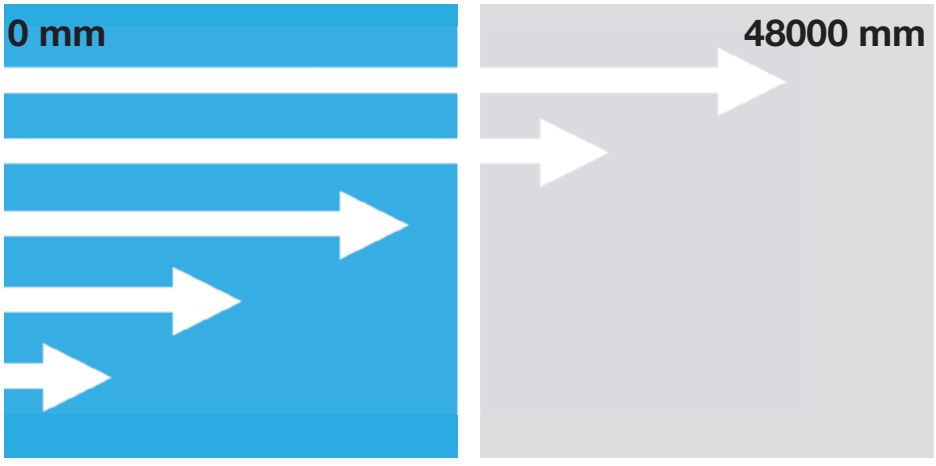
BALLUFF

sensors worldwide

Linear Position Sensing and Measurement

Matching products and technologies to applications



With over 50 years of sensor experience, Balluff is a leading global sensor specialist with its own line of connectivity products for every area of factory automation. Balluff is based in Germany and has a tight international network of 54 representatives and subsidiaries.

Balluff stands for comprehensive systems from a single source, continuous innovation, state-of-the-art technology, highest quality, and greatest reliability. That's not all: Balluff also stands for exceptional customer orientation, customized solutions, fast worldwide service, and outstanding application assistance.

High-quality, innovative products tested in our own accredited laboratory and a quality management system certified according to DIN ISO 9001 (EN 2008) form a secure foundation for optimized added value for our customers.

Whether electronic and mechanical sensors, rotary and linear transducers, identification systems or optimized connection technology for high-performance automation, Balluff masters not only the entire technological variety with all of the different operating principles, but also provides technology that fulfills regional quality standards and is suitable for use worldwide. Wherever you are in the world, Balluff technology is never far away. You won't have to look far for you nearest Balluff expert.

Balluff products increase performance, quality and productivity around the world every day. They satisfy prerequisites for meeting demands for greater performance and cost reductions on the global market. Including in the most demanding areas. No matter how stringent your requirements may be, Balluff delivers state-of-the-art solutions.

Benefit from comprehensive sensor expertise from a single source. Achieve solutions suited to your requirements.

Linear Position Sensing and Measurement
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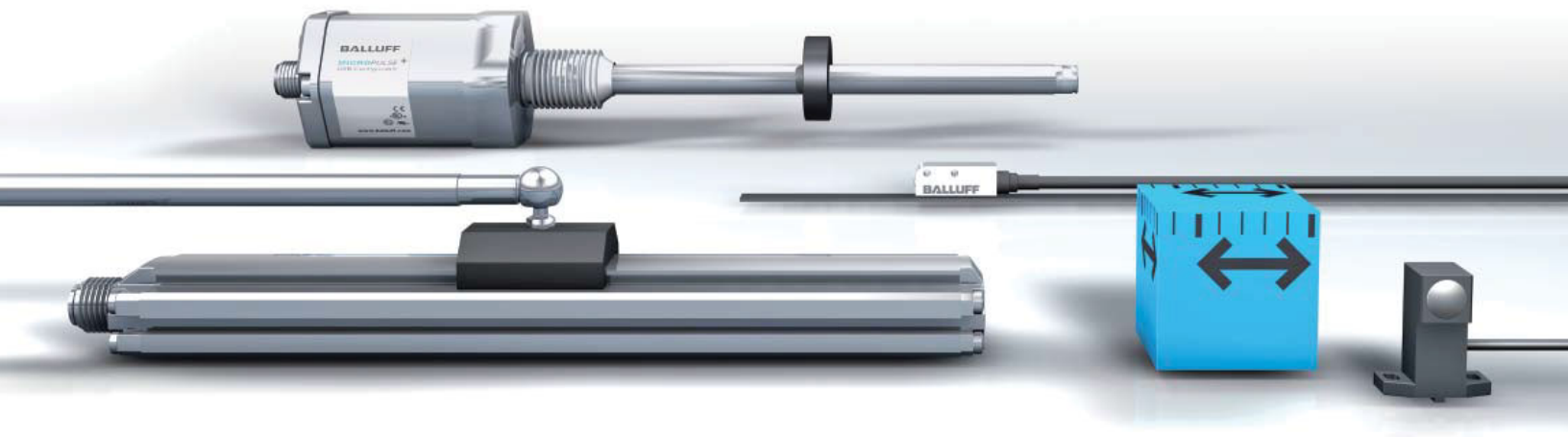


Linear Position Sensing and Measurement
Position or distance sensors

Balluff position measurement – the right solution for you
Balluff position measurement offers efficient individual solutions. With very diverse operating principles for distances from 1 to 48,000 mm and resolutions from 1 to 100 µm. From position detection to distance measurement,simply pick the system that's right for your specific requirements.
Robust industrial Balluff position measurement technology is accurate, reliable, non-contact, and wear-free. Balluff position measurement brings out the best from your machines.

Implement the optimum solution using the appropriate measuring principle
In order to be able to offer the optimum solution for specific measuring tasks, Balluff has built up a comprehensive portfolio of position measuring systems. These ensure that the solution not only works technically, but also functions reliably and is both flexible and cost-effective. From eight different position measurement principles, you can choose the solution for your application that is best from a technical and economic value perspective.

Equipped for the future!
- Extremely flexible
- Easily configurable
- Longer cycle times
- Increased up-time
- Short set-up times
- Decreased downtime
- Greater degree of automation

are just some of the requirements designers and developers must fulfill for future machine generations.

- **Greater flexibility through full range of sensing principles**
- **Greater efficiency with optimized solutions**
- **Superior position measurement technology for increased productivity**

The perfect solution for your application!
From the Balluff full-range assortment of position measurement technology, we can work out the most economical and technically appropriate solution for you.

Magnetically Coded Position and Angle Measurement System BML – for high accuracy and long lengths

BML_48 000 mm

Micropulse Transducers BTL/BIW – extremely robust and reliable

BTL/BIW_ 7 600 mm

Photoelectric Distance Sensors BOD – for any material or color

BOD_ 6 000 mm

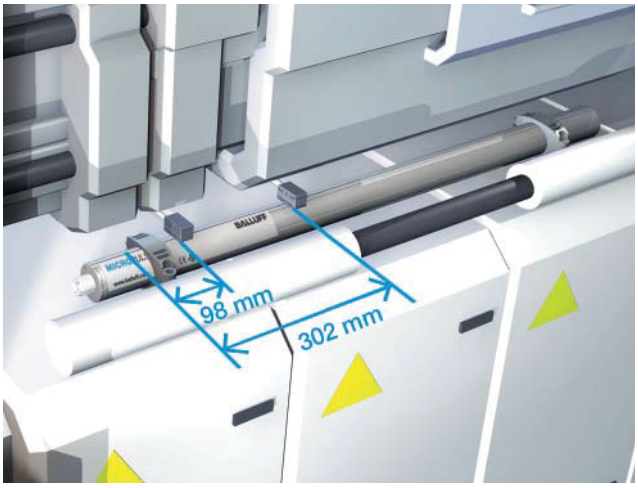
Inductive Position Sensors BIL/BIP– for short strokes

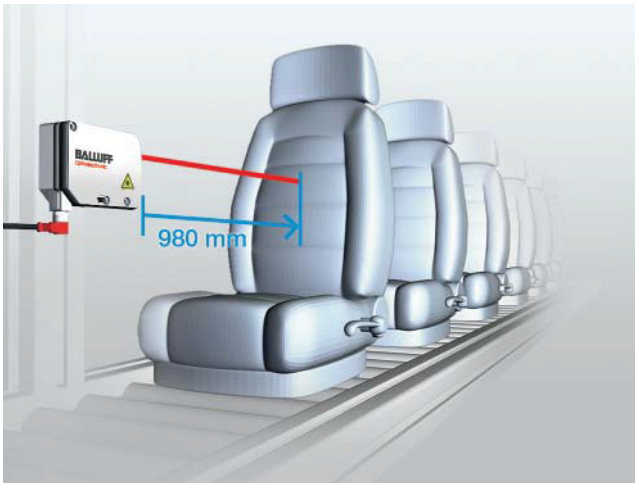
BIL/BIP_ 160 mm

Inductive Distance Sensors BAW – for short strokes

BAW_ 20 mm

Position or distance sensors
The main difference between position measurement and distance measurement consists in the element or target that gives the position.





With **position sensors**, the position-giving element or target is usually a position marker that is part of the system.

Example:
With magnetostrictive micropulse position measuring systems, the position-giving element is the position magnet, which is attached to the part that is moved.

Position measurement

See page 6

With **distance sensors**, the position-giving target can be any object.
However, in accordance with the distance sensor principle, the function or quality of the measurement depends on the kind of material or surface properties of the target.

Example:
With inductive distance sensors, the maximum measurement path depends on the target material used, and with optical sensors, the function depends on the surface properties of the object or target.

Distance measurement

See page 8

Find the right **position** measuring system in just 4 steps

1 Length
How long is the path to be measured?
Select the series that matches the range.

2 Accuracy
What level of accuracy is required?
Select the appropriate accuracy.

Resolution range

Accuracy class*

3 Interface
Select the interface appropriate for the controller or electronic evaluation unit.

4 Measuring principle
Select the measuring principle in accordance with the requirements.

*** Accuracy class**
Selecting the sensor via the accuracy class should help match the sensor principles that come into question to the practical requirements. The underlying values are correspondingly typical values for the sensor principle.

Example:
Accuracy class "**2**-1"
Typical value **2** (<10 µm), with the trend to 1 (1 µm)

Accuracy	Class
< 1 µm	1
< 10 µm	2
< 50 µm	3
< 100 µm	4
< 500 µm	5
< 1 mm	6
< 5 mm	7
< 100 mm	8

Typical applications

Basic information
- Technical data
- Housing dimensions
- Ambient condition
- Mechanical features
- Approvals
- Ordering code
- Accessories

You can find this in the chapter devoted to the selected series.

					
	0...(20...48,000) mm	0...(25...7600) mm	0...(25...7600) mm	0...(75...750) mm	0...(10...160) mm
	1...100 µm	1...100 µm	1...100 µm	5 µm	0.1 mm
	2-1	**3**-2	**3**-2	**4**-5	**4**
	Digital square-wave, SIN/COS 1 V_{pp}, SSI, BiSS	Analog, digital SSI, fieldbus, Ethernet	Analog, digital SSI, fieldbus, Ethernet	analog	Analog, digital
	Incremental/absolute	Absolute	Absolute	Absolute	Absolute
	Magnetoelectric scanning	Magnetostrictive	Magnetostrictive	Inductive	Inductive
	Automation and handling, linear drives, wood-working machines, drive technology	Plastic injection molding machines, pre-cast concrete block machines, presses	Feedback system in hydraulic axes, valve actuators, level measurement, hazardous area	Contactless substitute for potentiometers, plastic injection molding-machines	Gripper, spindle clamping distance monitor, format adjustment, roll gap measurement
	BML	**BTL profile**	**BTL rod**	**BIW**	**BIL/ BIP**
	See page 10	See page 76	See page 136	See page 131	See page 268

Find the right **distance** measurement system in just 4 steps

1 Length
How large is the distance to be measured?
Select the series that are in question.

2 Accuracy
What accuracy is required?
Select the appropriate accuracy.

Resolution range

Accuracy class*

3 Interface
Select the interface appropriate for the controller or electronic evaluation unit.

4 Measuring principle
Select the measuring principle in accordance with the conditions of use.

Typical applications

*** Accuracy class**
Selecting the sensor via the accuracy class should help match the sensor principles that come into question to the practical requirements. The underlying values are correspondingly typical values for the sensor principle.

Example:
Accuracy class "**2**-1"
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Basic information
- Technical data
- Housing dimensions
- Ambient condition
- Mechanical features
- Approvals
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- Accessories

You can find this information in the chapter devoted to the selected series.

				
	0...(20...6000) mm	0...(25...6000) mm	0...(0.5...50) mm	0...8 mm
	0.02...1 mm	0.02...1 mm	0.2...0.5 mm	0.05 mm
	6-4	**5**-6	**4**-3	**4**-7
	Analog, digital	Analog, digital	analog	Analog
	Absolute	Absolute	Absolute	Absolute
	Photoelectric, light travel time or triangulation	Ultrasound, echo-travel time measurement	Inductive	Capacitive
	Measurement and position determination of objects in the material flow of production equipment	Level measurement for liquids and granular materials, distance control for overhead conveyors, measurement of roll diameters	Clamping distance monitoring on spindles and grippers, sheet thickness measurement, roll distance monitoring, eccentricity measurement for shafts, shape monitoring for metal parts	Layer thickness and shape monitoring for non-metallic materials and objects, level monitoring
	BOD See page 292	**BUS** See page 316	**BAW** See page 330	**BCS** See Balluff Object Detection Catalog

Magnetically Coded Position and Angle Measurement System

For more information, visit us online!

