BALLUFF
Sensors Worldwide

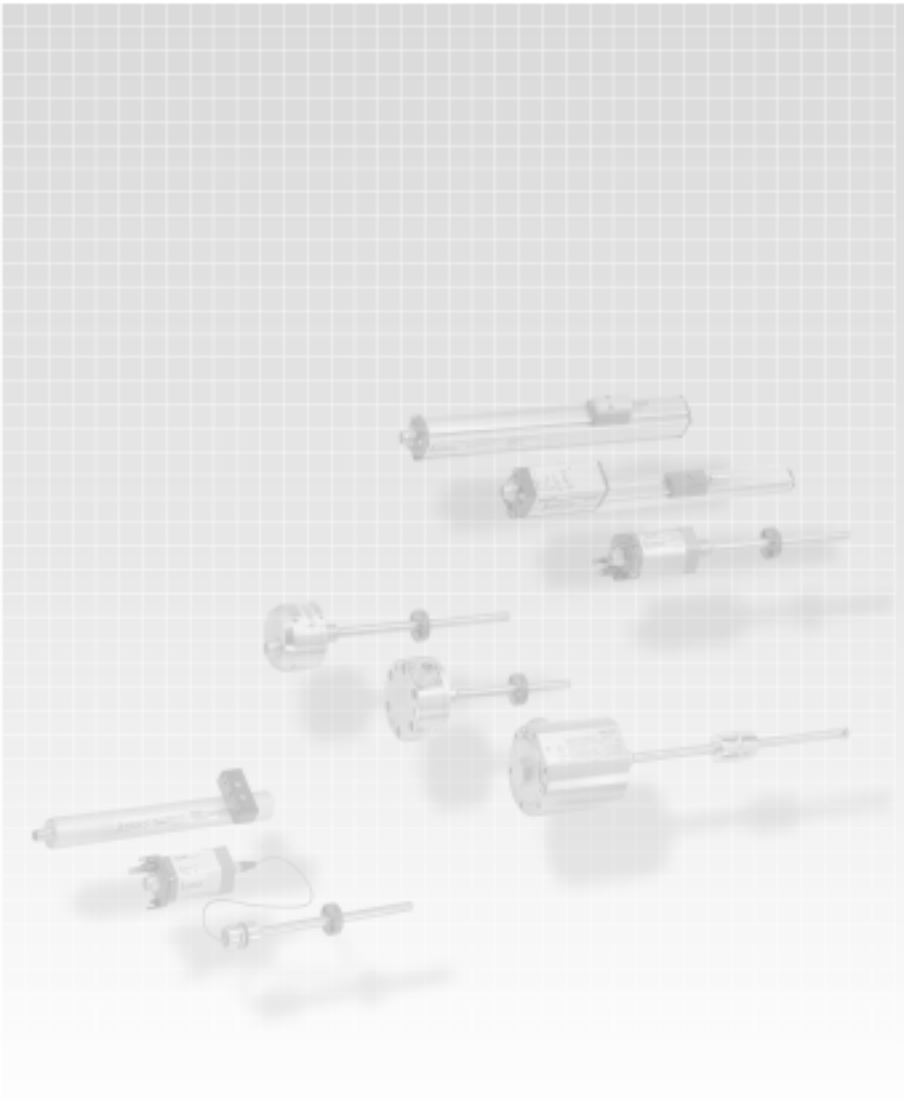
Technical Description / User's Guide

BTL5-A/C/E/G_-M____-P-S32/KA__

Micropulse Linear Transducer

Analog Output/Profile Housing

MICROPULSE™



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
B	T	L	-	5	-	A	1	1	-	M	0	3	0	5	-	P	-	S	3	2	
																		K	A	0	5

Balluff - Linear Transducer

Generation 5

Output Type

A = 0 to 10Vdc
B = -5 to +5Vdc
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

0	3	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

inches	mm
2	0051
3	0077
4	0102
5	0127
6	0152
7	0178
8	0203
9	0230
10	0254
11	0280
12	0305
13	0330

inches	mm
15	0381
16	0407
18	0457
20	0508
22	0560
24	0610
26	0661
28	0711
30	0762
32	0813
36	0914
40	1016

inches	mm
42	1067
48	1220
50	1270
60	1524
70	1778
80	2032
90	2286
100	2540
110	2794
120	3048
130	3302
142	3606

inches	mm
148	3759
156	3962

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 (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 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

CE *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

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 magneto-strictive 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.

