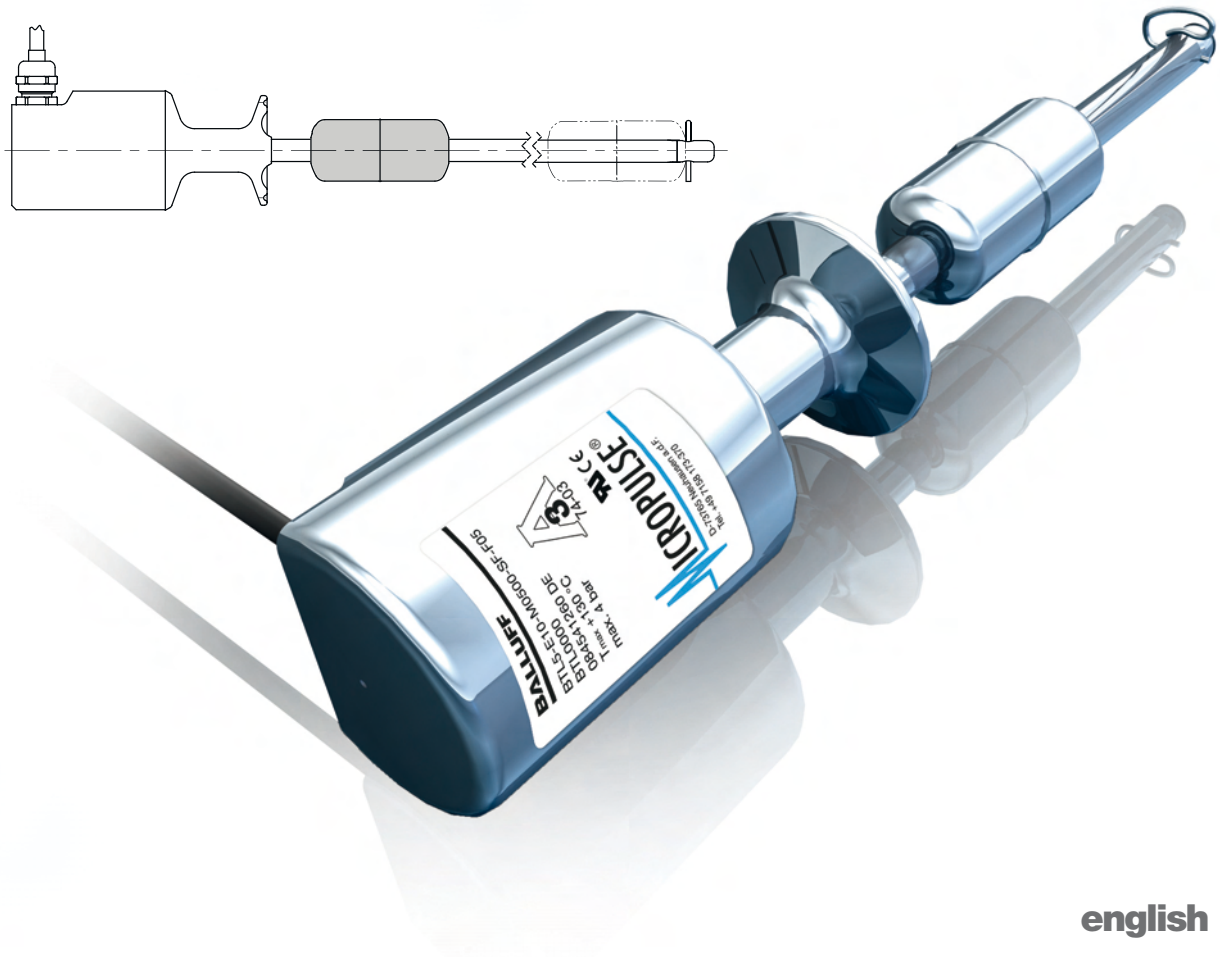
BALLUFF

sensors worldwide

BTL5-A/C/E1_-M-_ _ _ _-SF-F_ _

User's Guide



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1 Notes to the user

1.1 Validity

This guide describes the construction, function and setting options for the BTL5 Micropulse Transducer with analog interface. It applies to the types **BTL5-A/C/E1_-M_ _ _ _-SF-F_ _** (see Ordering code on page 13).

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.