Magnetically Coded Position and Angle Measurement System
Contents

A large range of position and angle measurement tasks or the dynamic, accurate detection of speed and rotational speeds of rotating shafts are solved in a wide variety of industries with magnetically coded systems. A magnetic tape system consists of the sensor head, a tape for linear or rotary use, and accessories such as a counter display or guide system. The operating principle is non-contact and therefore wear-free. The measured value is available as an incremental or absolute output signal.
The tapes, magnetized using the Permagnet® process specially developed by Balluff, enable the highest accuracy. High flexibility is offered by rolls of magnetic tape, with lengths available up to 48 m. Customized, fabricated solutions as well as special codings achieve optimum results.
The real-time-capable BML position measuring systems make the position information available within microseconds and therefore are optimum feedback systems for electric drive units.
By means of its extremely small dimensions and non-contact measurement technology, BML allows for integration even in tight spaces or extreme ambient conditions. Expensive downtime and service work are prevented by means of the wear-free operating principle; service-intensive encapsulation becomes unnecessary. Moreover, the non-contact technology allows for extremely high measurement speeds.

Accessories can be found on **page 48.**

Basic information and definitions can be found on **page 54.**

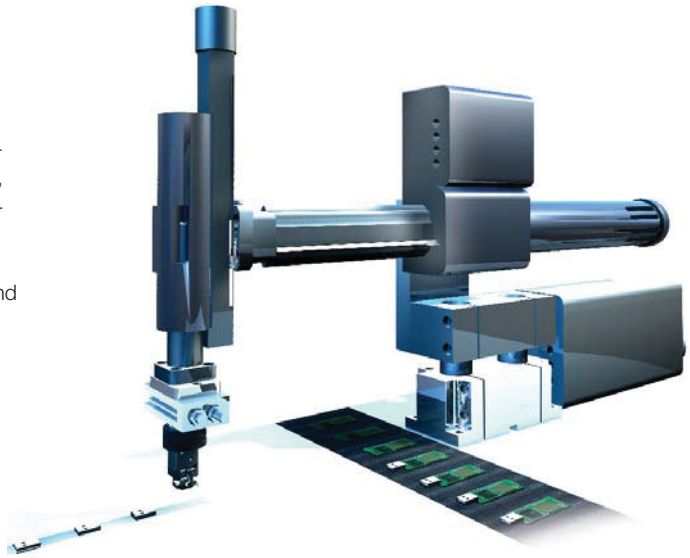
Magnetically Coded Position and Angle Measurement System

Applications

Feedback system for pick and place

With the smallest design of an absolute magnetic position measurement sensor and the option of measuring perpendicular to the tape, the BML-S1H provides position feedback in highly dynamic applications even in extremely tight spaces.

- Optimum control quality by means of a high measurement rate and linearity
- Additional analog signal for highly dynamic controls
- Smallest metal housing reduces installation space



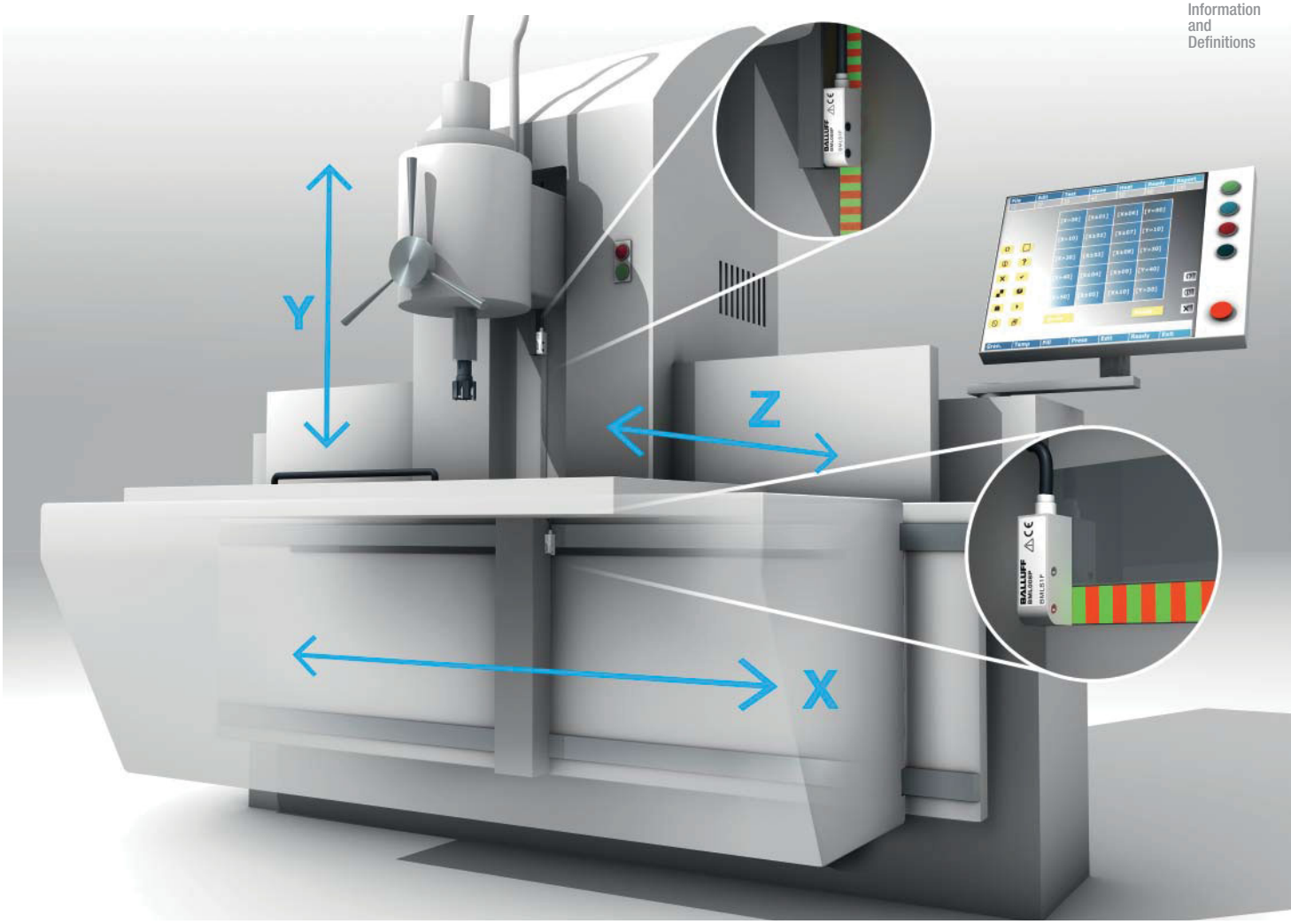
Fastest positioning with a high measurement rate and linearity. Small design reduces installation space.

Successfully used for years for to point mirrors towards the sun with high accuracy. With BML you achieve the best energy efficiency in concentrated solar power plants and parabolic trough power plants.

Magnetically Coded Position and Angle Measurement System
Applications

The BML enables ultimate control of dynamics and high gain factors by means of compact dimensions and high accuracy. Position with higher speeds and extreme precision.

Universal milling machines use magnetically coded position and angle measurement systems BML for accurate positioning of the x, y, and z axes.



Series	**BML-S1G0...**	**BML-S1F_-Q...**	
Resolution	1...10 µm	1...10 µm	
System accuracy	±20 µm	±10 µm	
Distance to tape	0.1…0.8 mm	0.1…0.35 mm	
Linear tape	0...48 m	0...48 m	
Rotary tape (magnet ring) Ø 30...300 mm		■	
Angle measurement with magnetic tape < 360°		■	
Interfaces			
Absolute SSI	■		
Absolute BiSS C	■		
Incremental digital RS422 (TTL)	■	■	
Incremental digital HTL (as supply voltage 10...30 V)			
Incremental analog sin/cos (1 V_{pp})	■		

Magnetic tape	BML-M02-A…-E	BML-M02-I3…	
Pole pitch (fine interpolation track)	2 mm	1 mm	
From page	18	26	

Magnetically Coded Position and Angle Measurement System

Product overview




	BML-S1F_-A...	BML-S2B0-Q...	BML-S2E0-Q...	BML-S1C0-Q...
	up to 0.25 µm*	5...50 µm	5...50 µm	100...2000 µm
	±10 µm	±50 µm	±100 µm	±100 µm
	0.1…0.35 mm	0.1...2 mm	0.1...2 mm	0.1...2 mm
	0...48 m	0...48 m	0...48 m	0...48 m
	■	■	■	■
	■	■	■	■
		■	■	
		■	■	■
	■			




	BML-M02-I3…	BML-M02-I4…	BML-M02-I4…	BML-M02-I4…
	1 mm	5 mm	5 mm	5 mm
	26	34	34	34

* Depending on the customer's electronics

Magnetically Coded Position and Angle Measurement System

Operating principle

The high-precision magnetic position and angle measurement system BML consists of a sensor head and a magnetically encoded tape. The sensor head glides over the tape, which is encoded with magnetic poles, with a gap of up to 2 mm.
Incremental systems make available the period changes of the tape encoded with alternating polarity as square- or sine-wave signals at the sensor output. The signals are processed using standard incremental inputs or sine-wave counter inputs of the electronic evaluation unit.
With the absolute systems, the absolute position is processed as an SSI or BiSS signal at the standard interface of the electronic evaluation unit. Additionally, the absolute BML makes a real-time incremental signal available for evaluation for fast control applications with high sample rates.

Magnetically coded systems are highly accurate and real-time-capable

Displacement sensors with a magnetically encoded tape are very robust and operate highly accurately and particularly fast as a measuring system. Resolution is down to 1 µm. Accuracy degrees of ±10 µm can be achieved. The BML has no trouble with absolute measurement of travel speeds up to 5 m/s and incremental measurement up to 20 m/s. The absolute position values can be clocked with up to 10 MHz. The measured position value is available in fractions of microseconds. The controller receives the incremental position signal in real time.

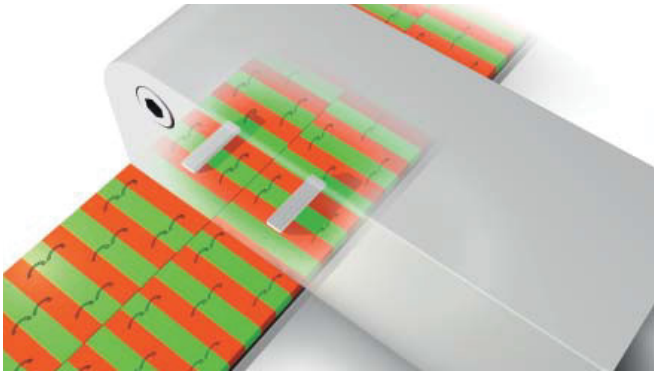
Non-contact and highly robust, even for applications in rough conditions

In addition to the high accuracy and real-time capability, the BiSS interface allows for bidirectional communication including signal error detection. Since the measuring system operates magnetically, unlike optical systems it is highly immune to contamination such as oil, swarf, or dust and does not require encapsulation. Unlike with inductive systems, with the BML, metal swarf merely causes attenuation and does not register as a measurement variable. These properties make it excellently suited for use in harsh or dusty industrial environments.

System features of absolute systems

- Non-contact operating principle
- Resolution down to 1 µm
- System accuracy to ±10 µm
- Absolute signal SSI and BiSS-C
- Additional incremental signal analog sin/cos (1 V_{ss})
- Gap between sensor and tape up to 0.35 mm

Operating principle of absolutely coded position and angle measurement system BML

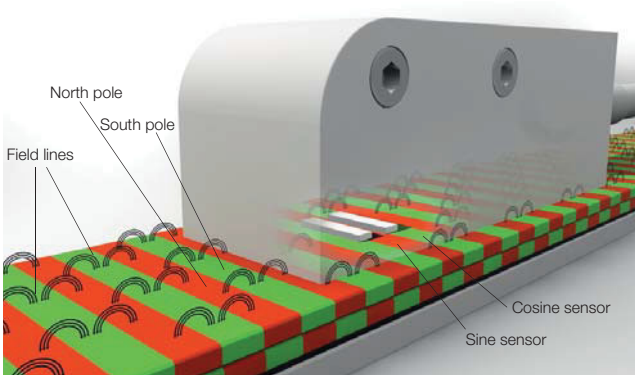


Magnetically Coded Position and Angle Measurement System
Operating principle

System features of incremental systems

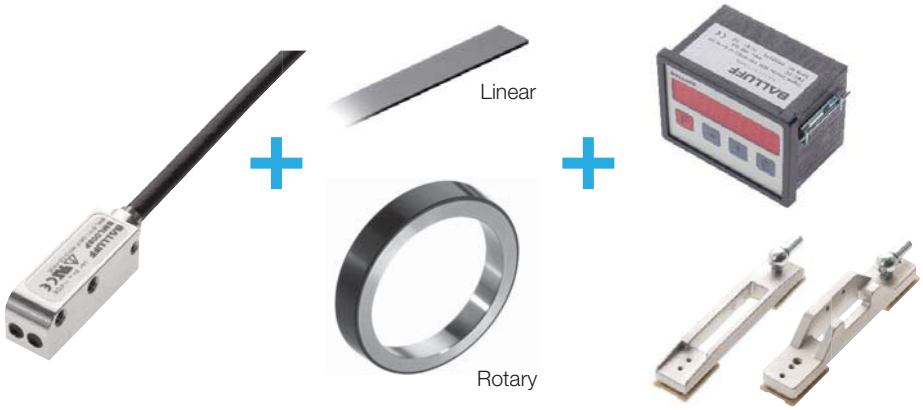
- Non-contact operating principle
- Resolution down to 1 µm
- Digital square-wave signals RS422 (TTL) or 10...30 V (HTL)
- Sinusoidal output signals 1 V_{ss}
- Gap between sensor and tape up to 2 mm
- Reference and limit switch function

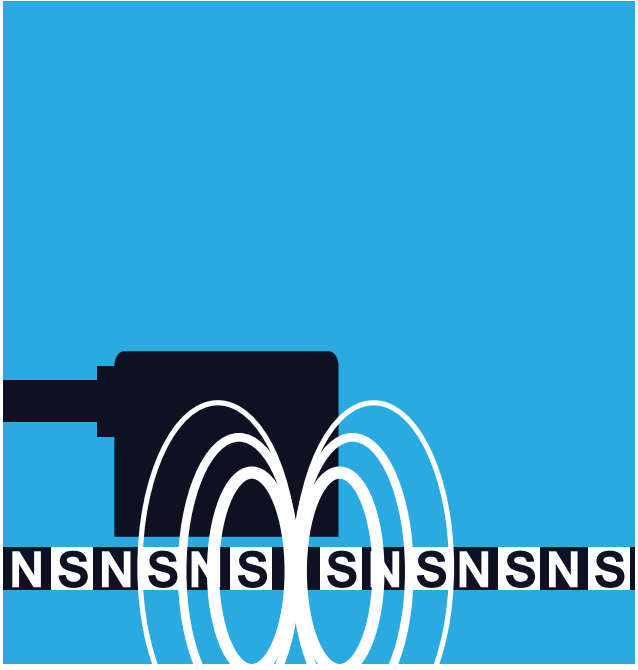
Operating principle of incremental position and angle measurement system BML