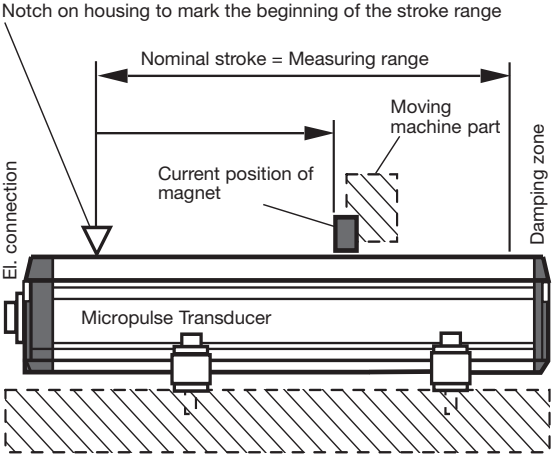


Fig. 2-1: Basic arrangement

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.

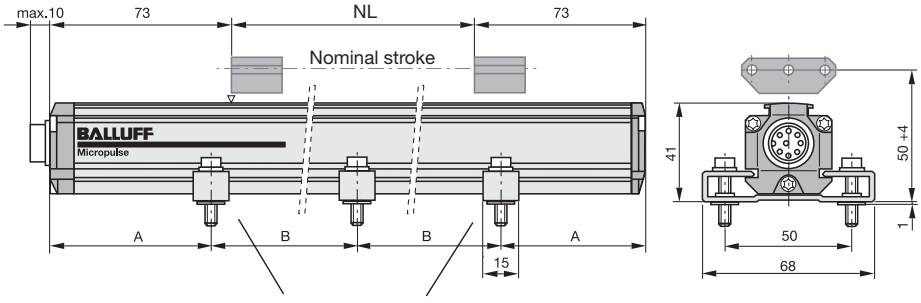
Any orientation is permitted. The mounting brackets and cylinder head screws allow the transducer to be mounted on a flat machine surface. These should be evenly spaced (Figs. 3-1 and 3-5).

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. 3-1and 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 Installation (cont.)



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

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

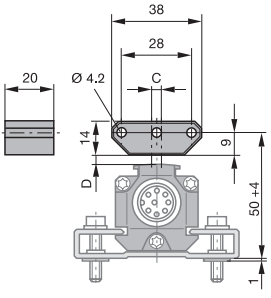


Fig. 3-2: BTL5-P-3800-2 magnet

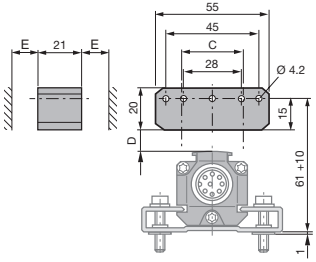


Fig. 3-3: BTL5-P-5500-2 magnet

max. permissible tightening torque 2 Nm

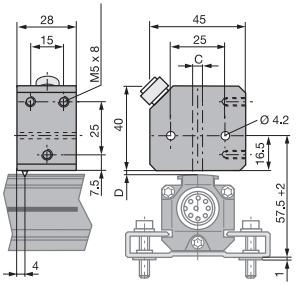


Fig. 3-4: BTL5-P-4500-1 electromagnet (24 V/100 mA)

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:

Magnet type	Distance " D "	Offset " C "
BTL5-P-3800-2	0.1 ... 4	± 2
BTL5-P-5500-2	5 ... 15	± 15
BTL5-P-4500-1	0.1 ... 2	± 2

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).