1.3 Scope of delivery

– BTL5 transducer
– Condensed guide

Floats must be ordered separately (see Accessories, page 12).

1.4 Approvals and markings

3-A sanitary standard no. 74-03:
This product has authorization number 1486 and only corresponds to the specifications from 3-A SSI Inc. if used in conjunction with a BTL-S-3112-4Z float and the cotter pin included in the scope of delivery for the float.

UL approval
File no.
E227256

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

The CE Mark verifies that our products meet the requirements of EU Directive 2004/108/EC (EMC Directive) entsprechen.

The transducer meets the requirements of the following generic standards:
– EN 61000-6-2 (noise immunity)
– EN 61000-6-4 (emission)

Emission tests:

– RF emission EN 55016-2-3	Group 1, Class A and B

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.

1.5 Abbreviations

3-A SSI	3-A Sanitary Standards, Incorporated
EHEDG	European Hygienic Engineering & Design Group
FDA	U.S. Food and Drug Administration

2 Safety

2.1 Intended use

The BTL5 Micropulse Transducer, together with a machine controller (e.g. PLC), comprises a displacement measurement 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, and use of any other components will void the warranty.

Note
Compliance with the 3-A SSI specifications is only attained through the use of the components listed under accessories (see page 12).

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. Specialists 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, take it out of service and secure against unauthorized use.

2.3 Meaning 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:

SIGNAL WORD

Hazard type and source
Consequences if not complied with
▶ Measures to avoid hazards

The individual signal words mean:

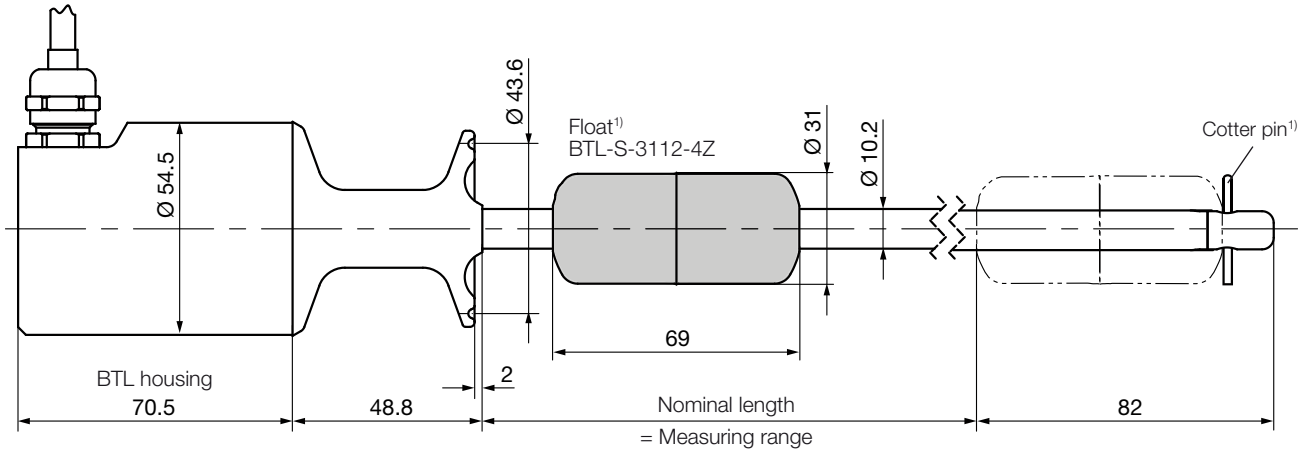
NOTICE
Identifies a hazard that could **damage or destroy the product**.

⚠ DANGER
The general warning symbol in conjunction with the signal word DANGER identifies a a hazard which, if not avoided, **will certainly result in death or serious injury**.

2.4 Disposal

Observe the national regulations for disposal.

3 Construction and function



[1)] Not included

Fig. 3-1: BTL5...-SF-F... transducer, construction

3.1 Construction

Electrical connection: The electrical connection is made via a cable and permanent (see Ordering code on page 13).

BTL housing: Stainless steel housing containing the processing electronics.

Float: Defines the position to be measured on the waveguide. Floats must be ordered separately (see Accessories on page 12).

Nominal length: Defines the travel/length range available. Rods with various nominal stroke lengths from 70 mm to 2500 mm are available depending on the model.