System overview

Sensor head **Tape** **Accessories**



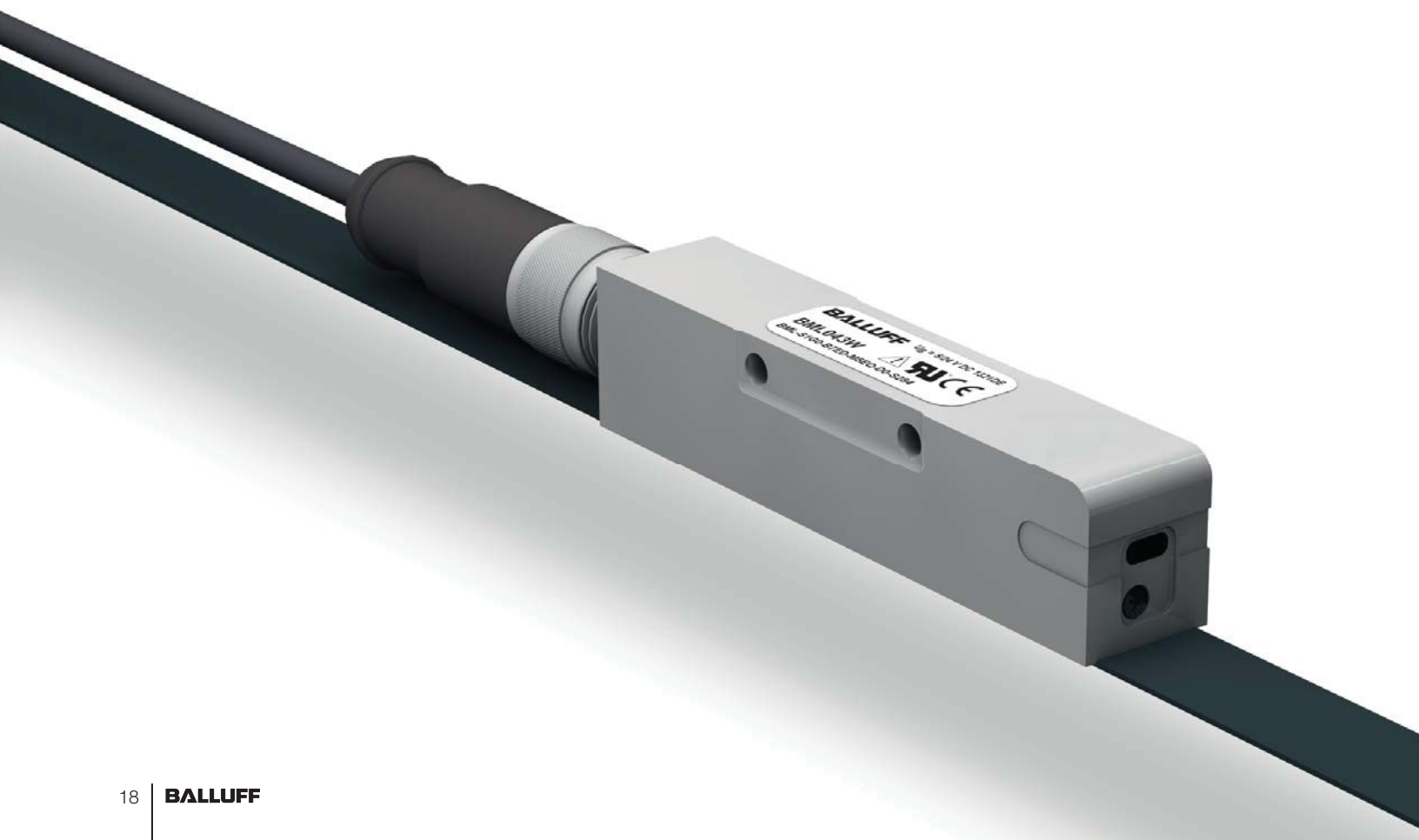


Magnetically Coded Position and Angle Measurement System

S1G Series, 1 µm Absolute

The absolutely coded position measurement system BML-S1G offers high resolutions at large measuring lengths.

The rugged metal housing with stainless steel-encapsulated floor protects against electromagnetic influences and allows for reliable operation even in heavily contaminated environments. With the absolute coding, the position value is available immediately after the system is switched on. The installation tolerances and the LED feedback make it really easy to set up and install the system. The diagnostic function enables fast error detection and thus provides for short downtimes during setup and when errors arise.



S1G Series, Absolute
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Tape
Page 35

Digital display
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Connection cables
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Features
- Absolute measurement system
- Additional real-time signals for fast control applications (sin/cos or RS422)
- ±20 µm system accuracy
- 1 µm resolution
- Rugged metal housing
- Very easy installation with multicolored LED
- Large installation tolerances
- Large length up to 48 m

Ordering example: sensor head

BML-S1G0-_7__-M5E__-_0-S284

Interface

B	BiSS C (bidirectional, serial, synchronous), absolute
S	SSI (serial, synchronous), absolute

Data format

Interface B:

E	Binary, rising (32-bit)

Interface S:

0	Binary, rising (24-bit)
1	Gray, rising (24-bit)
6	Binary, rising (25-bit)
7	Gray, rising (25-bit)
A	Binary, rising (26-bit)
B	Gray, rising (26-bit)
E	Binary, rising (32-bit)
F	Gray, rising (32-bit)

Resolution per LSB

C	~ 0.98 µm
D	1 µm
E	2 µm
F	5 µm
G	10 µm

Additional real-time signal

Z-9	None
A-D	Analog (sin/cos), period 2 mm
Q-D	Digital, 0.12 µs edge separation
Q-E	Digital, 0.3 µs edge separation
Q-F	Digital, 0.5 µs edge separation
Q-G	Digital, 1 µs edge separation
Q-H	Digital, 2 µs edge separation
Q-K	Digital, 4 µs edge separation
Q-L	Digital, 8 µs edge separation
Q-N	Digital, 16 µs edge separation
Q-P	Digital, 24 µs edge separation

Connection

S284	M12 connector, axial with pin contacts, 12-pin

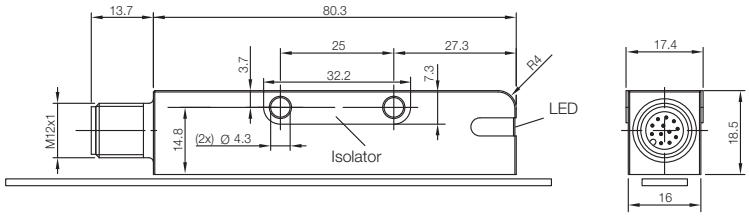
Preferred models
- **BML-S1G0-S7ED-M5EA-D0-S284 (BML041H)**
  SSI interface, 1 µm resolution, additional real-time signal sin/cos, M12 connector, 12-pin
- **BML-S1G0-B7ED-M5EZ-90-S284 (BML042T)**
  BiSS-C interface, 1 µm resolution, without real-time signal, M12 connector, 12-pin

For large lengths

S1G Series, Absolute
SSI Interface, BiSS-C interface

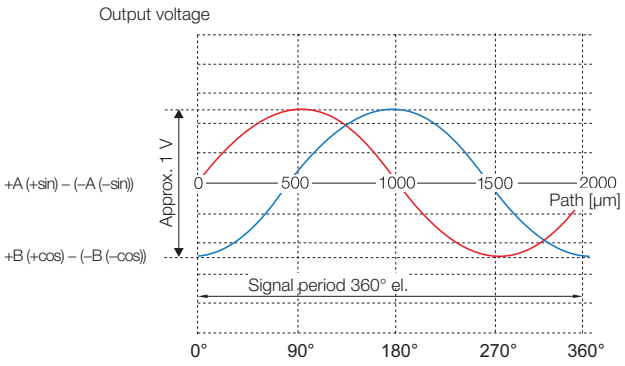
Series	**BML-S1G...**
Output signal	Absolute: SSI or BiSS C, additional real-time signal sin/cos, 1 V_{pp} or RS422
Data format	24, 25, 26 or 32 bit
Resolution	~0.98, 1, 2, 5 or 10 µm
Part number	BML-S1G0-B/S7_ _-M5E_-_0-S284
Repeat accuracy	±1 increment
Overall system accuracy	±20 µm
Supply voltage	5 V ±5 % and 10…28 V DC
Current consumption	70 mA at 24 V DC supply voltage
Max. read distance sensor/tape	0.8 mm (without cover strip)
Max. measuring length	48 m
Pole pitch, fine interpolation track	2 mm
Max. travel speed	10 m/s
Measurement rate	$f_{STANDARD}$ = 50 kHz (SSI), $f_{STANDARD}$ = 10 MHz (BiSS C)
Operating temperature	–20...+70 °C
Storage temperature	–25...+85 °C
Housing material	Zinc, surface coated
Degree of protection	IP 67

All data applies in conjunction with tape BML-M02-A33... (see page 23)



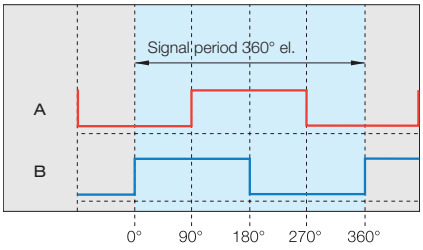
Additional analog, incremental real-time signal
(BML-S1G0-_ _ _ _-M5E**A**-_0-…)

In addition to the SSI or BiSS signal, an analog real-time signal sin/cos 1 V_{pp} is output for highly dynamic control applications.



Additional digital, incremental real-time signal
(BML-S1G0-_ _ _ _-M5E**Q**-_0-…)

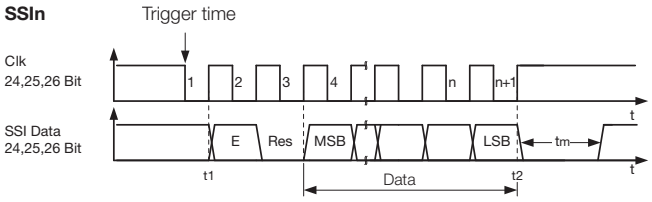
In addition to the SSI or BiSS signal, a digital differential voltage signal is output to the controller (RS422).



SSI Interface

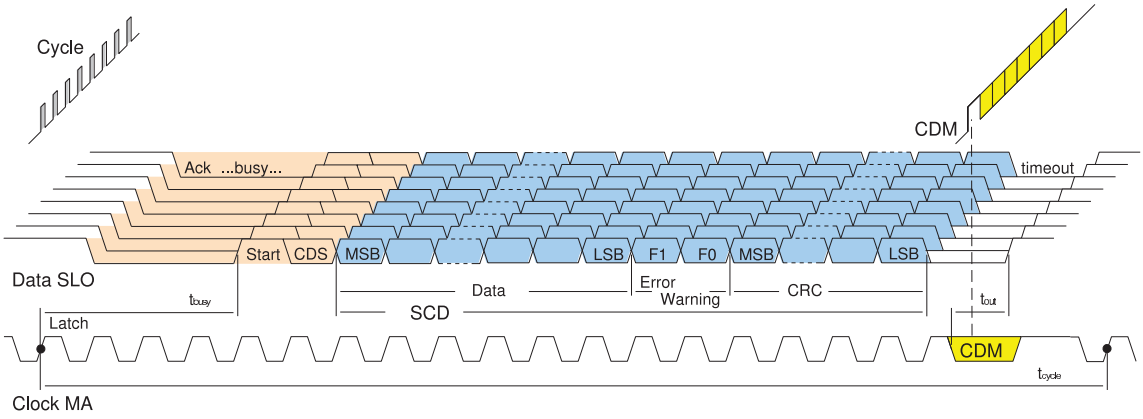
The SSI interface provides synchronous serial data transmission and is suitable for controllers from different manufacturers.
Reliable signal transmission, even with cable lengths of up to 400 m between controller and transducer. This is guaranteed by the especially interference-freeRS485/422 differential drivers and receivers.
Any interference signals are effectively suppressed.
The standard BML is factory-configured with the following settings for the position output, which cannot be modified later:

- optionally 24, 25, 26 or 32-bit
- Binary or Gray-coded



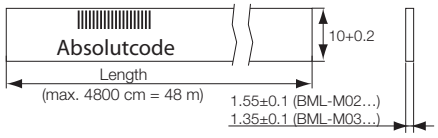
BiSS-C interface

BiSS C stands for the synchronous serial data transmitter and is suitable for controllers from different manufacturers.
Unlike SSI, the data transmission is bidirectional. In BiSS-C mode, settings can be (continuously) configured on the sensor head without interrupting the sensor data.
BiSS-C supports CRC, warnings and error messages.



Caution!
Before design, installation and startup please familiarize yourself with the user's guide to be found at www.balluff.com.