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

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

3 Installation (cont.)

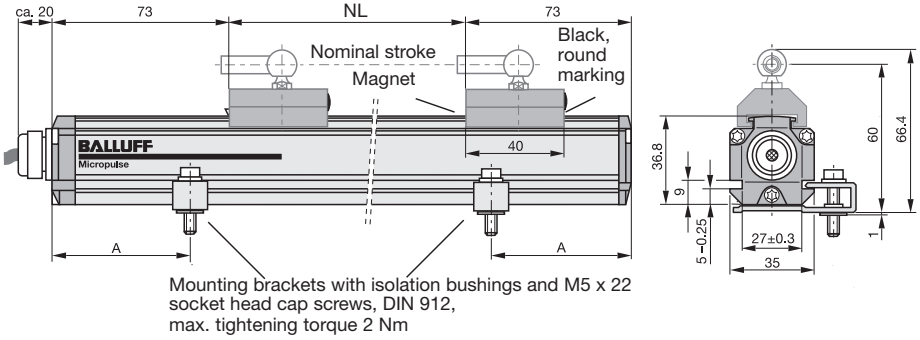


Fig. 3-5: Dimensional drawing (BTL5...P-KA transducer with captive magnet BTL5-F-2814-1S)

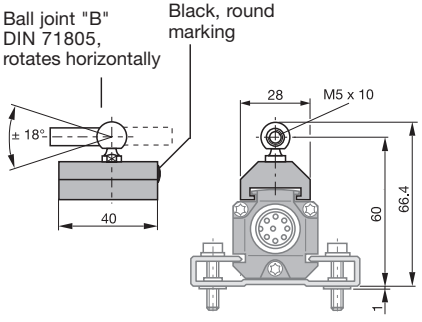


Fig. 3-6: BTL5-F-2814-1S magnet

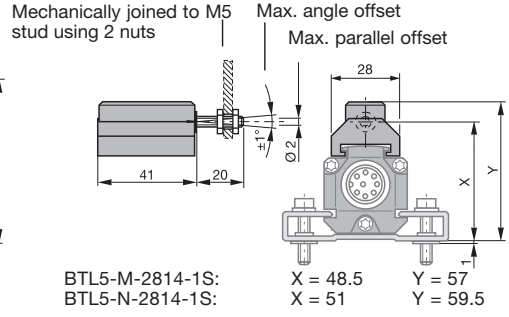


Fig. 3-7: BTL5-M/N-2814-1S magnet

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).

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

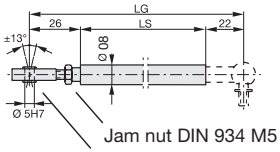
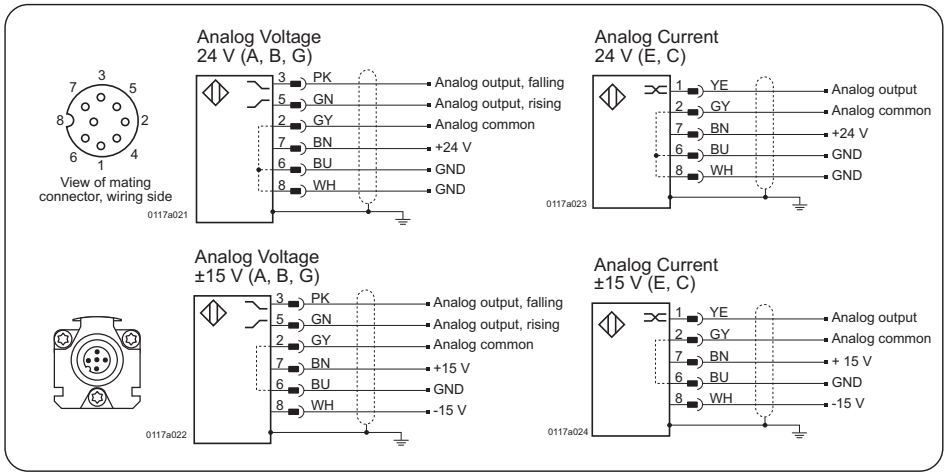


Fig. 3-8: BTL2-GS08-_ _ _ _-A connecting rod

4 Wiring



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 inthe illustration above . Connections on the controller side may vary according to the controller and configuration used.

