BTL5-P1 _-M_ _ _ _-HB/WB-FA_ _/F_ _-C
Micropulse Linear Transducer - Rod Style

User's Manual

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Contents

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 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-P1...HB/WB-... Micropulse transducer.

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

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

2 Function and characteristics

2.1 Characteristics

Micropulse transducers are characterized by:

- Very high resolution, repeatability, and linearity
- Absolute output signal
- Tough assembly
- Housing of stainless steel
- Wear- and maintenance-free measuring principle
- Insensitive to shock, vibration, contamination, and noise
- Pressure rated to 600 bar
- Teflon cable
- Capability of connecting cable guard systems
- Enclosure rating per IEC 60529:
  Cable version IP 68
  (type tested at 5 bar / 48 h)
  IP69/K with connected cable guard system

2.2 Function

The transducer contains a waveguide enclosed by an outer stainless steel rod. A magnet attached to the moving member of the machine or to the cylinder piston is moved over the rod and its position constantly updated. The magnet ring must remain within the measuring range.

The magnet defines the measured position on the waveguide. An externally 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 determine the position which is output as digital information. This takes place with high precision and repeatability within the measuring range indicated as the nominal stroke length.

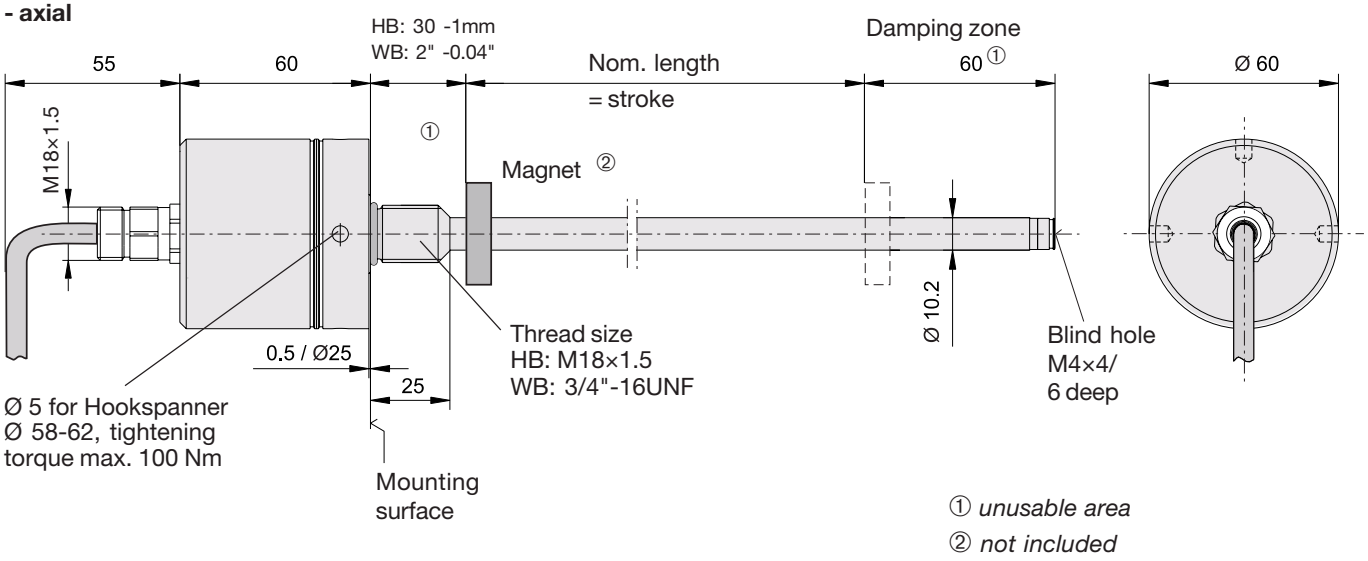
At the rod end is a damping zone, within which no reliable signal is available, but which may be entered by the magnet.

The electrical connection between the transducer, the controller and the power supply is via a fixed cable.