Series	**Magnetic tape**
Output signal	for BML-S1G
Ordering code	
Part number	BML-M02-A55-A3-M0100-E
Length	e.g. 100 cm
Magnetic tape material	Rubber ferrite, stainless steel carrier
Cover strip material	Stainless steel



Ordering example: magnetic tape

B M L - M 0 _ - A 5 5 - A _ - M _ _ _ _ - E

Thickness

2 1.55 mm
Has an adhesive strip for fastening
(with protective foil)
3 1.35 mm
Without adhesive strip

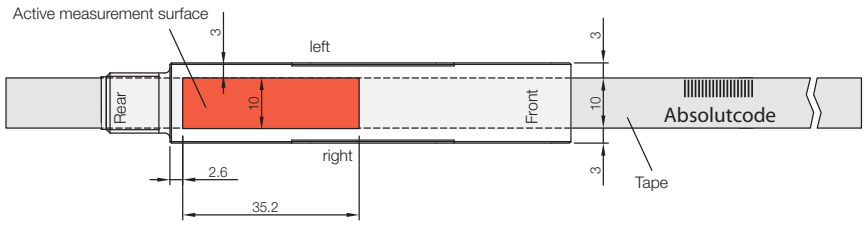
Cover strip

0 No cover strip
3 With cover strip

Length in cm

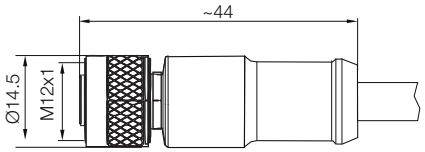
Order length,
max. 4800 = 48 m

Positioning



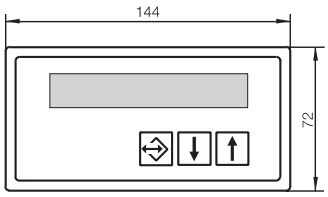
Connection cables

Accessories		**M12 connection cable** 12-pin, female straight	
Series		BML-S1H...-S284	
Length 2 m	**Ordering code**	**BCC09MW**	
	Part number	BCC M41C-0000-1A-169-PS0C08-020-C009	
Length 5 m	**Ordering code**	**BCC09MY**	
	Part number	BCC M41C-0000-1A-169-PS0C08-050-C009	
Length 10 m	**Ordering code**	**BCC09MZ**	
	Part number	BCC M41C-0000-1A-169-PS0C08-100-C009	
Length 15 m	**Ordering code**	**BCC09N0**	
	Part number	BCC M41C-0000-1A-169-PS0C08-150-C009	
Length 20 m	**Ordering code**	**BCC09N1**	
	Part number	BCC M41C-0000-1A-169-PS0C08-200-C009	
Material		PUR, with connector, molded, black	
Description/additional data		■ Cable: Ø 4.9 mm, 12×0.08 mm² ■ Bending radius: 15×D (dynamic), 7.5×D (static) ■ Temperature range: –25 °C...+70 °C	

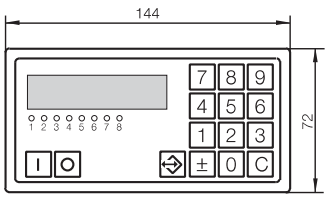


S1G Series, Absolute
Digital display, CAM controller

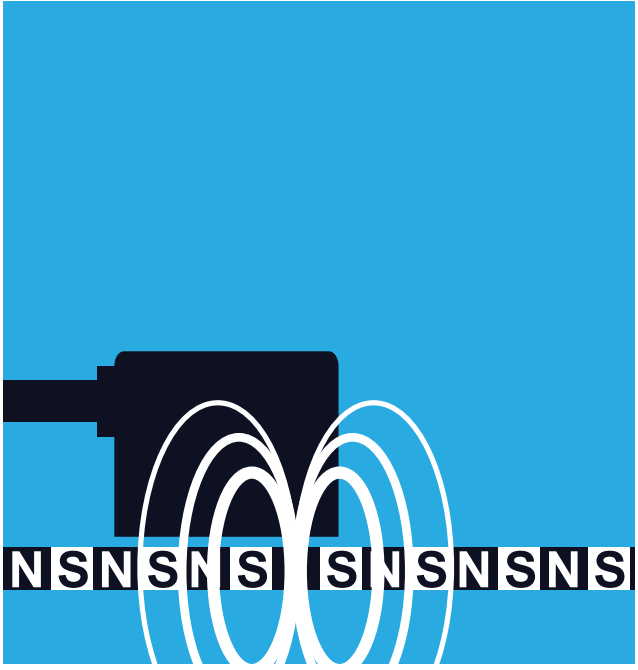
Series	BDD-AM 10-1-SSD	BDD-CC 08-1-SSD
	Digital display	CAM controller
	SSI Interface	SSI Interface
Ordering code	**BAE0069**	**BAE006F**
Part number	BDD-AM 10-1-SSD	BDD-CC 08-1-SSD
Features	■ 7 1/2-digit display with leading sign ■ LED display, 14 mm-high red 7-segment digits ■ Scalable measured values ■ Variable decimal place setting ■ Adjustable zero point ■ Supply voltage 10...32 V ■ 2 programmable relay outputs, each as limit switch/comparator ■ Cam ■ 2-point controller ■ 1 configurable input ■ External zeroing ■ Retention of the display value ■ Integrated transducer supply voltage 300 mA, 5 V or 24 V ■ Insulated DIN housing for mounting in front panel (clamp included in the scope of delivery)	■ 8 programmable outputs ■ 8 directional switching points possible ■ LED display, six 14-mm high red 7-segment digits ■ Switching points can be monitored using LEDs on the front panel ■ 300 switching points can be distributed over up to 15 programs ■ Adjustable top dead center/zero point shift ■ Dynamic dead-time compensation for each individual switching point ■ Multiple BDD-CC 08 units can be wired in parallel ■ Integrated transducer supply voltage 300 mA, 5 V or 24 V ■ Insulated DIN housing for mounting in front panel (clamp included in the scope of delivery)



Housing depth 110 mm



Housing depth 110 mm



Magnetically Coded Position and Angle Measurement System

S1F series – incremental measurement

With the S1F sensor heads, the magnetically coded position and angle measurement system BML provides high-resolution designs in robust metal housings. They also detect reference points on the tape. The S1F series can be used either parallel or perpendicular.
The S1F series has an extremely compact design and is therefore easy to integrate in systems with restricted installation space.

S1F Series – Incremental
Contents

S1F Series – Incremental
General data

Tape
Page 30

Magnet Rings
Page 31

Counter-Displays
Page 50

Features
- 1 µm resolution (digital)
- ±10 µm system accuracy permits high gain factors (analog)
- High repeat accuracy ±1 increment
- Reference signal
- Compact design
- Rugged metal housing
- Mounted parallel or perpendicular to tape

System selection:
Relationship between resolution, edge separation and speed
Selection guide, page 32

Ordering example: sensor head with digital square-wave signal RS422

BML-S1F_-A62Z-M3_0-90-_ _ _ _ (with analog output signal sin/cos)
BML-S1F_-Q61_-M3_0-_0-_ _ _ _ (with digital square-wave signal RS422)

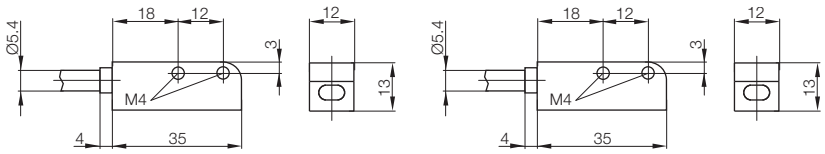
Approach direction		Resolution		Reference signal		Min. Edge separation		Connection	
1	Parallel	D	1 µm	0	None	D	0.12 µs	KA02	PUR cable 2 m
2	Perpendicular	E	2 µm	1	Individually or fixed-periodic	E	0.29 µs	KA05	PUR cable 5 m
		F	5 µm			F	0.48 µs	KA10	PUR cable 10 m
		G	10 µm	2	Pole-periodic only with digital design ...-Q61_-...	G	1 µs	KA15	PUR cable 15 m
						H	2 µs	KA20	PUR cable 20 m
						K	4 µs		
						L	8 µs		
						N	16 µs		
						P	24 µs		

Preferred models
- **BML-S1F1-A62Z-M310-90-KA05 (BML02J1):**
  Installed parallel to tape, analog output sin/cos, with reference signal, 5 m cable
- **BML-S1F1-Q61D-M310-F0-KA05 (BML001A):**
  Installed parallel to tape, RS422 digital signal, with reference signal, 5-m cable, resolution 1 µm, edge separation 0.48 µs, max. travel speed 1 m/s

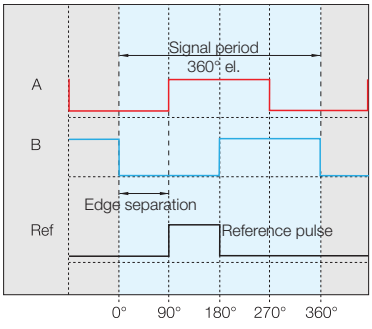
S1F Series – Incremental
General data

Series	BML-S1F_-Q...	BML-S1F_-A...
Output signal	Digital square-wave signals RS422	Sinusoidal analog signals sin/cos
Resolution	1 µm, 2 µm, 5 µm or 10 µm	processing-dependent
Part number	BML-S1F_-Q61_-M3_ 0-_0-_ _ _ _	BML-S1F_-A62Z-M3_ 0-90-_ _ _ _
Output voltage (A/B/Z)	RS422 to DIN 66259	1 V_{pp}
Overall system accuracy	±10 µm	±10 µm
Supply voltage	5 V ±5%	5 V ±5%
Current consumption at 5 V operating voltage	< 50 mA + current consumption of the controller (depending on internal resistance)	< 50 mA + current consumption of the controller (depending on internal resistance)
Max. read distance sensor/tape	0.35 mm	0.35 mm
Max. traverse speed	20 m/s	20 m/s
Operating temperature	–20...+80 °C	–20...+80 °C
Housing material	Al	Al
Degree of protection	IP 67	IP 67

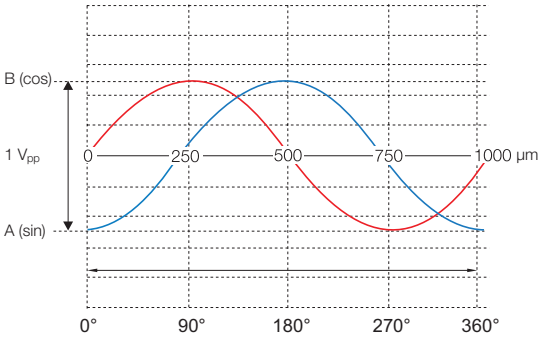
All specifications in conjunction with tape BML-...-I34... (see page 30).



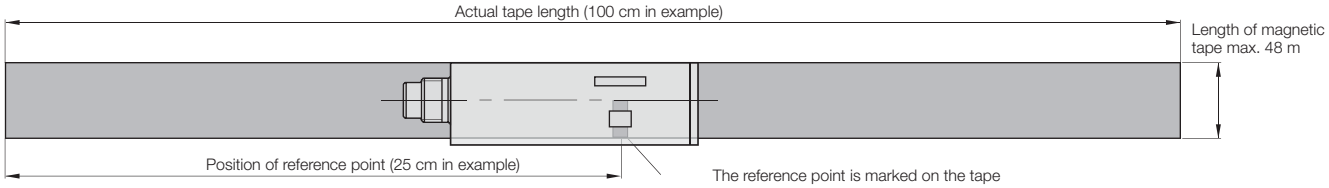
Digital square-wave signals RS422
- RS422 square-wave signals in acc. with DIN 66259
- 90° phase shifted
- Edge separation A/B corresponds to the resolution of the sensor head
- Differential signal
- Terminating resistor ≥ 120 ohms (typically integrated into control system)



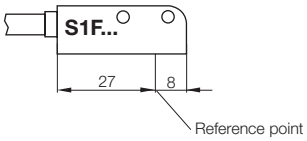
Sinusoidal analog signals 1 V_{pp}
- Sinusoidal voltage signals with inversion
- Signal period 360°, electrical = 1000 µm
- Terminating resistor ≥ 120 ohms (typically integrated into control system)



Position of single reference point using example of BML-M02-I34-A3-M0100-R0025/0000



Typical position of reference points in sensor head



Fabricated magnetic tape, pole width 1 mm

BML-M_ _-I3_-A_-M_ _ _ _-_ _ _ _ _

Design	Accuracy class	Cover strip	Length in cm	Reference point positions
02 1.55 mm thick, with adhesive strip	4 8 µm, overall accuracy ±10 µm	3 With cover strip (thickness 0.15 mm)	Order length, max. 4800 = 48 m	R0000 None or pole-periodic
03 1.35 mm thick, without adhesive strip	5 18 µm, overall accuracy ±20 µm	0 18 µm, overall accuracy ±20 µm		Rxxxx/0000 Position of 1 reference point in cm
				Rxxxx/yyyy Position of no more than 2 reference points in cm
				C0006/yyyy Fixed-periodic* all yyyy cm, 0002, 0005, 0010, 0020

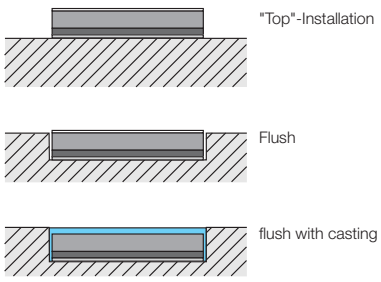
* Fixed-periodic reference point only for BML-M02-I34...

