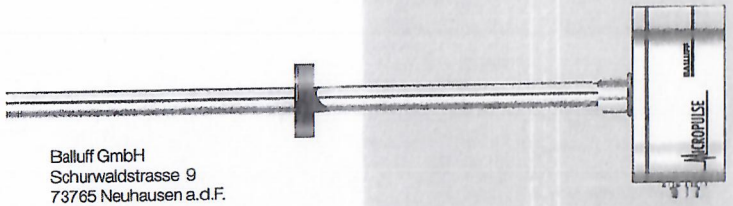
BALLUFF

BTL5-A/C/E/G1_-M/U_ _ _ _-K-SR 32/K_ _

english Technical Description
User's Guide



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6 Technical Data

Typical values at DC 24 V and 25 °C. Ready for operation at once, full accuracy after warm-up. With magnet BTL-P-1013-4R, BTL-P-1013-4S or BTL-P-1012-4R:

Resolution + hysteresis = repeatability
Voltage 0.3 mV
Current 0.6 µA
Minimum 5 µm

Sampling rate:

Nom. length	$f_{Standard}$
≤ 2000 mm	1 kHz
> 2000 mm	0.5 kHz

Non-linearity

Nom. length	≤ 500 mm	> 500 mm
in µm	±100	±0,02 % FS

Temperature coefficient
Voltage output:
[150 µV/K + (5 ppm/K • P • V/NL)] • ΔT
Current output:
[0,6 µA/K + (10 ppm/K • P • I/NL)] • ΔT
V = output voltage range in [V]
I = output current range in [mA]
NL = nominal length in [mm]
ΔT = temperature coefficient in [K]
P = magnet position in [mm]

Shock loading 100 g/6 ms per IEC 68-2-27 [1]
Continuous shock 100 g/2 ms per IEC 68-2-29 [1]
Vibration 12 g, 10 bis 2000 Hz per IEC 68-2-6 [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

6.1 Dimensions, weights, ambient conditions

Nominal length ≤ 4000 mm
Dimensions ➥ Fig. 3-2
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
6 socket head cap screws, ISO 4762 M6 x 16 - A2-70
Operating temp. –40 °C to +85 °C
Humidity < 90 %, non-dewing
Protection rating per IEC 529
with connector attached:
connector version IP 67
cable version IP 68
(type tested at 5 bar / 48 h)

6.2 Supply voltage (external)

Regulated supply voltage
BTL5-_1... DC 20 to 28 V
Ripple ≤ 0.5 V_{PP}
Current draw ≤ 150 mA
Inrush ≤ 3 A/0.5 ms
Polarity reversal protection built-in
Overvoltage protection
Transzorb diodes
Electric strength
GND to housing 500 V

6.3 Outputs

BTL5-A11...
Output voltage 0...10/10...0 V
Load current ≤ 5 mA
Ripple ≤ 5 mV
BTL5-G11...
Output voltage –10...10/10...–10 V
Load current ≤ 5 mA
Ripple ≤ 5 mV
BTL5-C1_...
Output current 0...20/20...0 mA
Load resistance ≤ 500 Ohm
BTL5-E1_...
Output current 4...20/20...4 mA
Load resistance ≤ 500 Ohm

6.4 Connection to processor

Analog interface
for shielded cable (max. length, see Wiring), Ø 6 to 8 mm

6.5 Included in shipment

Transducer ➥ Fig. 3-2

6.6 Magnets (order separately)

Magnets BTL-P-1013-4R, BTL-P-1013-4S, BTL-P-1012-4R
Dimensions ➥ Fig. 3-4
Weight approx. 10 g
Housing anodized aluminum
Operating temp. –40 °C to +85 °C

Magnets BTL5-P-4500-1
(Electromagnet)
Weight approx. 90 g
Housing plastic
Operating temp. –40 °C to +60 °C

6.7 Accessories (optional)

Connectors ➥ Fig. 4-3

7 Versions (indicated on product label)

BTL5-A11-M0450-K-SR 32

Micropulse Linear Transducer

- Supply voltage: 1 = DC 24 V
- Electr. connection, SR 32: with connector, K05: with 5 m cable
- Rod style, Mounting: 6 screws ISO 4762 M6 x 16 - A2-70
- Nom. length (4 digits): M= metric in mm, U = inches in 1/10 Inch
- Analog interface:
  - Voltage output A11 = 10 ... 0 V and 0 ... 10 V; G11 = 10 ... –10 V and –10 ... 10 V
  - Current output C10 = 0 ... 20 mA | E10 = 4 ... 20 mA; C17 = 20 ... 0 mA | E17 = 20 ... 4 mA

No. 814 511 E • Edition 0108; specifications subject to changes • Replaces edition 9812.