Dimensions for installing the Micropulse transducer: ➥ Fig. 3-1
Dimensions for installing the magnet: ➥ Fig. 3-4

3 Installation

BTL5...HB/WB-...-C
- axial



BTL5...HB/WB-...-C
- radial

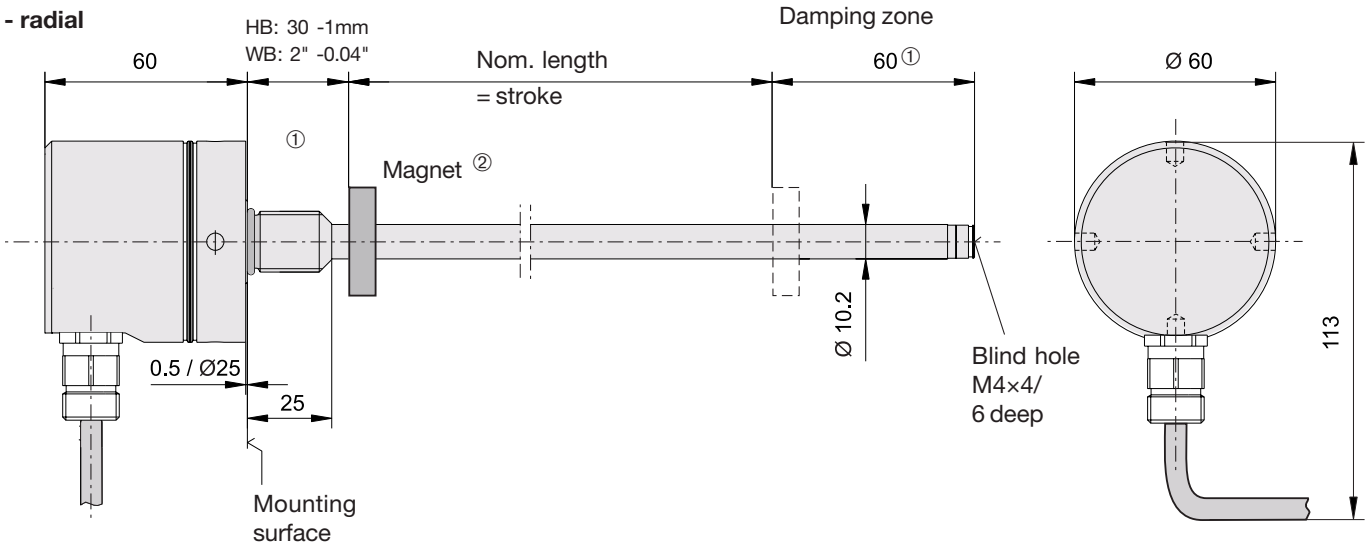


Fig. 3-1: Transducer BTL5-...HB/WB-..., Dimensions

Important Installation Notes:

The contact surface of the transducer must be completely contacted by the mounting surface. The O-ring supplied must make a perfect pressure seal, i.e. the bevel for the O-ring must be configured exactly as shown in Fig. 3-3.

To achieve secure mounting, use the proper nut for the mounting thread. When tightening the transducer, do not exceed a tightening torque of 100 Nm.

For horizontal mounting of transducer with stroke lengths greater than 500 mm, the pressure tube should be supported or attached at its end.

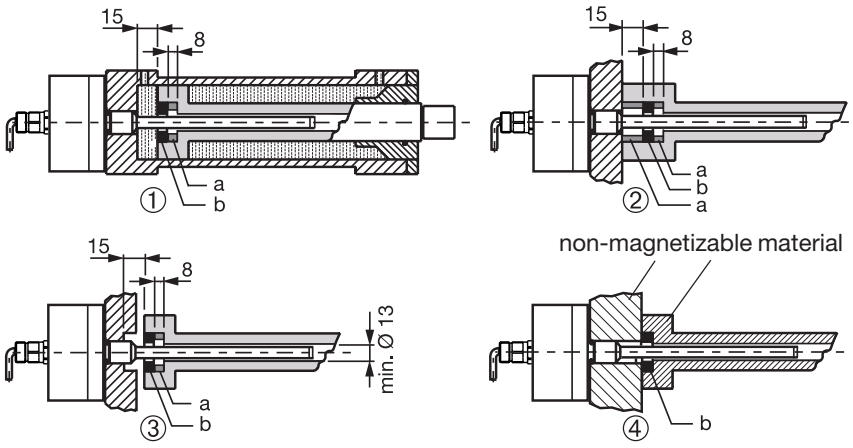
When installing in a hydraulic cylinder, do not allow the magnet ring to rub against the pressure tube. The bore diameter in the piston and cylinder rod should be at least 13 mm.