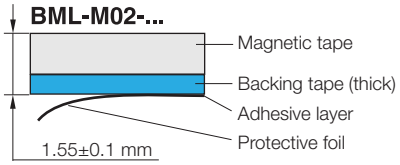
Ordering example: Magnetic tape by the roll, pole width 1 mm

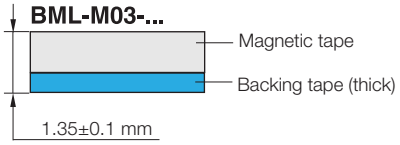
BML-M02-I3_-A0-T_ _ _ _-R0000

Accuracy class	Length
4 8 µm, overall accuracy ±10 µm	0500 5 m
5 18 µm, overall accuracy ±20 µm	1000 10 m
	2400 24 m
	4800 48 m

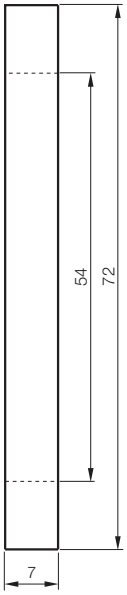
Magnetic tape mounting options

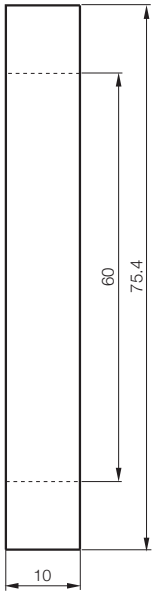


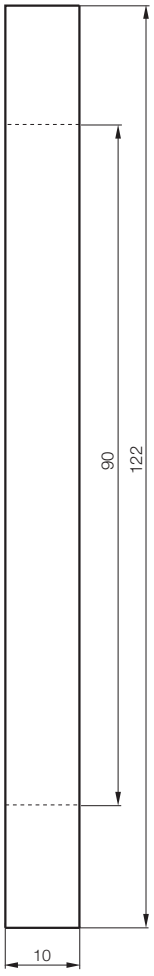




Series	Sensor family F	Sensor family F	Sensor family F
Ordering code	**BML002K**	**BML01KM**	**BML01EW**
Part number	BML-M20-I30-A0-M072/054-R0	BML-M31-I30-A0-M075/060-R0	BML-M30-I30-A0-M122/090-R0
Number of poles	228	238	384
Pole width	1 mm	1 mm	1 mm
With reference mark	No	No	No
Material	Hard ferrite	Elastomer on steel ring with fit H7	Elastomer on steel ring with fit H7







The BML system enables precise adaptation to the relevant application. Balluff offers a technical selection guide that provides valuable assistance. For additional examples, see Basic Information and Definitions on page 54.

Selecting a suitable controller

Each sensor with a digital output signal has a characteristic minimum edge separation gap that the higher level controller must reliably detect. We therefore recommend selecting a controller with a counting frequency that is higher than the theoretically calculated counting frequency.

Please use the following formula to select a suitable controller:

$$\text{Counting frequency of the controller} \geq \frac{1}{\text{Min. edge separation}}$$

Example: If the sensor has a minimum edge separation gap of 1 µs, then a controller capable of detecting at least 1 MHz must be selected based on the above formula.

Maximum travel speed, resolution and edge separation

The following tables show the relationship between the selected resolution of the sensor head, the minimum edge separation and the potential travel speed:

Min. edge separation		V_{max} in accordance with edge separation and resolution Mechanical resolution			
		D 1 µm	**E** 2 µm	**F** 5 µm	**G** 10 µm
D	0.12 µs	5 m/s	10 m/s	20 m/s	20 m/s
E	0.29 µs	2 m/s	4 m/s	10 m/s	10 m/s
F	0.48 µs	1 m/s	2 m/s	5.41 m/s	5.41 m/s
G	1 µs	0.65 m/s	1.3 m/s	2.95 m/s	2.95 m/s
H	2 µs	0.3 m/s	0.6 m/s	1.54 m/s	1.54 m/s
K	4 µs	0.15 m/s	0.3 m/s	0.79 m/s	0.79 m/s
L	8 µs	0.075 m/s	0.15 m/s	0.34 m/s	0.34 m/s
N	16 µs	0.039 m/s	0.079 m/s	0.19 m/s	0.19 m/s
P	24 µs	0.026 m/s	0.052 m/s	0.13 m/s	0.13 m/s

Table 1: Selection guide for maximum travel speed of the S1F series

Rotary applications
The BML system allows precision adaptation of rotary tapes to the relevant application.
Balluff offers a technical selection guide for rotary systems that provides valuable assistance.

Determining the pulses per rotation
The number of required pulses per rotation varies depending on the application. It determines the resolution of the sensor head and the diameter of the magnet ring.

Sensor head resolution	Pulses/revolution with 4-fold evaluation		
	Ø of magnet ring, outside		
	72 mm	75 mm	122 mm
Ordering code	**BML002K**	**BML01KM**	**BML01EW**
D = 1 µm	228000	238000	384000
E = 2 µm	114000	119000	192000
F = 5 µm	45600	47600	76800
G = 10 µm	22800	23800	38400

Table 2: Selection guide for magnet rings from the S1F series

Maximum speed
The BML system enables the detection of rotary movements. The speed and the diameter of the magnetic ring determine the speed of the ring on the sensor head.
The maximum travel speed that the sensor can still identify depends on the resolution and the edge separation of the sensor head.
Resolution and edge separation can be selected. A maximum speed is then calculated using the following formula:

$$\text{Max. speed (rpm)} = \frac{60 \times \text{max. travel speed (m/s)}}{\pi \times \text{magnet ring diameter (m)}}$$

Refer to Table 1 for the maximum travel speed. When selecting a maximum speed for the application, we recommend using a value 10% lower than this value.

Example:
You are using a BML-S1F sensor with a resolution of 5 µm (F) and a minimum edge separation of 1 µs (G). For this sensor, Table 1 gives a maximum travel speed of 2.95 m/s.

If the magnet ring diameter is 72 mm = 0.072 m, a speed of 783 rpm can be achieved according to the formula.
With consideration for the reduced value, the speed should not exceed 705 rpm.

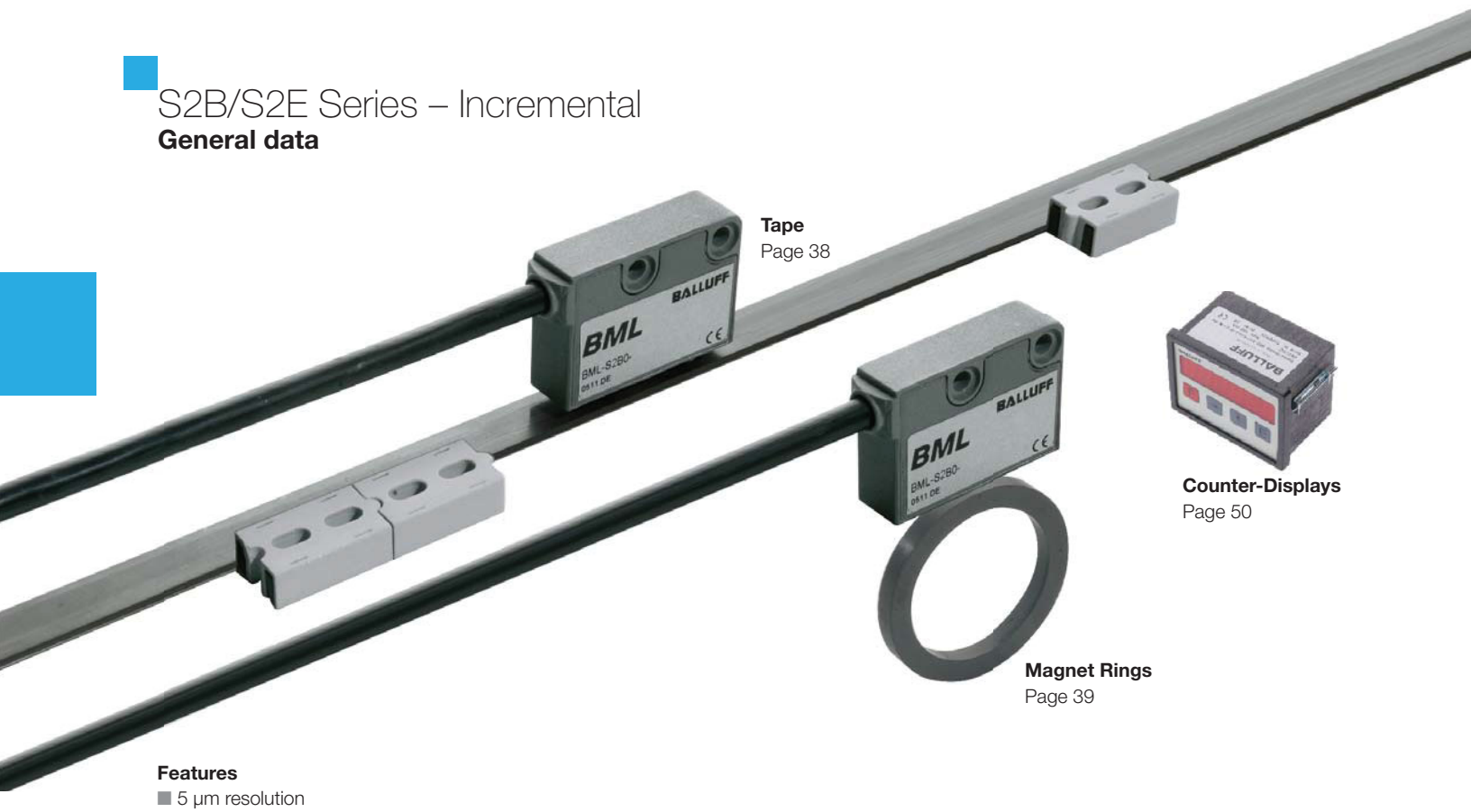
Magnetically Coded Position and Angle Measurement System

S2B/S2E/S1C series – incremental measurement

With the S2B/S2E/S1C sensor heads, the magnetically coded position and angle measurement system BML provides three systems for optimum adaptation to your measuring task.
Resolution and accuracy can be appropriately selected depending on the application. Integration of reference points is also possible.
All three systems have a compact design and the same dimensions throughout the series, making them extremely versatile to integrate.

S2B/S2E/S1C Series – Incremental
Contents

S2B/S2E Series – Incremental
General data



Tape
Page 38

Counter-Displays
Page 50

Magnet Rings
Page 39

Features
- 5 µm resolution
- System accuracy to ±50 µm
- High repeat accuracy ±1 increment
- 20 m/s maximum travel speed
- Digital square-wave signals RS422 or 10 to 30 V
- Two freely positionable limit switches
- Reference signal
- LED display for reference signal

System selection
Relationship between resolution, edge separation and speed
Selection guide, see page 41

Ordering example: sensor head

BML-S2E0-Q_ _ _-M4_ _-_-0-_ _ _ _
BML-S2B0-Q_ _ _-M4_ _-_-0-_ _ _ _

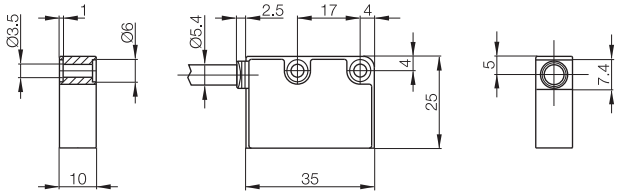
Operating voltage		Output voltage		Resolution		Reference signal		Limit switch		Min. edge separation		Connection	
5	10...30 V	1	Digital square-wave signal RS422	F	5 µm	0	None	0	No limit switch	D	0.12 µs	KA02	PUR cable 2 m
6	5 V	3	Level same as supply voltage (only for 10...30 V)	G	10 µm	1	Individually or fixed-periodic	3	Two limit switches (including 1 set of magnets)	E	0.29 µs	KA05	PUR cable 5 m
				H	25 µm	2	Pole-periodic			F	0.48 µs	KA10	PUR cable 10 m
				K	50 µm					G	1 µs	KA15	PUR cable 15 m
										H	2 µs	KA20	PUR cable 20 m
										K	4 µs		
										L	8 µs		
										N	16 µs		
										P	24 µs		

Preferred models
- **BML-S2B0-Q53F-M410-D0-KA05 (BML0211)**
  Digital signal, 10 to 30 V, with reference signal, 5 m cable, resolution 5 µm, edge separation 0.12 µs, max. travel speed 20 m/s
- **BML S2E0-Q53G-M410-P0-KA05 (BML00JC)**
  Digital signal, 10 to 30 V, with reference signal, 5 m cable, resolution 10 µm, edge separation 24 µs, max. travel speed 26 cm/s
- **BML S2E0-Q61F-M410-G0-KA05 (BML001E)**
  Digital signal, 5 V, with reference signal, 5 m cable, resolution 5 µm, edge separation 1 µs, max. travel speed 3.25 m/s

S2B/S2E Series – Incremental
General data

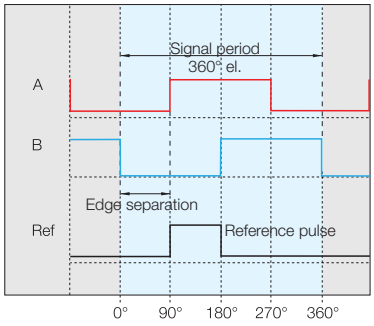
Series	BML-S2B0-...	BML-S2E0-...
Output signal	Digital square-wave signals	Digital square-wave signals
Resolution	5 µm, 10 µm, 25 µm or 50 µm	5 µm, 10 µm, 25 µm or 50 µm
Part number	BML-S2B0-Q_ _ _-M4_ _-_0-_ _ _ _	BML-S2E0-Q_ _ _-M4_ _-_0-_ _ _ _
Output voltage (A/B/Z)	RS422 to DIN 66259 or same as operating voltage 10...30 V (without Ā/B̄/Z̄)	RS422 to DIN 66259 or same as operating voltage 10...30 V (without Ā/B̄/Z̄)
Overall system accuracy	±50 µm	±100 µm
Supply voltage	10...30 V or 5 V ±5%	10...30 V or 5 V ±5%
Current consumption at 5 V supply voltage	< 50 mA + current consumption of the controller (depending on internal resistance)	< 50 mA + current consumption of the controller (depending on internal resistance)
Current consumption at 10 to 30 V supply voltage	< 40 mA + current consumption of the controller (depending on internal resistance)	< 40 mA + current consumption of the controller (depending on internal resistance)
Max. read distance sensor/tape	2 mm	2 mm
Max. traverse speed	20 m/s	20 m/s
Operating temperature	–20...+80 °C	–20...+80 °C
Housing material	PBT	PBT
Degree of protection	IP 67	IP 67

All specifications in conjunction with tape BML-...-I45-... (BML-S2B0...) or BML-...-I46-... (BML-S2E0...) at a read distance of 1 mm (see page 38).