Contents

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

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/G1...K... Micropulse transducer.

An overview of the various models can be found in section 7 Versions (indicated on product label) on page 8.

> ***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.).*

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
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

BTL5-A/C/E/G1_-M/U_ _ _ _-K-SR 32/K_ _
Micropulse Linear Transducer - Rod Style

2 Function and Characteristics

2.1 Characteristics

Micropulse transducers feature:
- Very high resolution, repeatability and linearity
- Wear- and maintenance-free
- Immunity to shock, vibration, contamination and electrical noise
- An absolute output signal
- Pressure rated to 600 bar
- Protection class per IEC 529: IP 67 for connector version, IP 68 (5 bar/48 h) for cable version

2.2 Function

The Micropulse transducer contains a tubular 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 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 measuring high precision and repeatability within the stroke range defined as 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 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: ➥ Fig. 3-2
Dimensions for installing the magnet: ➥ Fig. 3-4

2.3 Available stroke lengths and magnets

To provide for optimum fit in any application, a wide range of standard stroke lengths and magnets in various form factors are available. Magnets must therefore be ordered separately.

The following nominal stroke lengths are available:

Stroke lengths [mm]			Increments [mm]
50	...	500	25
500	...	1000	50
1000	...	2000	100
2000	...	4000	250

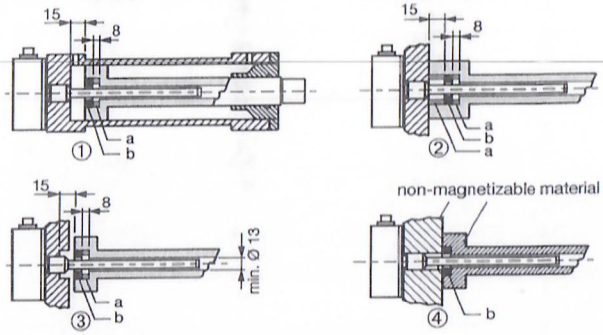
Other stroke lengths on request.

3 Installation

3.1 Mounting

When possible, use non-magnetizable material for attaching the transducer and magnet ring. ➥ Fig. 3-1.

> *When attaching the transducer to magnetizable materials, appropriate measures must be taken to protect against magnetic disturbances ➥ Fig. 3-1. 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. 3-1: Mounting

3 Installation (cont.)

3.2 Transducer, Installation

The smallest permissible distance between magnet ring and rod mounting surface is shown in Fig. 3-2.

The sealing is carried cut with the O-ring supplied at the flange facing.

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 a secure mounting, attach the transducer with all 6 cylinder head screws ISO 4762, M6 x 16 - A2-70 (➥ Fig. 3-2). All screws must be tightened to 3..5 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.

