BTL5-A/C/E/G-M---P-S32/KA
Micropulse Linear Transducer
Analog Output/Profile Housing
## Balluff - Linear Transducer

### Generation 5

### Output Type

- **A**: 0 to 10 Vdc
- **B**: -5 to +5 Vdc
- **C**: 0 to 20 mA
- **E**: 4 to 20 mA
- **G**: -10 to +10 Vdc

### Supply Voltage

- **1**: 24 Vdc ±20%
- **2**: ±15 Vdc ±2% (Not available for S, T, or H outputs)

### Analog Output Operation

- **Voltage type** (Output type A, B & G)
  - **1**: User selectable rising or falling
- **Current type** (Output type C & E)
  - **0**: Minimum output at connector end (rising towards opposite end)
  - **7**: Maximum output at connector end (falling towards opposite end)

### Normal Stroke Length

- **K 0 0 0 5** = 305mm active stroke

### Housing Type

- **P**: Standard Profile Housing

### Connection Type

- **S 3 2** = 8-pin quick disconnect metal connector
- **K A 0 5** = Cable out (5m standard; specify length in meters)

### Standard Stroke Lengths

(consult factory for additional lengths)

#### Electrical Stroke

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1 Safety Advisory
Read this manual before installing and operating the Micropulse Transducer.

1.1 Proper application
The BTL5 Micropulse transducer is intended to be installed in a machine or system. Together with a controller (PLC) or a processor (BTA) it comprises a position measuring system and may only be used for this purpose.

Unauthorized modifications and non-permitted usage will result in the loss of warranty and liability claims.

1.2 Qualified personnel
This guide is intended for specialized personnel who will perform the installation and setup of the system.

1.3 Use and inspection
The relevant safety regulations must be followed when using the transducer system. In particular, steps must be taken to ensure that should the transducer system become defective, no hazards to persons or property can result. This includes the installation of additional safety limit switches, emergency shutoff switches and maintaining the permissible ambient conditions.

1.4 Scope
This guide applies to the model BTL5-A/C/E/G...P... Micropulse transducer.

An overview of the various models can be found in section 6 Versions (indicated on part label) on page 7.

Note: For special versions, which are indicated by an -SU_ _ _ designation in the part number, other technical data may apply (affecting calibration, wiring, dimensions etc.).

The CE Mark verifies that our products meet the requirements of EC Directive 89/336/EEC (EMC Directive) and the EMC Law. Testing in our EMC Laboratory, which is accredited by DATech for Testing Electromagnetic Compatibility, has confirmed that Balluff products meet the EMC requirements of the following Generic Standards:

- EN 50081-2 (emission)
- EN 61000-6-2 (noise immunity)

Emission tests:
- RF Emission
  - EN 55011 Group 1, Class A
- Static electricity (ESD)
  - EN 61000-4-2 Severity level 3
- Electromagnetic fields (RFI)
  - EN 61000-4-3 Severity level 3
- Fast transients (Burst)
  - EN 61000-4-4 Severity level 3
- Surge
  - EN 61000-4-5 Severity level 2
- Line-induced noise induced by high-frequency fields
  - EN 61000-4-6 Severity level 3
- Magnetic fields
  - EN 61000-4-8 Severity level 4
2 Function and Characteristics

2.1 Characteristics

Micropulse transducers feature:

— Very high resolution, repeatability and linearity
— Immunity to shock, vibration, contamination and electrical noise
— An absolute output signal
— IP 67 per IEC 529

2.2 Function

The Micropulse transducer contains a tubular waveguide enclosed by an extruded aluminum housing. A magnet attached to the moving member of the machine is moved across the top of the housing and its position constantly updated.

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

The torsional wave arriving at the end of the waveguide is absorbed in the damping zone. The wave arriving at the beginning of the waveguide creates an electrical signal in the coil surrounding the waveguide. The propagation time of the wave is used to derive the position. Depending on the version the corresponding value is output as a voltage or a current either with rising or falling characteristic. This process takes place with high precision and repeatability within the stroke range defined as nominal stroke length.

On both ends of the nominal stroke length is an area which provides an unreliable signal, but which may be entered.

The electrical connection between the transducer, the processor/controller and the power supply is via a cable, which depending on the version is either fixed or connected using a female connector.

Dimensions for installing the Micropulse transducer and for the magnets and control arm are found on pages 4 and 5.

2.3 Available stroke lengths and magnets

To provide for optimum fit in any application, a wide range of stroke lengths, magnets and mounting hardware is available. Magnets, control arms and mounting brackets must be ordered separately.

See inside front cover for available stroke lengths.

3 Installation

3.1 Transducer installation

Ensure that no strong electrical or magnetic fields are present in the immediate vicinity of the transducer.

Any orientation is permitted. The mounting brackets and cylinder head screws allow the transducer to be mounted on a flat machine surface. These should be evenly spaced (Figs. 3-1 and 3-5).

The recommended spacing for long transducers and extreme conditions (e.g. strong shock or vibration): A = 80 mm; spacing between the individual brackets B = 250 mm.

The isolation bushings are used to electrically insulate the transducer from the machine (Fig. 3-1 and 3-5 and chapter 5.6 Noise elimination).