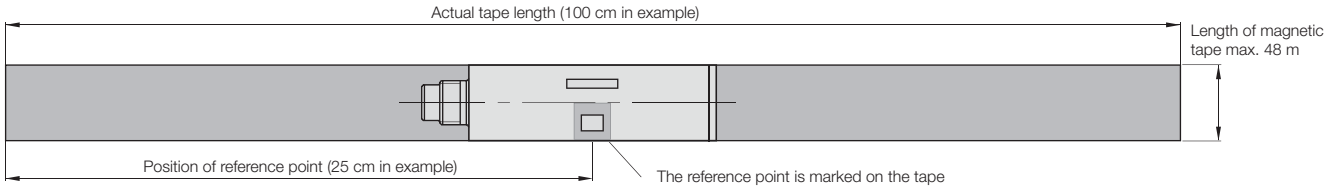


Digital square-wave signals RS422

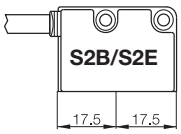
- RS422 square-wave signals in acc. with DIN 66259
- 90° phase shifted
- Edge separation A/B corresponds to the resolution of the sensor head
- Differential signal for RS422
- Terminating resistor ≥ 120 ohms (integrated in the evaluation unit)



Position of single reference point using example of BML-M02-I45-A0-M0100-R0025/0000



Typical position of reference points in sensor head



Fabricated magnetic tape, pole width 5 mm

BML-M_ _-I4_-A_-M_ _ _ _-_ _ _ _ _

Design

02 1.55 mm thick, with adhesive strip
03 1.35 mm thick, without adhesive strip

Accuracy class

5 18 µm, overall accuracy ±50 µm
6 50 µm, overall accuracy ±100 µm (S2E... and S1C... only)

Cover strip

3 With cover strip
0 Without cover strip

Length in cm

Order length, max. 4800 = 48 m

Reference point positions

R0000	None or pole-periodic
Rxxxx/ 0000	Position of 1 reference point in cm
Rxxxx/ yyyy	Position of no more than 2 reference points in cm
C0006/ yyyy	Fixed-periodic all yyyy cm, 0005, 0010

* Fixed-periodic reference point only for type BML-M02-I45-...

Ordering example: Magnetic tape by the roll, pole width 5 mm

BML-M02-I4_-A0-T_ _ _ _-R0000

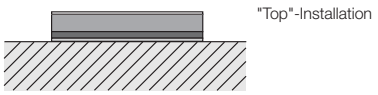
Accuracy class

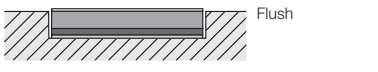
4 18 µm, overall accuracy ±50 µm
5 50 µm, overall accuracy ±100 µm
(Better accuracy classes available on request)

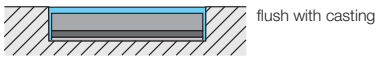
Length

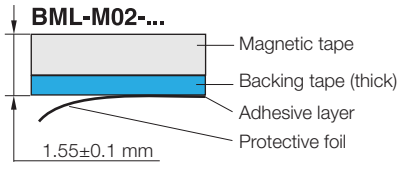
0500	5 m
1000	10 m
2400	24 m
4800	48 m

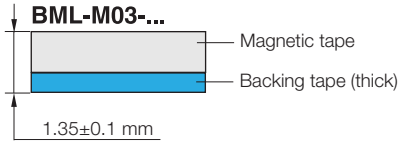
Magnetic tape mounting options





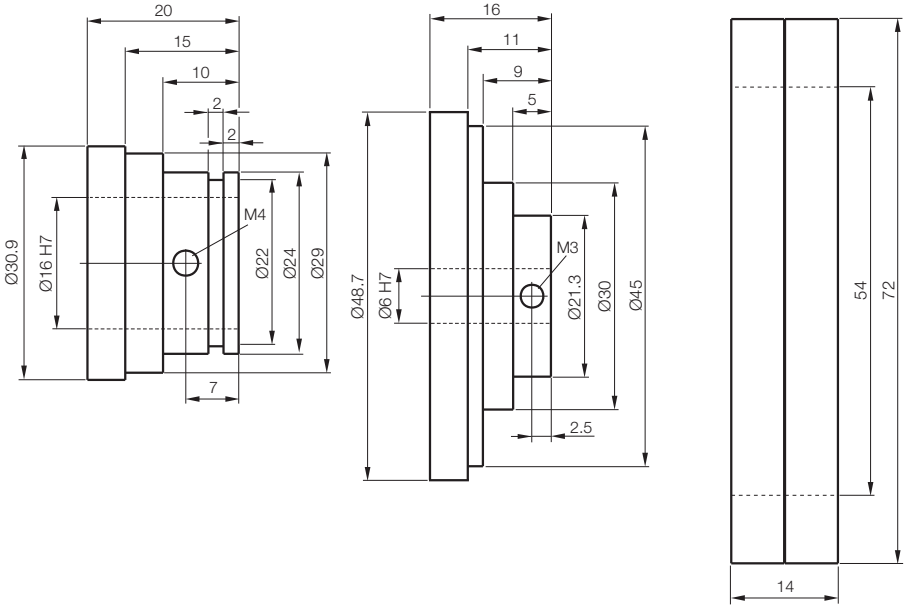






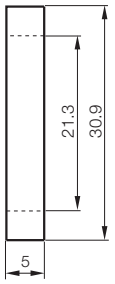
Magnet rings

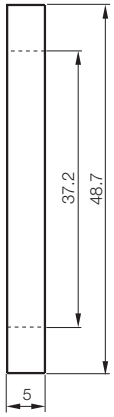
Series	Sensor range B/C/E	Sensor range B/C/E	Sensor range B/C/E
Ordering code	**BML002T**	**BML002R**	**BML002P**
Part number	BML-M22-I40-A0-M031/016-R0	BML-M21-I40-A0-M048/006-R0	BML-M20-I40-A0-M072/054-R1
Number of poles	20	32	46
Pole width	5 mm	5 mm	5 mm
With reference mark	no	no	yes
Material	Hard ferrite/aluminum	Hard ferrite/aluminum	Hard ferrite

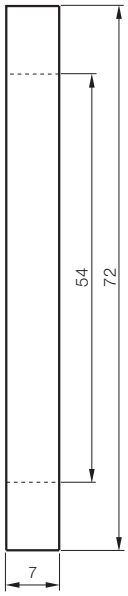


Magnet rings

Series	Sensor range B/C/E	Sensor range B/C/E	Sensor range B/C/E
Ordering code	**BML002L**	**BML002M**	**BML002N**
Part number	BML-M20-I40-A0-M031/021-R0	BML-M20-I40-A0- M048/037-R0	BML-M20-I40-A0-M072/054-R0
Number of poles	20	32	46
Pole width	5 mm	5 mm	5 mm
With reference mark	no	no	no
Material	Hard ferrite	Hard ferrite	Hard ferrite







The BML system allows precision adaptation to the relevant application. Balluff offers a technical selection guide that provides valuable assistance. For additional examples, see Basic Information and Definitions on page 54.

Selecting a suitable controller

Each sensor with a digital output signal has a characteristic minimum edge separation gap that the higher-level controller must reliably detect. We therefore recommend selecting a controller with a counting frequency that is higher than the theoretically calculated counting frequency.

Please use the following formula to select a suitable controller:

$$\text{Counting frequency of the controller} \geq \frac{1}{\text{Min. edge separation}}$$

Example: If the sensor has a minimum edge separation of 1 µs, then a controller capable of detecting at least 1 MHz must be selected based on the above formula.

Maximum travel speed, resolution and edge separation

The following tables show the relationship between the selected resolution of the sensor head, the minimum edge separation and the potential travel speed:

Min. edge separation		V_{max} in accordance with edge separation and resolution Mechanical resolution			
		F 5 µm	**G** 10 µm	**H** 25 µm	**K** 50 µm
D	0.12 µs	20 m/s	20 m/s	20 m/s	20 m/s
E	0.29 µs	10 m/s	20 m/s	20 m/s	20 m/s
F	0.48 µs	5 m/s	10 m/s	20 m/s	20 m/s
G	1 µs	3.25 m/s	6.5 m/s	14.75 m/s	14.75 m/s
H	2 µs	1.5 m/s	3 m/s	7.7 m/s	7.7 m/s
K	4 µs	0.75 m/s	1.5 m/s	3.95 m/s	3.95 m/s
L	8 µs	0.375 m/s	0.75 m/s	1.7 m/s	1.7 m/s
N	16 µs	0.195 m/s	0.395 m/s	0.95 m/s	0.95 m/s
P	24 µs	0.13 m/s	0.26 m/s	0.65 m/s	0.65 m/s

Table 1: Selection guide for maximum travel speed of the S2B/S2E series

Rotary applications

The BML system allows precision adaptation of rotary tapes to the relevant application.
Balluff offers a technical selection guide for rotary systems that provides valuable assistance.

Determining the pulses per rotation

The number of required pulses per rotation varies depending on the application. It determines the resolution of the sensor head and the diameter of the magnet ring.

Sensor head resolution	Pulses/revolution with 4-fold evaluation Ø of magnet ring, outside		
	31 mm	**49 mm**	**72 mm**
Ordering code	**BML002T BML002L**	**BML002R BML002M**	**BML002P BML002N**
F = 5 µm	20000	32000	46000
G = 10 µm	10000	16000	23000
H = 25 µm	4000	6400	9200
K = 50 µm	2000	3200	4600

Table 2: Selection guide for magnetic rings from the S2B/S2E series

Maximum speed

The BML system enables the detection of rotary movements. The speed and the diameter of the magnetic ring determine the speed of the ring on the sensor head.
The maximum travel speed that the sensor can still identify depends on the resolution and the edge separation of the sensor head. Resolution and edge separation can be selected. A maximum speed is then calculated using the following formula:

$$\text{Max. speed (rpm)} = \frac{60 \times \text{max. travel speed (m/s)}}{\pi \times \text{magnet ring diameter (m)}}$$

Refer to Table 1 for the maximum travel speed. When selecting a maximum speed for the application, we recommend using a value 10% lower than this value.
Example:
You are using a BML-S2B sensor with a resolution of 5 µm (F) and a minimum edge separation of 1µs (G). For this sensor, Table 1 gives a maximum travel speed of 3.25 m/s.
If the magnetic ring diameter is 48 mm = 0.048 m, a speed of 1293 rpm can be achieved using the formula. With consideration for the reduced value, the speed should not exceed 1164 rpm.

Tape
Page 44

Magnet Rings
Page 45

Counter-Displays
Page 50

Features
- 0.1 mm resolution
- High repeat accuracy ±1 increment
- 10 m/s maximum travel speed
- Gap between sensor and tape up to 2 mm
- Digital square wave signals, output voltage 10 to 30 V (HTL)
- Cable connection
- 10 to 30 V DC supply voltage

System selection
Relationship between resolution, edge separation and speed
Selection guide, see page 47.

Ordering example: sensor head

BML-S1C0-Q53_-M400-_0-KA_ _

Resolution	Max. edge separation	Connection
L 100 µm	M 10 µs	KA02 PUR cable 2 m
M 200 µm	R 100 µs	KA05 PUR cable 5 m
N 500 µm		KA10 PUR cable 10 m
P 1000 µm		KA15 PUR cable 15 m
R 2000 µm		KA20 PUR cable 20 m

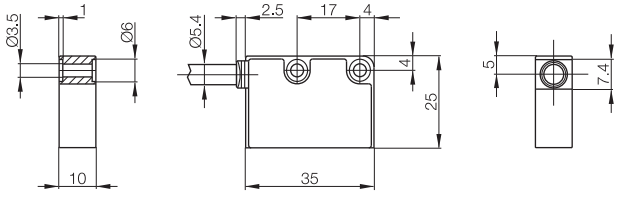
Sensor connectors (e.g. SUB-D or M12 connectors) are available on request.

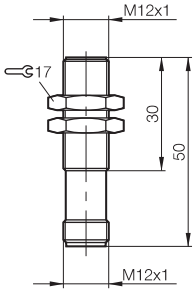
Preferred type
- **BML S1C0-Q53L-M400-M0-KA05 (BML0034)**
  Digital signal, 10 to 30 V, 5 m cable, resolution 0.1 mm, edge separation 10 µs, max. travel speed up to 8 m/s

S1C Series – Incremental
General data

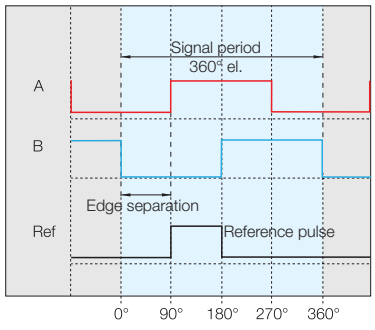
Series	BML-S1C0-...	BMF 12M-...
Output signal	Digital square-wave signals	PNP/NPN normally open
Resolution	100 µm, 200 µm, 500 µm, 1000 µm or 2000 µm	
Switching output		Per pole width 5 mm
Ordering code		**BMF0022**
Part number	BML-S1C0-Q53_-M400-_0-KA_ _	BMF 12M-PS-D-2-S4 (PNP normally open)
Ordering code		**BMF0021**
Part number		BMF 12M-NS-D-2-S4 (NPN normally open)
Output voltage (A/B)	Same as operating voltage 10...30 V	Supply voltage $-U_d$
Overall system accuracy	±100 µm	> ±5 mm
Supply voltage	10...30 V	10...30 V DC
Voltage drop U_d		≤ 3.15 V
Current consumption at 10 to 30 V supply voltage	< 40 mA + current consumption of the controller (depending on internal resistance)	200 mA
Max. read distance sensor/tape	2 mm	2 mm
Max. travel speed	10 m/s	7 kHz
Operating temperature	–20...+80 °C	–25...+85 °C
Housing material	PBT	Brass-coated
Degree of protection	IP 67	IP 67

All data applies in conjunction with tape BML-...-I46-... at a read distance of 1 mm (see page 44).