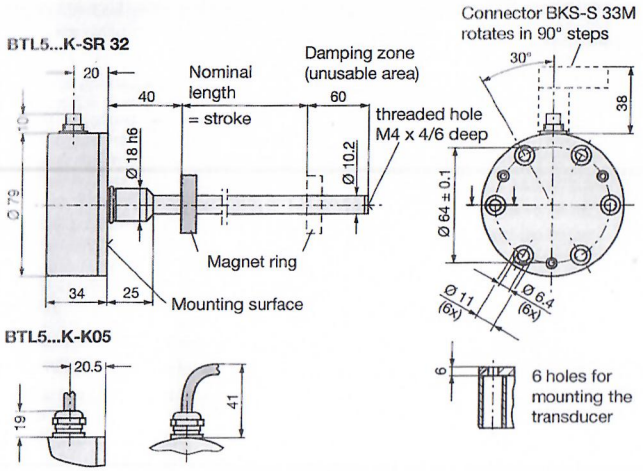


Fig. 3-2: Transducer BTL5...K..., dimensions

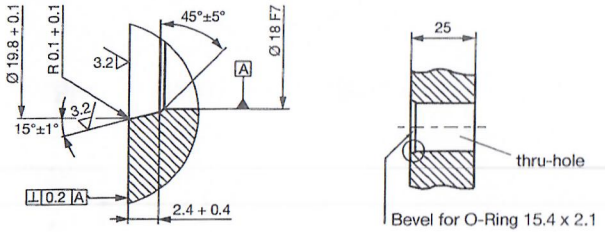


Fig. 3-3: Thru-hole design for mounting BTL with O-ring

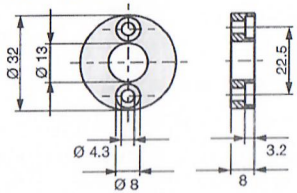
3 Installation (cont.)

3.3 Magnets, Installation

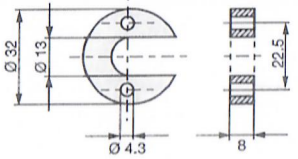
A magnet is required for each transducer. This must be ordered separately. ➥ Fig. 3-4.

For mounting the magnet we recommend to use non-magnetizable material. ➥ Fig. 3-1.

BTL-P-1013-4R



BTL-P-1013-4S



BTL-P-1012-4R

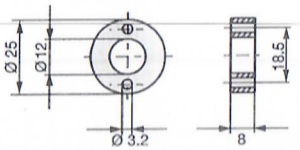


Fig. 3-4: Magnet (optional)

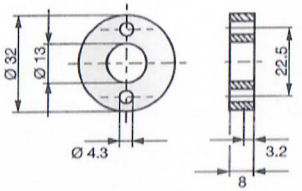


Fig 3-5: Spacer

4 Wiring

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, 80% coverage.

The shield must be tied to the connector housing in the BKS connector (➥ Fig. 4-3); 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 ➥ Table 4-1. Connections on the controller side may vary according to the controller and configuration used.

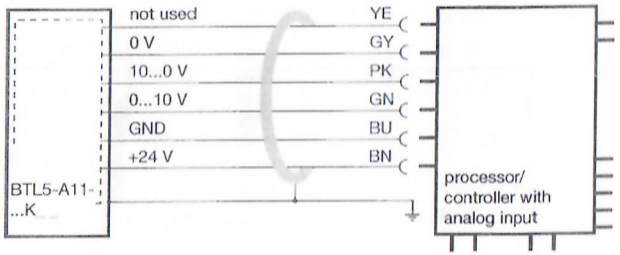


Fig. 4-1: BTL5-A11...K_ _ with processor/controller, wiring example

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.

BKS connector, view towards solder side of female BKS-S 32M-00 or BKS-S 33M-00

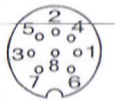


Fig. 4-2: Pin assignments BKS, connector type BTL

straight	right-angle
BKS-S 32M-00	**BKS-S 33M-00**
No. 99-5672-19-08	No. 99-5672-78-08
(Binder part no.)	(Binder part no.)

Cable entry (PG 9 fitting)

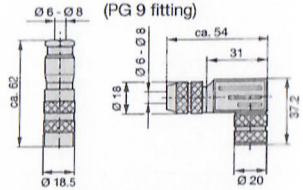


Fig. 4-3: Connector (optional)

4 Wiring (cont.)

Output signals

Pin	Cable	BTL5-A11	-C10	-C17	-E10	-E17	-G11	
1	YE yellow	not used ②	0...20 mA	20...0 mA	4...20 mA	20...4 mA	not used ②	①
2	GY grey	0 V						
3	PK pink	10...0 V	10...0 V	10...0 V	10...0 V	10...0 V	10...–10 V	①
4	not used							
5	GN green	0...10 V	0...10 V	0...10 V	0...10 V	0...10 V	–10...10 V	①

Supply voltage (external)

Pin	Cable	BTL5-A/C/E/G1
6	BU blue	GND
7	BN brown	+24 V
8	WH white	not used ②

① Because of the separate output drivers and the current adjustment (Pin 1) there are small voltage differences between Pin 3 and 5 (offset < 10 mV).
② 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 Start-up

5.1 Check connections

Although the connections are protected against polarity reversal, components can be damaged by improper wiring and overvoltage. Before you turn on the power, double check your connections.