3.2 Function

The BTL5 transducer contains the waveguide which is protected by an outer stainless steel tube (rod). A float is moved along the waveguide. This float also rises and falls with the level of the liquid whose position is to be determined.

The float defines the position to be measured on the waveguide.

An internally generated INIT pulse interacts with the magnetic field of the float 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 with rising or falling gradient.

4 Installation and connection

4.1 Installing the transducer

For holding the transducer and float we recommend non-magnetizable material.

Installing the float

1. Install the float (accessory) taking the orientation into account (raised markings on top, see Figures 4-1 and 4-2).
2. Secure the float using the cotter pin provided in the scope of delivery, without placing any mechanical loads on the outer rod. Guide the cotter pin through the hole until it engages (see Figure 4-3).

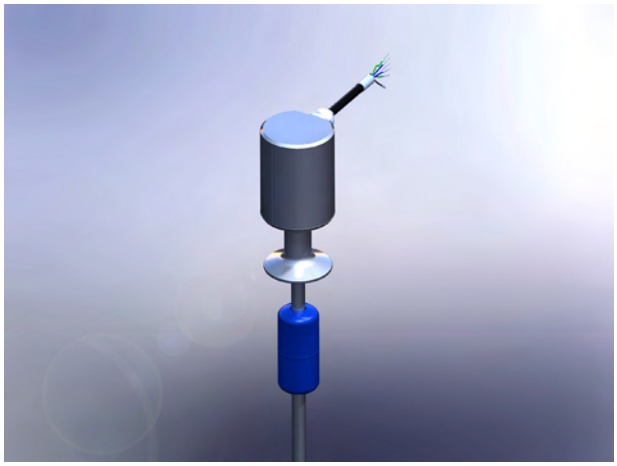


Fig. 4-1: Installing the float

Fig. 4-2: Raised markings on float

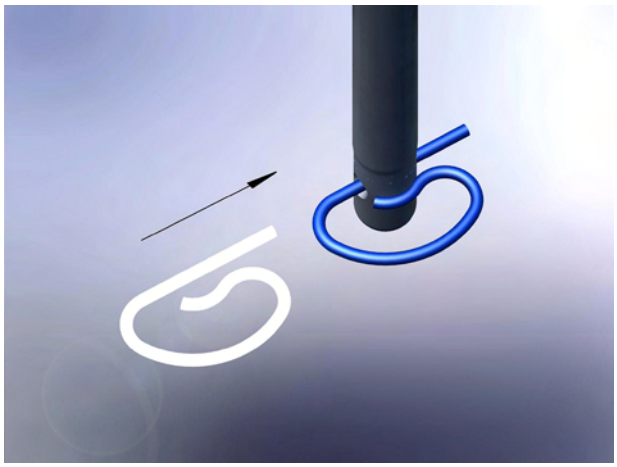


Fig. 4-3: Inserting the cotter pin

4 Installation and connection (continued)

Installing the transducer

NOTICE

Interference in function

Improper installation can compromise the function of the transducer and result in increased wear.

- Only vertical mounting is permitted!
- The flange surface of the transducer must make full contact with the mounting surface and be perfectly sealed through the use of a seal and tri-clamp.
- Mounting must be done in a manner where the outer rod cannot touch the container wall. Deflection of the outer rod to the side, e.g. through flow currents, must be prevented by suitable brackets.

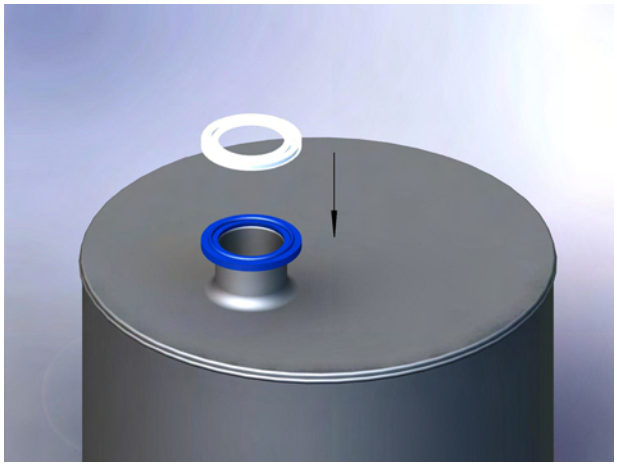


Fig. 4-4: Inserting the seal

1. Insert suitable seal (see Figure 4-4).
2. Place the transducer on the mounting surface, so it makes full contact and perfectly seals the hole (see Figure 4-5).
3. Fasten the transducer with a 1 1/2" tri-clamp (see Figure 4-6).