Digital square-wave signals HTL
- Square-wave signals HTL
- 90° phase-shifted
- Edge separation A/B corresponds to the resolution of the sensor head
- Terminating resistor ≥ 120 ohms (integrated in the evaluation unit)
- Without reference pulse



Magnetic tape

Ordering example:
Fabricated magnetic tape, pole width 5 mm

BML-M_ _-I4_-A_-M_ _ _ _-R0000

Design

02 1.55 mm thick, with adhesive strip
03 1.35 mm thick, without adhesive strip

Accuracy class

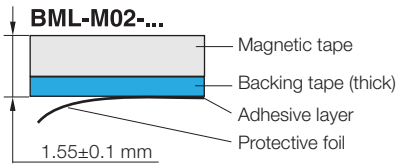
6 50 µm, overall accuracy ±100 µm

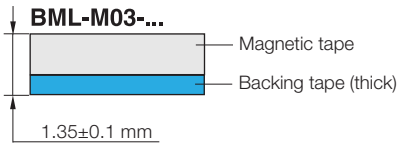
Cover strip

3 With cover strip
0 Without cover strip

Length in cm

Order length, max. 4800 = 48 m





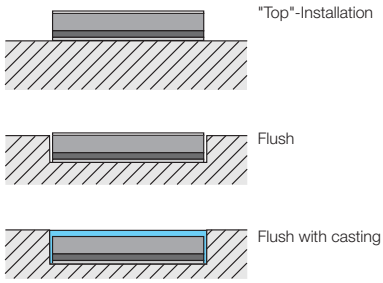
Ordering example:
Magnetic tape by the roll, pole width 5 mm

BML-M02-I46-A0-T_ _ _ _-R0000

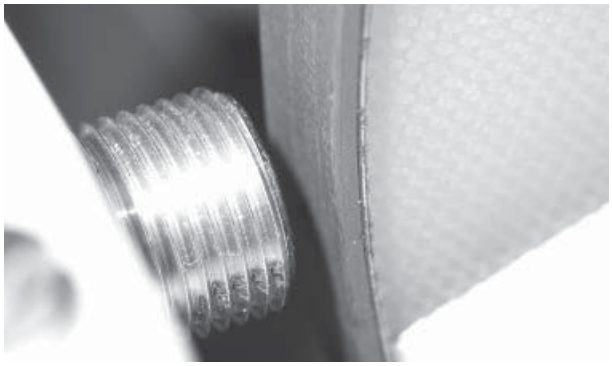
Length

0500 5 m
1000 10 m
2400 24 m
4800 48 m

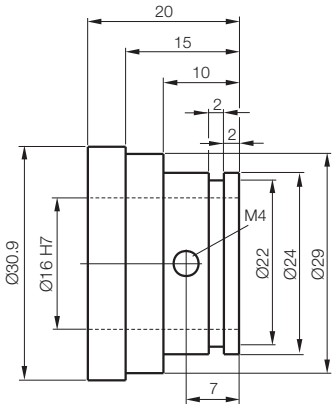
Magnetic tape mounting options
(also in magnetizable material)

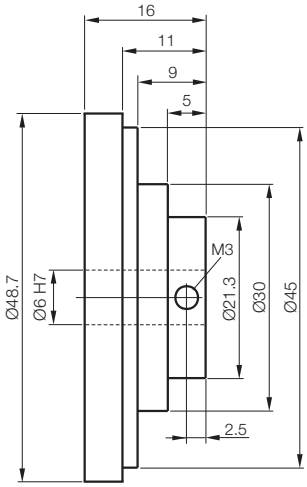


BMF 12M-PS-D-2-S4
Speed monitoring in rotary applications:
Simply more cost-effective.
Designed for the B/C/E sensor family, the magnet rings and magnetic tapes shown here allow you to measure speed by means of switching magnetic field sensors from the BMF series. With its standard M12 thread, the BMF 12M-PS-D-2-S4 sensor can be installed in a wide range of applications. and can be installed as close as 2 mm from the magnet. A pulse signal that reflects the rotary speed is present at the switching output. The sensor can detect frequencies up to 7 kHz, therefore speeds of up to about 20,000 rpm are possible, depending on the selected tape.

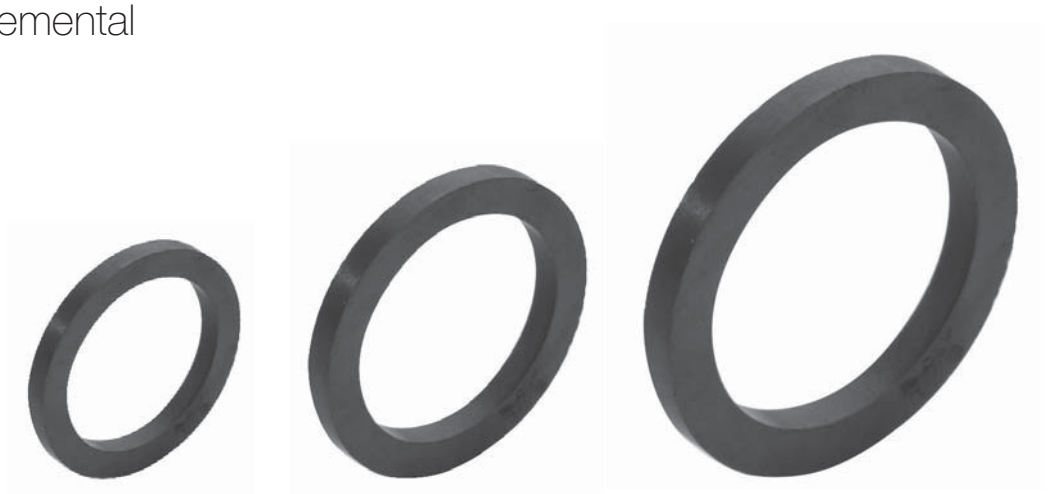


Series	Sensor range B/C/E	Sensor range B/C/E
Ordering code	**BML002T**	**BML002R**
Part number	BML-M22-I40-A0-M031/016-R0	BML-M21-I40-A0-M048/006-R0
Number of poles	20	32
Pole width	5 mm	5 mm
With reference mark	no	no
Material	Hard ferrite/aluminum	Hard ferrite/aluminum

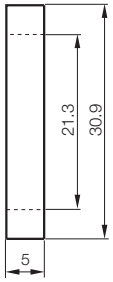


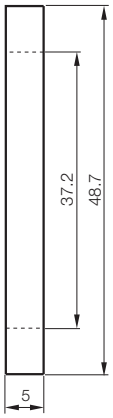


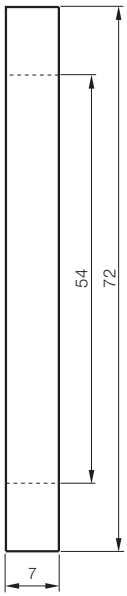
Magnet rings



Series	Sensor range B/C/E	Sensor range B/C/E	Sensor range B/C/E
Ordering code	**BML002L**	**BML002M**	**BML002N**
Part number	BML-M20-I40-A0-M031/021-R0	BML-M20-I40-A0-M048/037-R0	BML-M20-I40-A0-M072/054-R0
Number of poles	20	32	46
Pole width	5 mm	5 mm	5 mm
With reference mark	no	no	no
Material	Hard ferrite	Hard ferrite	Hard ferrite







The BML system allows precision adaptation to the relevant application. Balluff offers a technical selection guide that provides valuable assistance. For additional examples, see Basic Information and Definitions on page 54.

Selecting a suitable controller

Each sensor with a digital output signal has a characteristic minimum edge separation gap that the higher-level controller must reliably detect. We therefore recommend selecting a controller with a counting frequency that is higher than the theoretically calculated counting frequency.

Please use the following formula to select a suitable controller:

$$\text{Counting frequency of the controller} \geq \frac{1}{\text{Min. edge separation}}$$

Example: The sensor has a minimum edge separation of 1µs. Then the outcome, according to the formula above, is a controller that can detect at least 1 MHz.

Maximum travel speed, resolution and edge separation

The following tables show the relationship between the selected resolution of the sensor head, the minimum edge separation and the potential travel speed:

Min. edge separation		V_{max} in accordance with edge separation and resolution Mechanical resolution				
		L 100 µm	**M** 200 µm	**N** 500 µm	**P** 1000 µm	**R** 2000 µm
M	10 µs	8 m/s	10 m/s	10 m/s	10 m/s	10 m/s
R	100 µs	0.9 m/s	1.8 m/s	4.2 m/s	8.8 m/s	10 m/s

Table 1: Selection guide for maximum travel speed of the S1C series

Rotary applications

The BML system allows precision adaptation of rotary tapes to the relevant application.
Balluff offers a technical selection guide for rotary systems that provides valuable assistance.

Determining the pulses per rotation

The number of required pulses per rotation varies depending on the application. It determines the resolution of the sensor head and the diameter of the magnet ring.

Sensor head resolution	Pulses/revolution with 4-fold evaluation Ø of magnet ring, outside		
	31 mm	**49 mm**	**72 mm**
Ordering code	**BML002T** **BML002L**	**BML002R** **BML002M**	**BML002N**
L = 100 µm	1000	1600	2300
M = 200 µm	500	800	1150
N = 500 µm	200	320	460
P = 1000 µm	100	160	230
R = 2000 µm	50	80	115

Table 2: Selection guide for magnetic rings from the S1C series

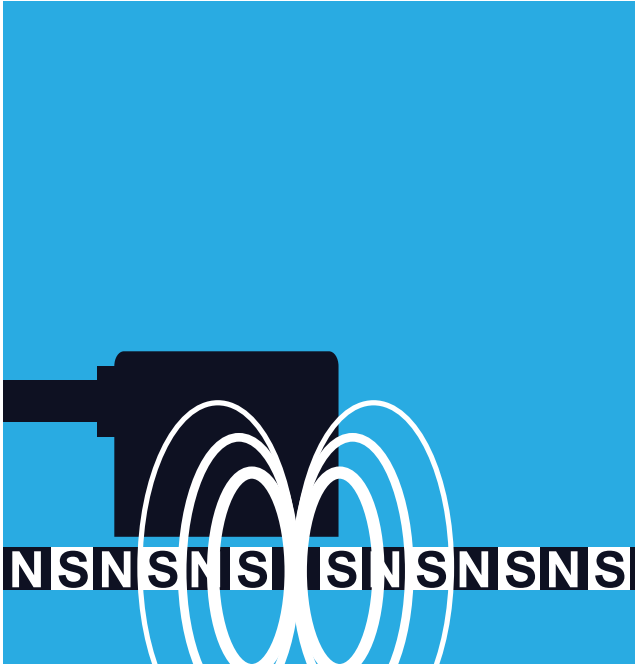
Maximum speed

The BML system enables the detection of rotary movements. The speed and the diameter of the magnetic ring determine the speed of the ring on the sensor head.
The maximum travel speed that the sensor can still identify depends on the resolution and the edge separation of the sensor head. Resolution and edge separation can be selected. A maximum speed is then calculated using the following formula:

$$\text{Max. speed (rpm)} = \frac{60 \times \text{max. travel speed (m/s)}}{\pi \times \text{magnet ring diameter (m)}}$$

Refer to Table 1 for the maximum travel speed. When selecting a maximum speed for the application, we recommend using a value 10% lower than this value.

Example:
You are using a BML-S1C sensor with a resolution of 100 µm (L) and a minimum edge separation of 10 µs (M). For this sensor, Table 1 gives a maximum travel speed of 8 m/s.
If the magnet ring diameter is 48 mm = 0.048 m, a speed of 3183 rpm can be achieved according to the formula.
With consideration for the reduced value, the speed should not exceed 2865 rpm.



Magnetically Coded Position and Angle Measurement System

Accessories

Counters and displays are available for all series to integrate the sensor systems perfectly into your application.
The range of sensor guides enables you to integrate robust, high-precision measurement systems even where there is no optimum guide.

Accessories
Contents

Magnetically Coded Position and Angle Measurement System: Measuring and displaying speeds

Speed detection of shafts and spindles as well as simple rotary encoder tasks can be optimally implemented with the combination of BML, BDD, and the magnet ring tapes.

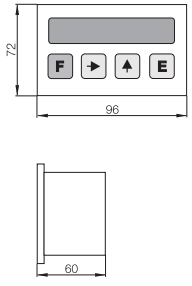
Series		
Interface		
Ordering code		
Part number		
Ordering code		
Part number		
Ordering code		
Part number		
Functions		
Features		
Use		

* Power supply unit for connecting to 115 V/230 V, for example, BAE00EN on page 355.

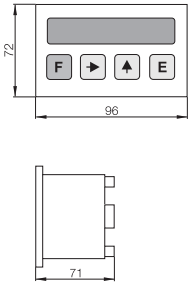



	BDD 610	**BDD 611/BDD 622/BDD 632**
	Single-axis counter for BML-S2B..., BML-S1C... and BML-S2E...	Single- or multi-axis counter 1, 2, 3 for all BML-Sxx...
	BAE004J	**BAE004K**
	BDD 610-R3Q3-0-53-N-00 (2 dig. inputs)	BDD 611-R3Q4-0-52-N-00 (1 axis)
	BAE004H	**BAE004M**
	BDD 610-R3Q3-0-51-N-00 (2 dig. outputs)	BDD 622-R3Q4-0-52-N-00 (2 axes)
		BAE004P
		BDD 632-R3Q4-0-52-N-00 (3 axes)
	■ Set value ■ Actual value memory ■ Factor calculation ■ Count direction reversal ■ Up to 3 decimal places ■ Assignable key functions ■ Reset and set logic ■ Logic for inputs and outputs ■ Security code	■ Set value ■ Actual value memory ■ Factor calculation ■ Edge evaluation ■ Count direction reversal ■ Up to 3 decimal places ■ Assignable key functions ■ Reset and set logic ■ Absolute and incremental measurement ■ Offset logic ■ Sawtooth correction ■ Logic for inputs and outputs ■ Security code ■ Reference pulse
	■ Power supply 24 V DC* ■ 1×6-decade LED display ■ Digit height 14 mm ■ Incremental measuring system with tracks A, B ■ max. 25 kHz ■ 2 digital inputs (-51-) ■ 2 digital outputs (-53-)	■ Power supply 24 V DC* ■ 1×6/2×6/3×6-decade LED display ■ Incremental measuring system with A, Ā, B, B̄, Z, Z̄ or A, B, Z ■ Digit height 14 mm ■ 4 digital inputs ■ 2 digital outputs ■ Min. edge separation with 4-fold evaluation: 250 µs ■ BDD 611: max. input frequency: Signal A or B: 1 MHz
	for BML-S2B0..., BML-S2E0... and BML-S1C0-..., min. edge separation Code M, N, P, R	For BML with supply voltage 5 V/10 to 30 V, output voltage RS422/HTL, min. edge separation Code E, F, G, H, K, L, M, N, P, R

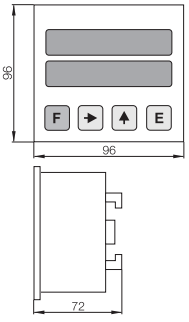
BDD 610



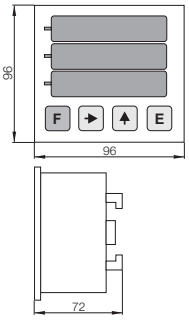
BDD 611



BDD 622



BDD 632



The sensor guide consists of an aluminum rail that retains the magnetic tape and a carriage with runners that guides the sensor head accurately. A standard control arm is used for the mechanical connection.

