-A... Output voltage
Load current 0 to 10 V and 10 to 0 V
≤ 5 mA

BTL7-C... Output current
Load resistance 0 to 20 mA / 20 to 0 mA
≤ 500 ohms

BTL7-E... Output current
Load resistance 4 to 20 mA / 20 to 4 mA
≤ 500 ohms

BTL7-G... Output voltage
Load current −10 to 10 V and 10 to −10 V
≤ 5 mA

Short circuit resistance
Signal cable to 36 V
Signal cable to GND

11.5 Input

Programming inputs La, Lb:
High-active

BTL7-1_ _ -... 20 to 28 V DC
BTL7-5_ _ -... 10 to 30 V DC

Overvoltage protection
up to 36 V

(1) Nominal length = 500 mm, magnet in the middle of the measuring range
(2) For RA: Use in enclosed spaces and up to a height of 2000 m above sea level.
(3) Individual specifications as per Balluff factory standard
(4) For RA: The transducer 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.
(5) A prerequisite is that no current can flow between GND and 0 V in the event of polarity reversal.
11.6 Dimensions, weights

**Diameter of rod** 8 mm or 10.2 mm

**Nominal length**
- For Ø 8 mm 25 to 1016 mm
- For Ø 10.2 mm 25 to 7620 mm

**Weight (depends on length)** Approx. 2 kg/m

**Housing material** Anodized aluminum

**Rod material** Stainless steel 1.4571

**Rod wall thickness**
- For Ø 8 mm 0.9 mm
- For Ø 10.2 mm 2 mm

**Young's modulus** Approx. 200 kN/mm²

**Housing mounting via threads** M18×1.5 or 3/4"-16UNF

**Tightening torque** Max. 100 Nm

---

**BTL7-...-KA_ _**

**Cable material** PUR
cULus 20549
80°C, 300 V, internal wiring

**Cable temperature** -40°C to +90°C

**Cable diameter** Max. 7 mm

**Permissible bending radius**
- Fixed routing ≥ 35 mm
- Movable ≥ 105 mm

---

**BTL7-...-FA_ _**

**Cable material** PTFE
No UL approval available

**Cable temperature** -55°C to +200°C

**Cable diameter** Max. 7 mm

**Permissible bending radius**
- Fixed routing ≥ 35 mm
- Movable No permissible bending radius
Accessories are not included in the scope of delivery and must be ordered separately.

### 12.1 Magnets

<table>
<thead>
<tr>
<th>Model</th>
<th>Dimensions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTL-P-1013-4R</td>
<td>Ø 2.5</td>
<td>Weight: Approx. 10 g</td>
</tr>
<tr>
<td></td>
<td>Ø 1.3</td>
<td>Housing: Anodized aluminum</td>
</tr>
<tr>
<td>BTL-P-1013-4S</td>
<td>Ø 2.5</td>
<td>Weight: Approx. 10 g</td>
</tr>
<tr>
<td></td>
<td>Ø 1.3</td>
<td>Housing: Anodized aluminum</td>
</tr>
<tr>
<td>BTL-P-1012-4R</td>
<td>Ø 2.5</td>
<td>Weight: Approx. 10 g</td>
</tr>
<tr>
<td></td>
<td>Ø 1.3</td>
<td>Housing: Anodized aluminum</td>
</tr>
<tr>
<td>BTL-P-1014-2R</td>
<td>Ø 2.1</td>
<td>Weight: Approx. 10 g</td>
</tr>
<tr>
<td></td>
<td>Ø 1.3</td>
<td>Housing: Anodized aluminum</td>
</tr>
</tbody>
</table>

The scope of delivery for BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R magnets includes:
- Spacer: 8 mm, material: polyoxymethylene (POM)

**BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R**
- Weight: Approx. 10 g
- Housing: Anodized aluminum

**BTL5-P-4500-1 magnet (solenoid):**
- Weight: Approx. 90 g
- Housing: Plastic
- Operating temperature: −40°C to +60°C

**BTL-P-1028-15R (special accessories for applications with a supporting rod):**
- Weight: Approx. 68 g
- Housing: Anodized aluminum

### 12.2 Mounting nut

- M18×1.5 mounting nut: BTL-A-FK01-E-M18×1.5

Fig. 12-1: Magnet installation dimensions
12.3 Connectors and cables

12.3.1 BKS-S32/S33M-00, freely configurable

BKS-S32M-00
Straight connector, freely configurable
M16 per IEC 130-9, 8-pin

BKS-S33M-00
Angled connector, freely configurable
M16 per IEC 130-9, 8-pin

12.3.2 BKS-S232/S233-PU-__, preassembled

BKS-S232-PU-__
Straight connector, molded, preassembled
M16, 8-pin
Various cable lengths can be ordered, e.g.
BKS-S232-PU-05: Cable length 5 m

BKS-S233-PU-__
Angled connector, molded, preassembled
M16, 8-pin
Various cable lengths can be ordered, e.g.
BKS-S233-PU-05: Cable length 5 m

The outlet direction and the pin assignment for the BKS-S233-PU-__ is the same as that for the BKS S116-PU-__ (see Fig. 12-8 or Tab. 12-1).
12.3.3 BKS-S115/S116-PU-_, preassembled

**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. 12-6: Connector type BKS-S115-PU-](image)

**BKS-S116-PU-**

Angled 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. 12-7: Connector type BKS-S116-PU-](image)

![Fig. 12-8: Connector type BKS-S116-PU- outlet](image)