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.

straight **BKS-S 32M-00** | right-angle **BKS-S 33M-00**

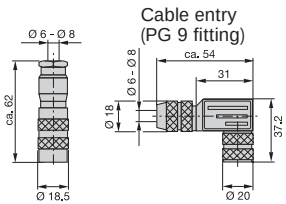


Fig. 4-1: Connector (optional)

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

4 Wiring (cont.)

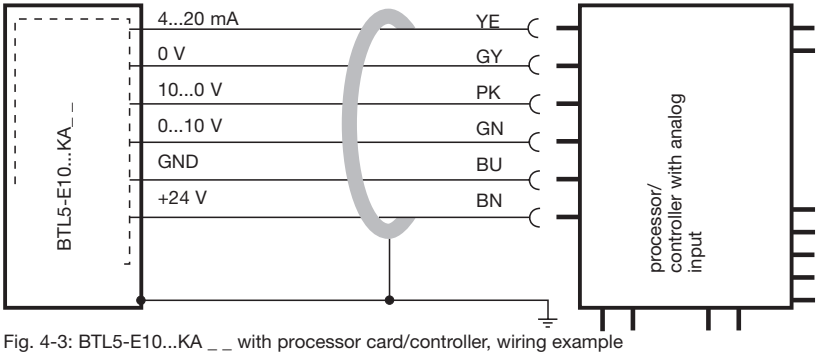


Fig. 4-3: BTL5-E10...KA _ _ with processor card/controller, wiring example

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	decreasing
$V_A > 10$ V	< 0 V

Current output 20 mA

increasing	decreasing
$I_A \geq 20$ mA	0 mA for BTL5-C...
$I_A \geq 20$ mA	≤ 4 mA for BTL5-E...

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 com ponents 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)

Micropulse Linear Transducer

BTL5-A11-M0457-P-S32

- 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 ... 0 V and 0 ... 10 V; G_1 = 10 ... –10 V and –10 ... 10 V
- Current output C_0 = 0 ... 20 mA | E_0 = 4 ... 20 mA; C_7 = 20 ... 0 mA | E_7 = 20 ... 4 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
=	Repeatability	≤ ±6 µm
≙	Voltage	≤ ±0.1 mV
≙	Current	≤ ±0.16 µA

Sampling rate $f_{Standard}$ = 1 kHz

Non-linearity:

Nom. length ≤ 500 mm	> 500 mm
±100 µm	±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 difference 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 to 2000 Hz
per IEC 68-2-6 [1]

[1] Individual specifications as per Balluff factory standard

7.1 Dimensions, weights, ambient conditions

- Nominal length ≤ 4000 mm
- Dimensions pages 4 and 5
- Weight approx. 1.4 kg/m
- Housing aluminum anodized
- Housing attachment: Mounting clamps with isolation bushings and screws
- Operating temp. –40 °C to +85 °C
- Humidity < 90%, non-condensing
- Protection class per IEC 529 IP 67 (with connector attached).