The Micropulse transducer in profile housing is suitable both for floating, i.e. non-contacting magnets (Page 4) and for captive magnets (Page 5).
3.2 Floating magnets

The floating magnet (Figs. 3-2 to 3-4) is attached to the moving member of the machine using non-magnetizable screws (brass, aluminum). To ensure the accuracy of the transducer system, the moving member must carry the magnet on a track parallel to the transducer.

The following table provides figures in [mm] for the spacing which must be maintained between magnet and transducer and for the permissible center offset:

<table>
<thead>
<tr>
<th>Magnet type</th>
<th>Distance <em>D</em></th>
<th>Offset <em>C</em></th>
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<tbody>
<tr>
<td>BTL5-P-3800-2</td>
<td>0.1 ... 4</td>
<td>± 2</td>
</tr>
<tr>
<td>BTL5-P-5500-2</td>
<td>5 ... 15</td>
<td>± 15</td>
</tr>
<tr>
<td>BTL5-P-4500-1</td>
<td>0.1 ... 2</td>
<td>± 2</td>
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</tbody>
</table>

BTL5-P-4500-1 magnet, special features: Multiple magnets on the same transducer can be turned on and off individually (PLC control signal).

Ensure that the distance E between parts made of magnetizable material and the BTL5-P-5500-2 magnet is at least 12 mm (Fig. 3-3).

The stroke range is offset 4 mm towards the BTL connector/cable (Fig. 3-4).
3 Installation (cont.)

Fig. 3-5: Dimensional drawing (BTL5...P-KA transducer with captive magnet BTL5-F-2814-1S)

Fig. 3-6: BTL5-F-2814-1S magnet

Fig. 3-7: BTL5-M/N-2814-1S magnet

3.3 Captive magnets

Lateral forces are to be avoided when using captive magnets (Figs. 3-6 and 3-7). Connections are required here which permit the corresponding degree of freedom with respect to the direction of movement of the magnet along the stroke range. It is assumed that the BTL5-F-2814-1S magnet is connected to the machine member using a connecting rod. The BTL2-GS08...A connecting rod (Fig. 3-8) is available as an accessory (please indicate length LS when ordering).
When routing the cable between the transducer, controller and power supply, avoid proximity to high voltage lines to prevent noise coupling. Especially critical is inductive noise caused by AC harmonics (e.g. from phase-control devices), against which the cable shield provides only limited protection.

Cable length max. 20 m; Ø 6 to 8 mm. Longer lengths may be used if construction, shielding and routing are such that external noise fields will have no effect on signal integrity.

Note the following when making electrical connections:

- System and control cabinet must be at the same ground potential.
- To ensure electromagnetic compatibility (EMC), which Balluff verifies by the CE Marking, the following points must be strictly observed.
- BTL transducer and the processor/control must be connected using shielded cable.
- Shielding: Copper filament braided, 80% coverage.
- The shield must be tied to the connector housing in the BKS connector (Fig. 4-1); see instructions accompanying the connector.
- In the cable version the cable shield is connected to the housing in the PG fitting.
- The cable shield must be grounded on the control side, i.e., connected to the protection ground.
- Pin assignments can be found in the illustration above. Connections on the controller side may vary according to the controller and configuration used.
4 Wiring (cont.)

Fig. 4-3: BTL5-E10...KA _ _ with processor card/controller, wiring example

5 Startup

5.1 Check connections
Although the connections are polarity reversal protected, components can be damaged by improper connections and overvoltage. Before you apply power, check the connections carefully.

5.2 Turning on the system
Note that the system may execute uncontrolled movements when first turned on or when the transducer is part of a closed-loop system whose parameters have not yet been set. Therefore make sure that no hazards could result from these situations.

If there is no magnet in the stroke range, the integrated function monitor provides the following defined output signals:

- Voltage output 10 V
  - increasing: $V_+ > 10 \text{ V}$
  - decreasing: $V_- < 0 \text{ V}$

- Current output 20 mA
  - increasing: $I_+ > 20 \text{ mA}$
  - decreasing: $I_- \leq 4 \text{ mA}$

5.3 Check output values
After replacing or repairing a transducer, it is advisable to verify the values for the start and end position of the magnet in manual mode. If values other than those present before the replacement or repair are found, a correction should be made.

* Transducers are subject to modification or manufacturing tolerances.

5.4 Check functionality
The functionality of the transducer system and all its associated components should be regularly checked and recorded.

5.5 Fault conditions
When there is evidence that the transducer system is not operating properly, it should be taken out of service and guarded against unauthorized use.

5.6 Noise elimination
Any difference in potential - current flow - through the cable shield should be avoided. Therefore:
- Use the isolation bushings, and
- Make sure the control cabinet and the system in which the BTL is contained are at the same ground potential.