<table>
<thead>
<tr>
<th>Pin</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>YE yellow</td>
</tr>
<tr>
<td>2</td>
<td>GY grey</td>
</tr>
<tr>
<td>3</td>
<td>PK pink</td>
</tr>
<tr>
<td>4</td>
<td>RD red</td>
</tr>
<tr>
<td>5</td>
<td>GN green</td>
</tr>
<tr>
<td>6</td>
<td>BU blue</td>
</tr>
<tr>
<td>7</td>
<td>BN brown</td>
</tr>
<tr>
<td>8</td>
<td>WH white</td>
</tr>
</tbody>
</table>

**Tab. 12-1: BKS-S115/116-PU- pin assignment**

12.3.4 BKS-S135/S136M-00, freely configurable

**BKS-S135M-00**

Straight connector, freely configurable M16 per IEC 130-9, 6-pin

![Fig. 12-9: Connector type BKS-S135M-00](image)

**BKS-S136M-00**

Angled connector, freely configurable M16 per IEC 130-9, 6-pin

![Fig. 12-10: Connector type BKS-S136M-00](image)

12.3.5 BKS-S140-23-00, freely configurable

**BKS-S140-23-00**

Straight connector, freely configurable 10-pin

![Fig. 12-11: Connector type BKS-S140-23-00](image)
12.3.6 Plug-in system, 8-pin

The transducer is available with an 8-pin pigtail plug-in system. The plug-in system has two parts:
- The M12 contact insert is preassembled to the transducer’s cable
- The square flange for assembly using the contact insert is included in the scope of delivery.

Fig. 12-12: Plug-in system based on the example installing the transducer in a hydraulic cylinder

Series ZA10
Square flange material: Nickel-plated brass
BTL7-…-KA00,2-ZA10, PUR cable 0,2 m
BTL7-…-KA00,3-ZA10, PUR cable 0,3 m

Series ZA15
Square flange material: Stainless steel 1.4404
BTL7-…-KA00,2-ZA15, PUR cable 0,2 m
BTL7-…-KA00,3-ZA15, PUR cable 0,3 m

Fig. 12-13: Square flange
Micropulse transducer

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

Supply voltage:
- 1 = 20 to 28 V DC
- 5 = 10 to 30 V DC

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

Nominal stroke (4-digit):
- M0500 = Metric specification in mm, nominal length 500 mm
  - (M0025 to M1016: A8, B8, Y8, Z8)
  - (M0025 to M7620: A, B, Y, Z)

Rod version, fastening:
- A = Metric mounting thread M18x1.5, rod diameter 10.2 mm
- B = Metric mounting thread M18x1.5, O-ring, rod diameter 10.2 mm
- Y = 3/4”-16UNF thread, rod diameter 10.2 mm
- Z = 3/4”-16UNF thread, O-ring, rod diameter 10.2 mm
- A8 = Metric mounting thread M18x1.5, rod diameter 8 mm
- B8 = Metric mounting thread M18x1.5, O-ring, rod diameter 8 mm
- Y8 = 3/4”-16UNF thread, rod diameter 8 mm
- Z8 = 3/4”-16UNF thread, O-ring, rod diameter 8 mm

Electrical connection:
- S32 = 8-pin, M16 plug per IEC 130-9
- S115 = 8-pin, M12 plug
- S135 = 6-pin, M16 plug per IEC 130-9
- S140 = 10-pin, plug
- KA05 = Cable, 5 m (PUR)
- FA05 = Cable, 5m (PTFE)
14.1 Converting units of length

1 mm = 0.0393700787 inch

Tab. 14-1: Conversion table mm to inches

<table>
<thead>
<tr>
<th>mm</th>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.03937008</td>
</tr>
<tr>
<td>2</td>
<td>0.07874016</td>
</tr>
<tr>
<td>3</td>
<td>0.11811024</td>
</tr>
<tr>
<td>4</td>
<td>0.15748031</td>
</tr>
<tr>
<td>5</td>
<td>0.19685039</td>
</tr>
<tr>
<td>6</td>
<td>0.23622047</td>
</tr>
<tr>
<td>7</td>
<td>0.27559055</td>
</tr>
<tr>
<td>8</td>
<td>0.31496063</td>
</tr>
<tr>
<td>9</td>
<td>0.35433071</td>
</tr>
<tr>
<td>10</td>
<td>0.393700787</td>
</tr>
</tbody>
</table>

Tab. 14-2: Conversion table inches to mm

1 inch = 25.4 mm

<table>
<thead>
<tr>
<th>inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.4</td>
</tr>
<tr>
<td>2</td>
<td>50.8</td>
</tr>
<tr>
<td>3</td>
<td>76.2</td>
</tr>
<tr>
<td>4</td>
<td>101.6</td>
</tr>
<tr>
<td>5</td>
<td>127</td>
</tr>
<tr>
<td>6</td>
<td>152.4</td>
</tr>
<tr>
<td>7</td>
<td>177.8</td>
</tr>
<tr>
<td>8</td>
<td>203.2</td>
</tr>
<tr>
<td>9</td>
<td>228.6</td>
</tr>
<tr>
<td>10</td>
<td>254</td>
</tr>
</tbody>
</table>

14.2 Part label

Fig. 14-1: BTL7 part label

BTL06WT
BTL7-A110-M0500-B-S32
15020900012345 DE

1 Ordering code
2 Type
3 Serial number

www.balluff.com