3 Installation (cont.)

3.1 Mounting

When possible, use non-magnetizable material for attaching the transducer and magnet ring. ➥ Fig. 3-2.

When attaching the transducer to magnetizable materials, appropriate measures must be taken to protect against magnetic disturbances ➥ Fig. 3-2. Note the recommended distance of the transducer and cylinder from strong, external magnetic fields.



① - ③ for magnetizable materials
④ for non-magnetizable materials

a = Spacer made of non-magnetizable materials
b = Magnet

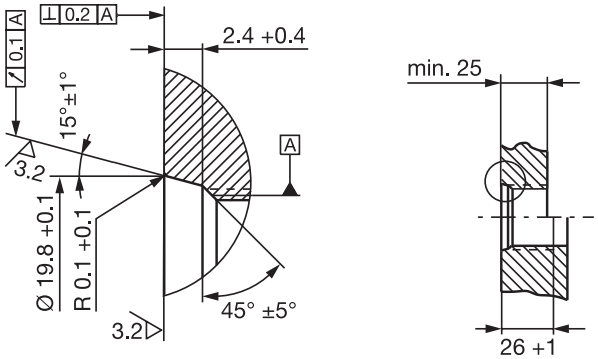
Fig. 3-2: Mounting

3.2 Transducer, Installation

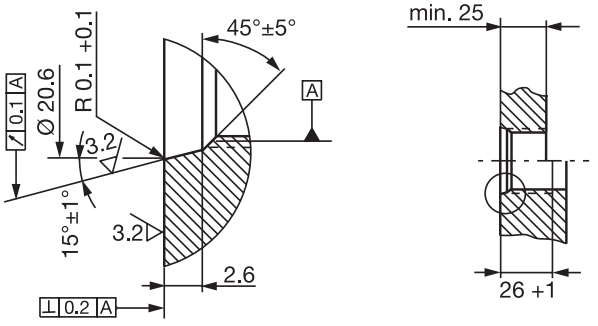
The smallest permissible distance between magnet ring and rod mounting surface is shown in ➥ Fig. 3-1.

The transducer has either a M18×1.5 thread or a 3/4"-16UNF thread for mounting. The sealing is carried cut with the O-ring supplied at the flange facing.

Threaded hole
M18×1.5 per
ISO 6149
O-ring 15.4 × 2.1



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



Bevel for O-ring

Threaded hole

Fig. 3-3: Threaded hole for mounting the BTL with O-ring

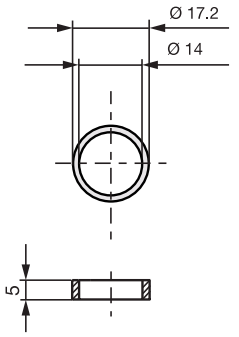
3 Installation (cont.)

3.3 Magnets, Installation

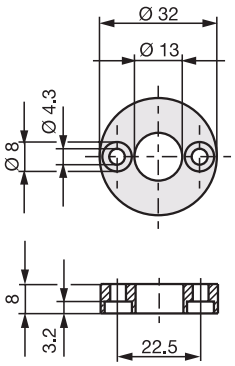
A magnet is required for each transducer. This must be ordered separately. ➥ Fig. 3-4.

For mounting the magnet we recommend to use non-magnetizable material. ➥ Fig. 3-2.

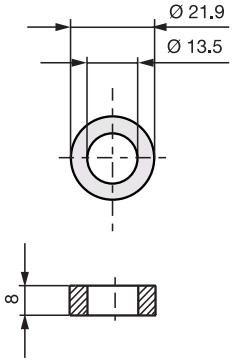
BTL-P-0814-GR-PAF



BTL-P-1013-4R



BTL-P-1014-2R



BTL-P-1012-4R

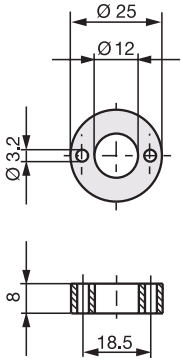


Fig. 3-4: Magnet (optional)

4 Wiring

4.1 Cable axial and radial

Cable length max. 500 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.

High noise immunity on the line between the transducer and processor is provided by the differential line drivers used for the RS 485/422 interface. The differential signal is carried to the processor, which makes it available as analog or digital information for further processing.