6 Versions (indicated on part label)

- Supply voltage 1 = DC 24 V, 2 = DC ±15 V
- Electr. connection: S32: with connector, KA05: with 5 m cable
- Profile form factor
- Nom. length (4 digits), M = metric in mm
- Analog interface: Voltage output $A_1 = 10 \ldots 0 \text{ V}$ and $0 \ldots 10 \text{ V}$
  $G_1 = 10 \ldots -10 \text{ V}$ and $-10 \ldots 10 \text{ V}$
- Current output $C_0 = 0 \ldots 20 \text{ mA}$
  $C_7 = 20 \ldots 0 \text{ mA}$
  $E_0 = 4 \ldots 20 \text{ mA}$
  $E_7 = 20 \ldots 4 \text{ mA}$
7 Technical Data

The following are typical values at DC 24 V and 25 °C. Fully operational after power-up, with full accuracy after warm-up. Values are with BTL5-P-3800-2, BTL5-P-4500-1 or BTL5-P-5500-2 magnet held at a constant offset from the transducer or with captive magnet BTL5-F/M/N-2814-1S (see magnet section for exceptions):

- Resolution: ≤ ±2 µm
- Hysteresis: ≤ ±4 µm
- Voltage: ≤ ±0.1 mV
- Current: ≤ ±0.16 µA
- Sampling rate: f_{standard} = 1 kHz
- Non-linearity:
  - Nom. length ≤ 500 mm: ±100 µm
  - > 500 mm: ±0.02 % FS
- Temperature coefficient
  - Voltage output: [150 µV/K + 5 ppm/K \cdot P \cdot V/NL] \cdot \Delta T
  - Current output: [0.6 µA/K + 10 ppm/K \cdot P \cdot I/NL] \cdot \Delta T
  - Where: V = output voltage range in [V]
  - I = output current range in [mA]
  - NL = nominal length in [mm]
  - \Delta T = temperature difference in [K]
  - P = magnet position in [mm]
- Shock loading: 100 g/6 ms per IEC 68-2-27
- Continuous shock: 100 g/2 ms per IEC 68-2-29
- Vibration: 12 g, 10 to 2000 Hz per IEC 68-2-6

7.2 Supply voltage (external)

Regulated supply voltage
- BTL5-1...: DC 20 to 29 V
  - Ripple: ≤ 0.5 Vpp
- BTL5-2...: DC ±14.7 to ±15.3 V
  - Current draw: ≤ 150 mA
  - Inrush: ≤ 3 A/0.5 ms
  - Polarity reversal protection built-in
  - Overvoltage protection
  - Transorb diodes
- Dielectric strength
  - GND to housing: 500 V

7.3 Outputs

BTL5-A...
- Output voltage: 0...10/10...0 V
  - Load current: ≤ 5 mA
  - Ripple: ≤ 5 mV
BTL5-G...
- Output voltage: 10...10/10...–10 V
  - Load current: ≤ 5 mA
  - Ripple: ≤ 5 mV
BTL5-C...
- Output current: 0...20/20...0 mA
  - Load resistance: ≤ 500 Ohm
BTL5-E...
- Output current: 4...20/20...4 mA
  - Load resistance: ≤ 500 Ohm

7.4 Connection to processor

Analog interface:
- With S32 connector for shielded cable (max. length, see “Wiring”), diameter 6 to 8 mm, or with integral cable KA05 (5 m long)

7.5 Included in shipment

Transducer Fig. 3-1
- Users Guide
  (Mounting brackets and magnets must be ordered separately).

7.6 Magnets

(order separately)
- Spacing, offset and installation pages 4 and 5
- Operating temp. –40 °C to +85 °C
- BTL5-P-3800-2 Fig. 3-2
  - Weight: approx. 12 g
  - Housing: plastic
- BTL5-P-5500-2 Fig. 3-3
  - Weight: approx. 40 g
  - Housing: plastic

7.7 Accessories (optional)

Connectors Fig. 4-1
- Balluff factory standard
7 Magnet and Control Arm Diagram References

Fig. 3-1: Dimensional drawing (BTL5...P-S 32 transducer with floating magnet BTL5-P-3800-2)

Mounting brackets with isolation bushings and M5 x 22 socket head cap screws, DIN 912, max. tightening torque 2 Nm

Fig. 3-2: BTL5-P-3800-2 magnet

Ball joint "B" DIN 71805, rotates horizontally

Fig. 3-3: BTL5-P-5500-2 magnet

Mechanically joined to M5 stud using 2 nuts

Fig. 3-4: BTL5-P-5500-1 electromagnet (24 V/100 mA)

Max. angle offset

Max. parallel offset

BTL5-M-2814-1S: X = 48.5 Y = 57
BTL5-N-2814-1S: X = 51 Y = 59.5

Fig. 3-5: Dimensional drawing (BTL5...P-KA transducer with captive magnet BTL5-F-2814-1S)

Mounting brackets with isolation bushings and M5 x 22 socket head cap screws, DIN 912, max. tightening torque 2 Nm

Fig. 3-6: BTL5-F-2814-1S magnet

Ball joint "B" DIN 71805, rotates horizontally (part of BTL5-F-2814-1S magnet)

Fig. 3-8: BTL2-G508..._...-A connecting rod

Jam nut DIN 934 M5
Swivel eye DIN 648

Fig. 3-7: BTL5-M/N-2814-1S magnet

Fig. 4-1: Connector (optional)
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