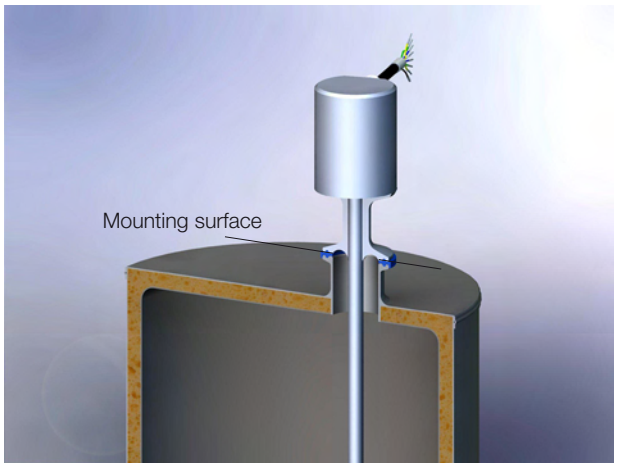


Fig. 4-5: Installing the BTL

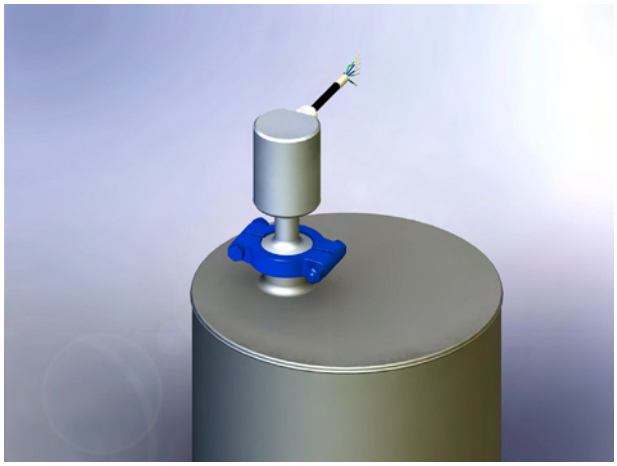


Fig. 4-6: Fastening the BTL with a 1 1/2" tri-clamp

4 Installation and connection (continued)

4.2 Electrical connection

The electrical connection is permanent and made using a cable (F_ _). The connection assignments depend on the respective model (see Tab. 4-1).

Output signals						
Cable		**BTL5-A11**	**-C10**	**-C17**	**-E10**	**-E17**
YE	Yellow	Not used[2)]	0 to 20 mA	20 to 0 mA	4 to 20 mA	20 to 4 mA
GY	Gray	0 V	0 V	0 V	0 V	0 V
PK	Pink	10 to 0 V[1)]	Not used[2)]	Not used[2)]	Not used[2)]	Not used[2)]
GN	Green	0 to 10 V[1)]	Not used[2)]	Not used[2)]	Not used[2)]	Not used[2)]

Supply voltage (external)		
Cable		**BTL5-A/C/E1**
BU	Blue	GND
BN	Brown	+24 V
WH	White	Not used[2)]

Tab. 4-1: Connection assignments

[1)] Because of the separate output drivers there are small voltage differences between PK and GN (offset < 10 mV).

[2)] Unassigned leads can be assigned to GND on the process controller side, but they must never be connected to the shield.

4.3 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.
– On the transducer side, the cable shielding is connected to the housing. Ground the cable shielding on the controller side (connect with the protection ground).

Magnetic fields

The transducer system is a magnetostrictive system. Ensure that there is sufficient distance between the transducer and between the holding 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).

Linear transducer	Maximum cable length[1)]	Cable diameter
BTL5-ACE...	20 m	6 - 8 mm

Tab. 4-2: Cable length

[1)] Prerequisite: Construction, shielding and routing preclude the effect of any external noise fields.

Bending radius for fixed cable

The bending radius for a fixed cable must be at least five times the cable diameter.

5 Startup

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 (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.
- Observe the directives of the FDA und 3-A SSI for monitoring hygiene and cleaning of the device, as well as the instructions for operation and maintenance of the entire system.
- It is possible to clean the device during the process.
- Take the position measuring system out of operation whenever there is a malfunction.
- Secure the system against unauthorized use.