7.2 Supply voltage (external)

Regulated supply voltage
BTL5-_1... DC 20 to 28 V
Ripple ≤ 0.5 V_{PP}
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
Transzorb 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
or Fig. 3-5
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
Non-linearity:

Nom. length ≤ 500 mm	> 500 mm
±150 µm	±0.03 % FS

BTL5-P-4500-1 Fig. 3-4
Weight approx. 90 g
Housing plastic
Operating temp. –40 °C to +60 °C

BTL5-F-2814-1S Fig. 3-6
Weight approx. 28 g
Housing plastic

BTL5-M-2814-1S Fig. 3-7
Weight approx. 32 g
Housing anodized aluminum
Contact surface plastic

BTL5-N-2814-1S Fig. 3-7
Weight approx. 35 g
Housing anodized aluminum
Contact surface plastic

Control arm (optional)
BTL2-GS08-_ _ _ _-A
Aluminum, dimensions Fig. 3-8
Various standard lengths LS available (please specify when ordering)

7.7 Accessories (optional)

Connectors Fig. 4-1

7 Magnet and Control Arm Diagram References

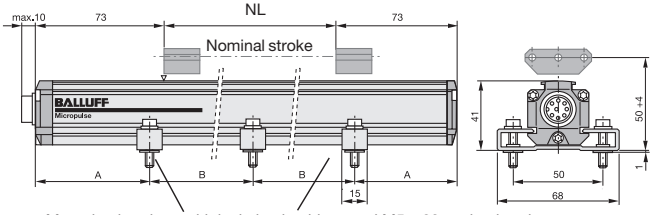


Fig. 3-1: Dimensional drawing (BTL5...P-S 32 transducer with floating magnet BTL5-P-3800-2)

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

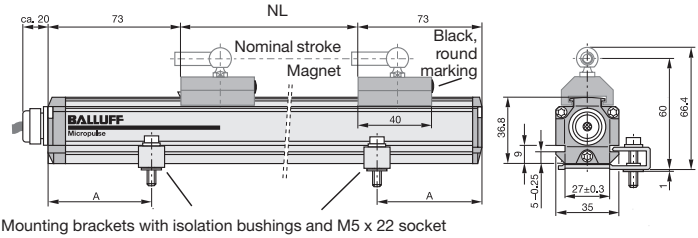


Fig. 3-5: Dimensional drawing (BTL5...P-KA transducer with captive magnet BTL5-F-2814-1S)

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

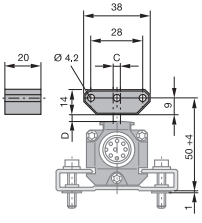


Fig. 3-2: BTL5-P-3800-2 magnet

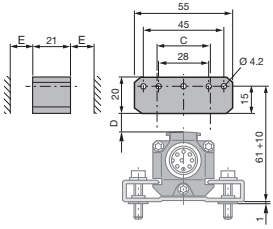


Fig. 3-3: BTL5-P-5500-2 magnet

max. permissible tightening torque 2 Nm

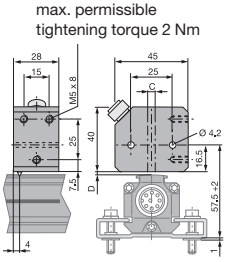


Fig. 3-4: BTL5-P-4500-1 electromagnet (24 V/100 mA)

Ball joint "B" DIN 71805, rotates horizontally

Black, round marking

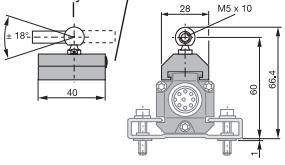
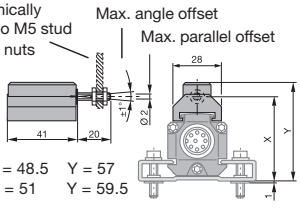


Fig. 3-6: BTL5-F-2814-1S magnet

Mechanically joined to M5 stud using 2 nuts

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

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

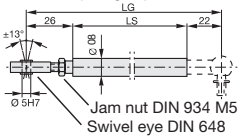


Fig. 3-8: BTL2-GS08-_ _ _ _-A connecting rod

straight
BKS-S 32M-00

right-angle
BKS-S 33M-00
Cable entry (PG 9 fitting)

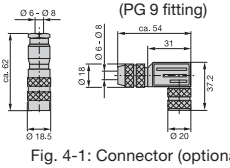


Fig. 4-1: Connector (optional)

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