5.2 Set null and span

Should mounting conditions require it, the factory set null and/or end point for the magnet can be shifted by a total of max. 15% of the full nominal stroke length.

Caution when opening: internal cable connections!

This recalibration is done under power with exposed electronics! Do not touch any other components with the screwdriver, since a short circuit could destroy the unit. The warranty does not extend to damage to the electronics resulting from such carelessness.

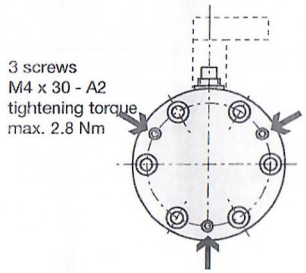
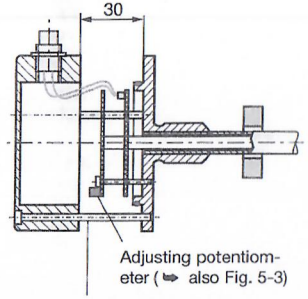


Fig. 5-1: BTL housing screws



3 M4 x 60 screws for securing the cover during the recalibration procedure

Fig. 5-2: BTL housing opened

The electrical output values of the null and endpoint are compensated using the "0" and "E" potentiometers (➥ Figs. 5-2 and 5-3 for location of these pots).

Always adjust the "0" potentiometer first, then the "E" potentiometer (regardless of whether the output is configured rising or falling).

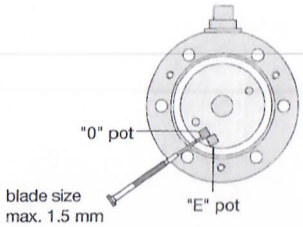


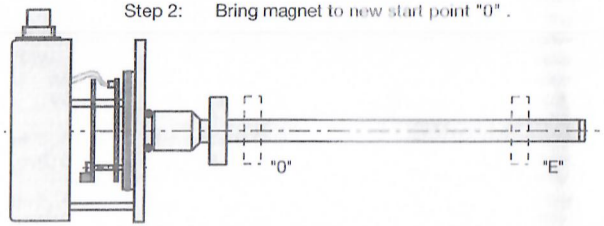
Fig. 5-3: Location of the adjustment pots (cover opened)

5 Startup (cont.)

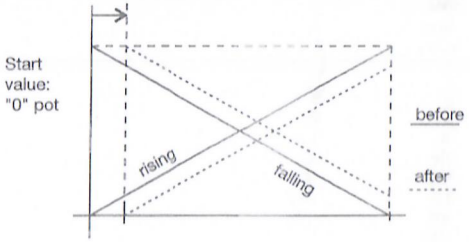
Example: Shift nullpoint out by 15%, no change to endpoint:

Step 1: Remove 3 M4 x 30 screws (see Fig. 5-1) and replace with 3 M4 x 60 screws (not included).
Caution: internal cable connection!
Remove cover **carefully** (see Fig. 5-2).

Step 2: Bring magnet to new start point "0".

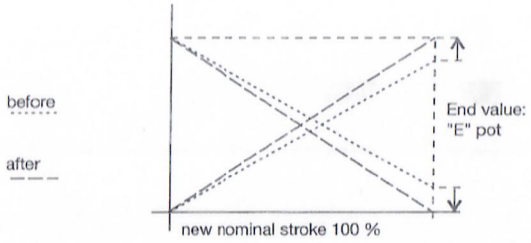


Step 3: Turn "0" pot until the desired start value is read on the output.



Step 4: Bring magnet to new endpoint "E".

Step 5: Turn "E" pot until the desired end value is read on the output.



Step 6: Replace cover using the original (shorter) M4 x 30 screws, and tighten using a max. tightening torque of 2.8 Nm.

Caution: Be sure the gasket is seated properly! Avoid any damage to the O-ring.

Fig. 5-4: Recalibration

5.3 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.

5.4 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.

5.5 Check functionality

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

5.6 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.