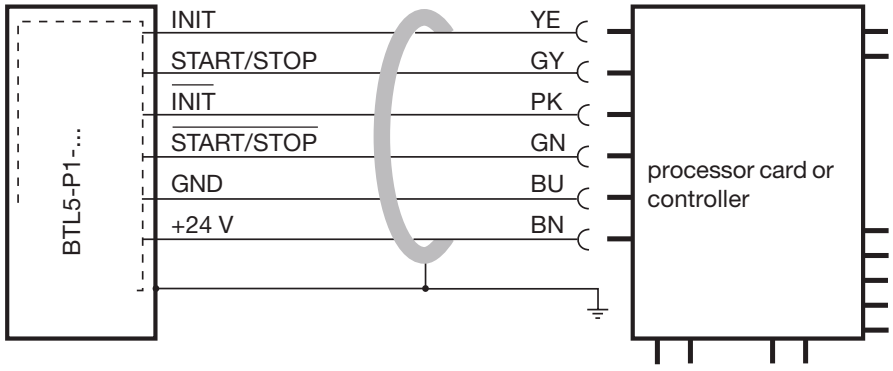


Fig. 4-1: BTL5-P1_ _-... with processor card/controller, wiring example

4 Wiring (cont.)

Note the following when making electrical connections:

System and control cabinet must be at the same ground potential.

To ensure the electromagnetic compatibility (EMC) which Balluff warrants with the CE Mark, the following instructions must be strictly followed.

BTL transducer and the processor/control must be connected using shielded cable.

Shielding: Copper filament braided, 85 % coverage.

The cable shield must be grounded on the control side, i.e., connected to the protection ground.

Pin assignments can be found in ➥ Table 4-1. Connections on the controller side may vary according to the controller and configuration used.

To avoid coupled noise, avoid proximity to high-current lines when routing cable between transducer, controller and power supply. Inductive coupled noise from AC harmonics (e.g., from phase controls) are especially critical, against which the cable shield offers very little protection.

Control and data signals

Cable	BTL5-P1...
YE yellow	INIT
GY gray	START/STOP (2nd edge)
PK pink	$\overline{\text{INIT}}$
GN green	$\overline{\text{START/STOP}}$ (2nd edge)
Supply voltage (external)	
BU blue	GND
BN brown	+24 V
WH white	not used ①

① *Unused leads can be tied to GND on the control side, but they must never be connected to the shield.*

Table 4-1: Wiring

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.

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.

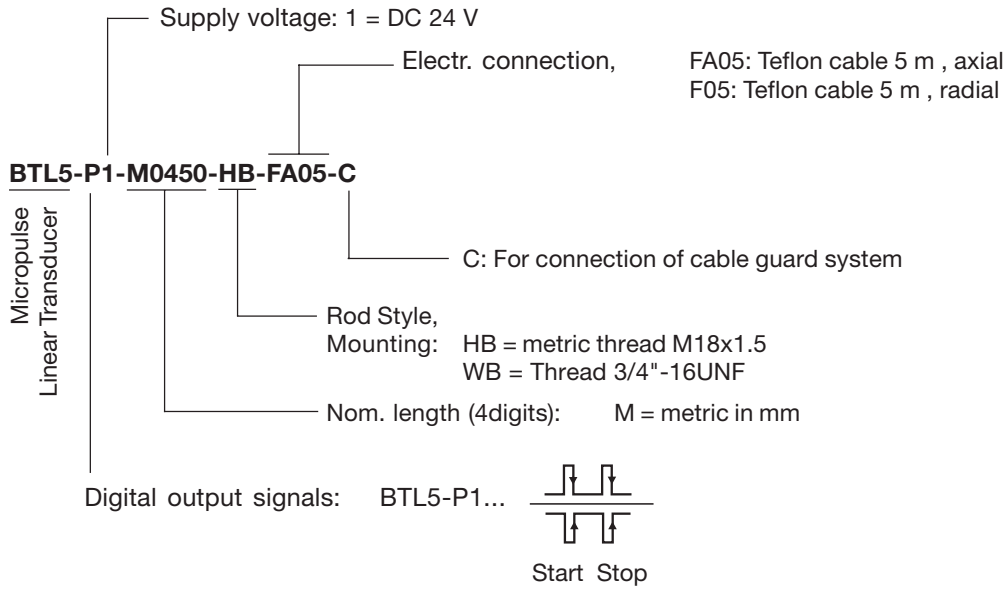
5.4 Check functionality

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.