6 Technical data

6.1 Accuracy

The specifications are typical values at 24 V DC and room temperature, with a nominal length of 500 mm in conjunction with the BTL-S-3112-4Z float.
The BTL is ready immediately, full accuracy after warm-up phase.

Reproducibility	
Current	0.6 µA
Minimum	0.05 mm
Sampling rate $f_{Standard}$	500 Hz
Non-linearity at	
≤ 500 mm	±250 µm
> 500 mm	±0.05% FS
Temperature coefficient (nominal length = 500 mm, float in the middle of measuring range)	≤ 40 ppm/K

6.2 Ambient conditions

Operating temperature[1)]	–10°C to +85°C
Process temperature[2)]	–20°C to +130°C
Storage temperature	–20°C to +100°C
Relative humidity	< 90%, non-condensing
Pressure rating (BTL outer rod)	≤ 300 bar
Pressure rating (limited by float)	≤ 4 bar
Degree of protection per IEC 60529 (when attached)	IP 67

[1)] Operating temperature: maximum permissible operating temperature at the BTL housing.

[2)] Process temperature: maximum permissible temperature of the rod below the flange (with contact with the media).Certain production processes require e.g. sterilization at 120°C–130°C for 0.5–1 hour.

6.3 Supply voltage (external)

Voltage, stabilized	
BTL5-A/C/E1...	20 to 28 V DC
Ripple	≤ 0.5 V_{pp}
Current draw	≤ 150 mA
Inrush current	≤ 3 A/0.5 ms
Reverse polarity protection	Installed
Overvoltage protection	36 V
Dielectric strength GND to housing	500 V DC

6.4 Outputs

BTL5-A...	
Output voltage	0 to10 V and 10 to 0 V
Load current	≤ 5 mA
BTL5-C...	
Output current	0 to 20 mA and 20 to 0 mA
Load resistance	≤ 500 Ohms
BTL5-E...	
Output current	4 to 20 mA and 20 to 4 mA
Load resistance	≤ 500 Ohms

6.5 Dimensions, weights

Diameter of outer rod	10.2 mm
Nominal length	≤ 2500 mm
Weight (depends on length)	Approx. 2 kg/m
Housing material	Stainless steel 1.4404
Outer rod material	Stainless steel 1.4404
Outer rod wall thickness	2 mm
Young's modulus	Approx. 200 kN/mm²
Housing mounting	1 1/2" tri-clamp as per SSI 3A standard 74-03 and seal BAM SE-XA-002-D38 (see accessories on page 12)

7 Accessories

Accessories are not included in the scope of delivery and must be ordered separately.

7.1 Float BTL-S-3112-4Z

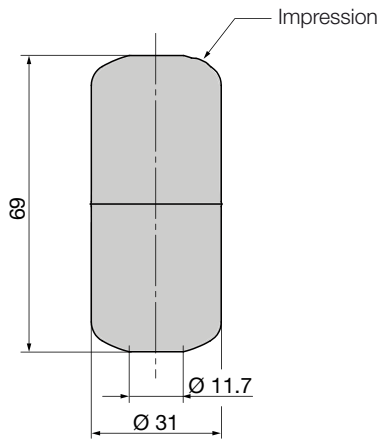


Fig. 7-1: Float BTL-S-3112-4Z

Weight	30 g
Housing	1.4404 stainless steel Electrolytic polishing
Operating temperature	–20°C to 130°C

Included in the scope of delivery for the float:

- Float
- Instructions
- Cotter pin (spring pin 2x30)

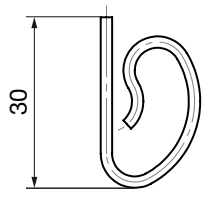


Fig. 7-2: Spring pin 2x30

7.2 Tri-clamp BAM MC-XA-006-D38

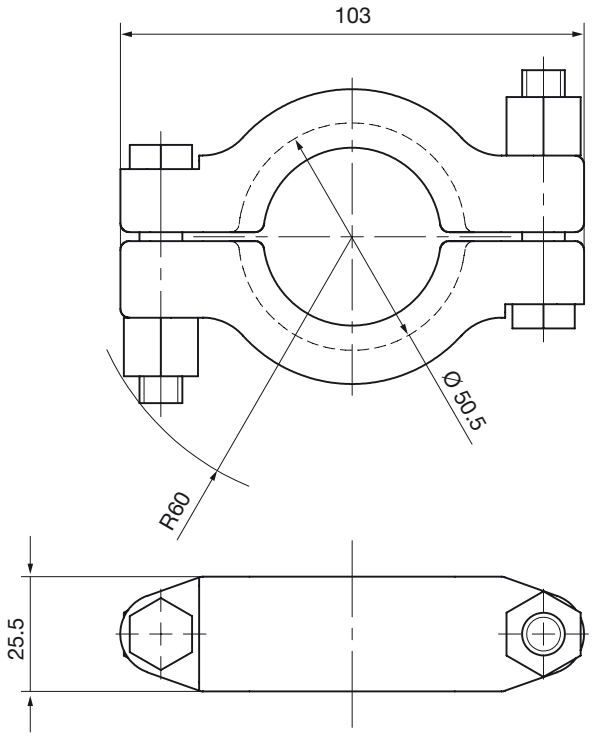


Fig. 7-3: BAM MC-XA-006-D38

Material USA ASTM 316 (1.4401)

7.3 Seal BAM SE-XA-002-D38

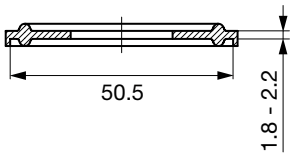


Fig. 7-4: BAM SE-XA-002-D38

Material Polytetrafluorethylene

7.4 Welded port AD-XA-003-D38

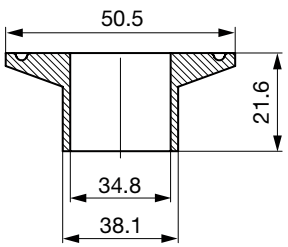


Fig. 7-5: BAM AD-XA-003-D38

Material St. no. w. 1.4435 BN2 (Fe < 0.5%) acc. to EB 10088

8 Ordering code

BTL5 - E 1 7 - M0500 - SF - F05

Micropulse transducer

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

Supply voltage:
- 1 = 24 V DC

Output gradient:
- 0 = Rising (C_0 = 0 to 20 mA, E_0 = 4 to 20 mA)
- 1 = Rising + falling (A_1 = 10 to 0 V and 0 to 10 V)
- 7 = Falling (C_7 = 20 to 0 mA, E_7 = 20 to 4 mA)

Nominal stroke (4-digit):
- M0500 = Metric specification in mm, nominal length 500 mm

Construction:
- SF = Plug-in flange
  Fastening: 1 1/2" tri-clamp

Electrical connection:
- F05 = Teflon cable, radial outlet 5 m

9 Appendix

9.1 Converting units of length

1 mm = 0.0393700787 inches

mm	inches
1	0.03937008
2	0.07874016
3	0.11811024
4	0.15748031
5	0.19685039
6	0.23622047
7	0.27559055
8	0.31496063
9	0.35433071
10	0.393700787

Tab. 9-1: Conversion table mm to inches

1 inch = 25.4 mm

inches	mm
1	25.4
2	50.8
3	76.2
4	101.6
5	127
6	152.4
7	177.8
8	203.2
9	228.6
10	254

Tab. 9-2: Conversion table inches to mm

9.2 Part label

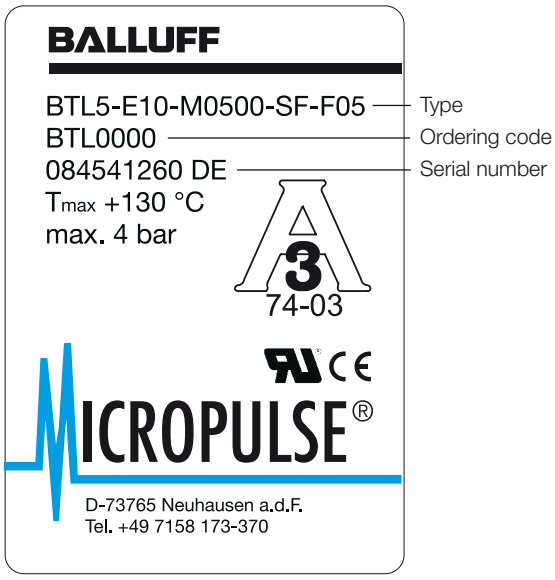


Fig. 9-1: BTL5 part label