6 Versions (indicated on part label)



6.1 Included in shipment

Transducer with condensed guide

6.2 Available lengths

Nominal stroke lengths of from 25 to 4000 mm are available for ideally sizing the transducer to the application.

7 Accessories (order separately)

7.1 Magnets

Magnet BTL-P-1013-4R, BTL-P-1012-4R

Dimensions	➥ Fig. 3-4
Weight	approx. 10 g
Housing	anodized aluminum
Operating temp.	–40 °C to +85 °C

included in shipment

Spacer	8 mm
Material	POM (Polyoxymethylene)

Magnet BTL-P-1014-2R

Dimensions	➥ Fig. 3-4
Weight	approx. 10 g
Housing	anodized aluminum
Operating temp.	–40 °C to +85 °C

Magnet BTL-P-0814-GR-PAF

Dimensions	➥ Fig. 3-4
Weight	approx. 2 g
Housing	Polyamide bound ferrite
Operating temp.	–40 °C to +85 °C

7.2 Mounting nut

BTL5...-HB...
Mounting nut M18x1.5
BTL-A-FK01-E-M18x1.5

BTL5...-WB...
Mounting nut 3/4"-16UNF
BTL-A-FK01-E-3/4"-16UNF

8 Technical Data

Typical values at DC 24 V, room temperature and BTL with nominal length of 500 mm. Ready for operation at once, full accuracy after warm-up. With magnet BTL-P-1013-4R, BTL-P-1014-2R or BTL-P-1012-4R:

Resolution ≤ 2 µm
Hysteresis ≤ 4 µm
Repeatability ≤ 6 µm
(resolution + hysteresis)
System resolution is determined by the processor or external controller.

Recommended sampling rate:

Nominal length	$f_{Standard}$
≤ 1000 mm	0.5 to 2 kHz
≤ 2000 mm	0.5 to 1 kHz
> 2000 mm	0.5 kHz

Non-linearity:

Nom. length ≤ 500 mm	> 500 mm
±100 µm	±0.02 % FS

Temperature coefficient
(6 µm + 5 ppm * nominal length)/K
Shock loading 100 g/6 ms
per IEC 60068-2-27 [1]
Continuous shock 100 g/2 ms
per IEC 60068-2-29 [1]
Vibration 12 g, 10 bis 2000 Hz
per IEC 60068-2-6 [1]
(take care to avoid inherent resonances of protective tube)
Pressure up to 600 bar
when installed in a
hydraulic cylinder

[1] Individual specifications as per Balluff factory standard

7.1 Dimensions, weights, ambient conditions

Nominal length ≤ 4000 mm
Dimensions ➥ Fig. 3-1
Weight ca. 2 kg/m
Housing Stainless steel
Pressure tube Stainless steel
1.4571
diameter 10.2 mm
wall thickness 2 mm
e-modulus ca. 200 kN/mm²
Mounting threads
M18×1.5 or 3/4"-16UNF
Operating temp. –40 °C to +85 °C
Humidity < 90 %, non-dewing
Protection rating per IEC 60529
with connector attached:
cable version IP 68
(type tested at 5 bar / 48 h)
IP69/K with connected cable guard system

8.2 Supply voltage (external)

Regulated supply voltage
BTL5-_1... 20 to 28 V DC
Ripple ≤ 0.5 V_{pp}
Current draw
≤ 90 mA (at 1 kHz)
Inrush ≤ 3 A/0.5 ms
Polarity reversal protection built-in
Overvoltage protection
Transzorb diodes
Electric strength
GND to housing 500 V DC

8.3 Control signals

INIT pulse
Level +5 V RS 485/422
driver Length 1 µs (max. 3 µs)

8.4 Connection to processor

BTL5-...-FA05
with connecting cable,
axial arrangement, 5 m long

BTL5-...-F05
with connecting cable,
radial arrangement, 5 m long

Teflon cable -40 °C to +200 °C

UL authorization
File No.
E227256

The following patents have been granted in connection with this product:

US Patent 5 923 164
Apparatus and Method for Automatically Tuning the Gain of an Amplifier

The CE Mark verifies that our products meet the requirements of EU Directive

2004/108/EC (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 61000-6-4 (emission)

EN 61000-6-2 (noise immunity)

Emission tests:
RF Emission
EN 55011 Group 1, Class A+B
Noise immunity tests:
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

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