Features

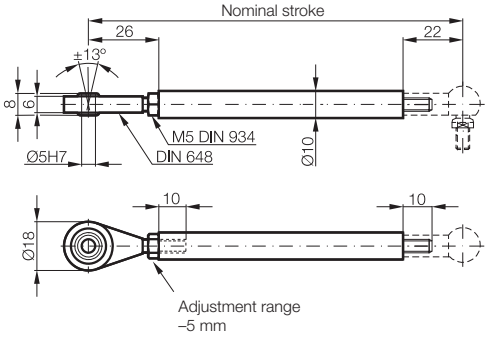
- Customized lengths
- Easily attached by directly screwing on or using mounting elements
- Rails can be mounted side by side and elements disassembled
- Connection of drag chains possible
- Flat design, minimal space requirements
- Low costs
- Runners need no lubrication, thus no maintenance costs
- Minimum stock-keeping, since the universal concept works for various sensor heads
- Mounting aid for easy installation of the magnetic tape

Sensor guide	
Ordering code	
Part number	
Features	

You may cover the magnetic tape with a stainless steel cover strip to protect it from damage caused by chips or chemicals.
Note that the permissible air gap between the sensor head and tape is reduced by the thickness of the cover strip with adhesive film (0.15 mm).

- Cover strip and magnetic tape can be ordered together in matching lengths (see tapes on page 30, 38, or 44).
- Cover strip by the roll can be ordered in 4 defined lengths.

Accessories	Joint rod for BML-C01, BML-C02	
Ordering code	e.g. **BAM000P** (100 mm)	
Part number	BTL2-GS10-_ _ _ _-A	
Use	For connecting the sliding carriage to the machine	



Accessories
Sensor guide

Guide rail
for sliding carriage BML-C01, BML-C02
e.g. **BAM04N4** (3 m)
BML-R01-M_ _ _

- Anodized aluminum
- Mounting holes
- Lateral groove for alternate mounting using brackets
- Mountable side by side
- Maintenance-free dry operation
- Lubricant-free
- Suitable for all linear tapes

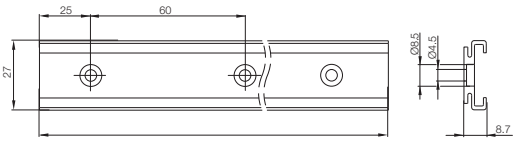
Sliding carriage
for sensors BML-S2B, BML-S2E, BML-S1C
BAM01MF
BML-C01

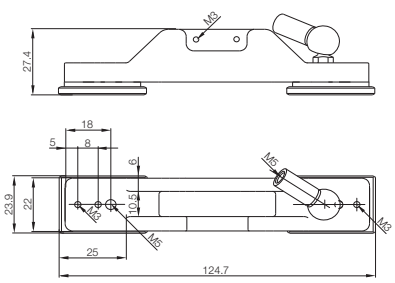
Aluminum

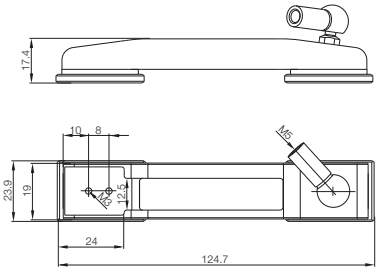
- Fully mounted with runners
- Connection for joint rod
- Connection for drag chains
- Maintenance-free dry operation
- Lubricant-free

Sliding carriage
for sensors BML-S1F
BAM01MH
BML-C02

- Aluminum
- Fully mounted with runners
- Connection for joint rod
- Connection for drag chains
- Maintenance-free dry operation
- Lubricant-free





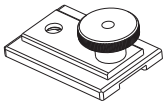


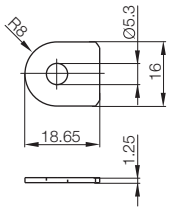
Mounting guide
BAM01L9
BML-Z0010
Installing the magnetic tape on BML-R01

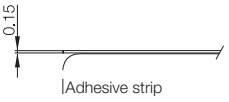
Brackets (2 pcs.)
for BML-R01
BAM01JL
BML-Z0008
For lateral mounting of the rail and at transition points

Cover strip from the roll
for BML-M02, BML-M03
e.g. **BML001K** (10 m)
BML-A013-T_ _ _ _

0500	1000	2400	4800
5 m	10 m	24 m	48 m







Magnetically Coded Position and Angle Measurement System

Basic Information and Definitions
Contents

Definitions

System accuracy

The accuracy of the sensor head depends largely on mechanical manufacturing tolerances and component tolerances; the accuracy of the tape is determined by the material quality and the magnetization grade.

The overall system accuracy or linearity class describes the deviations of the measured value from the real actual value. It contains the position deviations within any meter of the measurement section (or, when rotary: a rotation).

Accuracy of the tape BML-M02-I34

± 8 µm

+

Accuracy of the sensor head BML-S1F...

± 2 µm

=

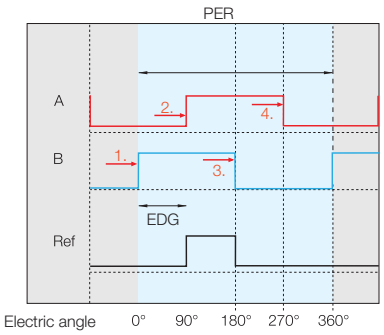
± 10 µm

4x evaluation

With 4-fold evaluation, the controller counts every 4 edge changes within a signal period. A signal period = 4x selected resolution.

Example:
Sensor head 1 µm resolution, magnet ring with 384 poles (1 mm).

4 edges (each 1 µm) per signal cycle
= 4 µm period length
= 250 periods per pin
= 96,000 periods per 360°
(384,000 pulses per 360°)



PER = a signal period
EDG = Edge separation

Edge separation

With 4-fold evaluation, the following applies (each edge is counted):

$$\text{Period length} = \frac{\text{Counting frequency}}{4}$$

$$\text{Counting frequency of the controller} \geq \frac{1}{\text{Min. edge separation}}$$

Example:
Edge separation = 1 µs
Counting frequency = 1 MHz
Period length = 250 kHz

Important!
The controller/display must be able to count the minimum time-based edge separations shown in the tables (note the counting frequency of your controller).
The minimum edge separation may occur even when the system is at rest due to the internal interpolation procedure.
Always select the next higher travel speed or the next faster minimum edge separation; otherwise, during the evaluation by the controller, errors can arise in the position determination.

Repeat accuracy

Repeat accuracy is the value resulting when moving to the same position from the same direction under unchanging ambient conditions.

Incremental

After the system is switched on, the measured value currently available is not defined. A reference run to a defined point, a reference point, is necessary in order to obtain a position value. The position value is calculated by adding or subtracting single identical increments from the reference point.

Absolute

The measured value for the current position is available immediately after the system is switched on. Each position, e.g. a measurement section, is assigned an absolute, coded digital signal or an analog value. A reference run is not required.

Temperature coefficient

The temperature coefficient indicates the relative change in length as temperature changes. This means that temperature factors change the measured value by the indicated amount.

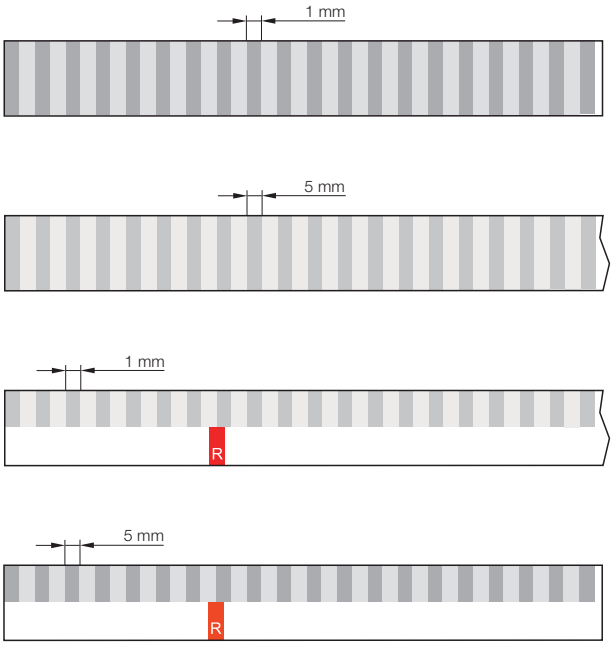
Sampling rate

The measurement rate is the frequency at which the output position information is updated. It can be the same as the number of measurements per second. A high sampling rate for rapidly changing positions is important when the process is time-critical.

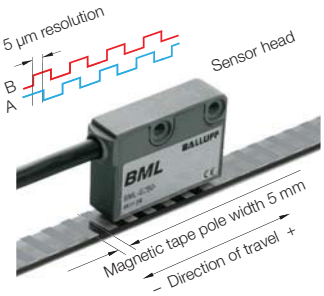
Tape, pole width

On the magnetic tape, there is a track with alternating magnetic north and south poles. In some variants, a second track with reference points is available.

The magnetic tape exists in 1 mm (BML-M...-I3_-...) and 5 mm (BML-M...-I4_-...) pole width.



The magnetic tape exists in various versions. You therefore have to take care that the magnetic tape and sensor head fit together.

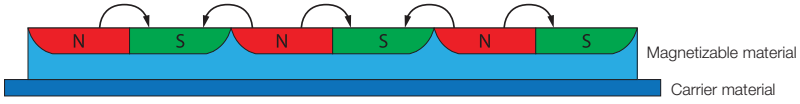


Interpolation

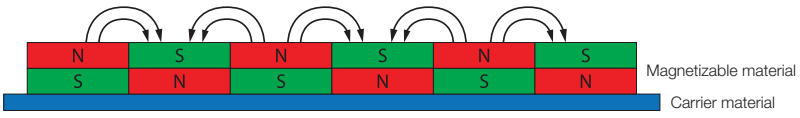
The magnetic period of the tape is interpolated by the sensor head with integrated interpolator with up to 10-bit (factor 1000).

Permagnet® perpendicular magnetic tape

Standard magnetic tape



Permagnet® perpendicular magnetic tape



+ larger field strength
+ better accuracy

Reference point function

For each incremental encoder system, the reference position is essential as a starting point for the counting.
How the reference point is determined depends on the sensor head, the magnetic tape and the controller itself.
Advantages of the pole-periodic and fixed-periodic tapes: The tape can be bought in great lengths and cut to size by the customer.
The reference point functions are possible with linear and with round tapes (rings, only with sensor head BML-S2B/E, BML-S1F...).

Relationship between resolution, speed and edge separation (examples)

Sensor head design for controller with 4-fold evaluation:

Example 1: Resolution needed: F = 5 µm
- In table 1 on page 41 Select column 1.
  Max. travel speed = 7 m/s
- Select line 2 = 10 m/s.
  ➔ Edge separation E = 0.29 µs

Example 2: Resolution needed: G = 10 µm
- In table 1 on page 41 Select column 2.
  Max. counting frequency of the controller = 0.5 m/s
  edge separation H = 2 µs
- Select line 5.
  ➔ Maximum possible travel speed: 3 m/s

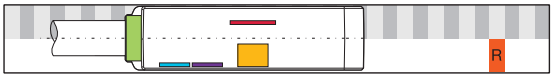
Example 3: Max. travel speed = 2 m/s
Controller detects min. edge separation M = 10 µs
- In table 1 on page 47 Select line 1.
- Select column 1.
  ➔ Maximum possible resolution L = 100 µm (BML-S1C)

Edge separation (= pulse width) min. edge separation [µs]		Controller identifies at least Max. counting frequency [kHz][1)]	Controller has the min. scan rate [kHz]
D	0.12	8,333	16,667
E	0.29	3,448	6,897
F	0.48	2,083	4,167
G	1	1,000	2,000
H	2	500	1,000
K	4	250	500
L	8	125	250
M	10	100	200
N	16	63	125
P	24	42	83
R	100	10	20

Table 1: Relationship of edge separation – counting frequency
[1)] Signal period = 1/4 × counting frequency

Single or double reference signal

System consisting of:
- BML-S_B/E…-M41_-…
  or BML-S1F...-M31...
- Tape BML-M…-I_ _-…-R_ _ _ _/0000 (single signal) or
  BML-M…-I_ _-…-R_ _ _ _/_ _ _ _ (double signal)

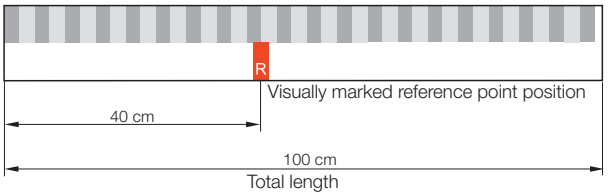


A sensor head with an additional reference point sensor can output a reference point signal as soon as it reaches the magnetically encoded reference point on the second track of the tape. No external reference switch is necessary.

Single reference point magnetic tape type BML-M...-R_ _ _ _ /0000

For the magnetic tape with single reference point, the reference point may be integrated as desired at any location. To determine the exact absolute position, the reference run must cover the entire length of the tape up to the reference point.

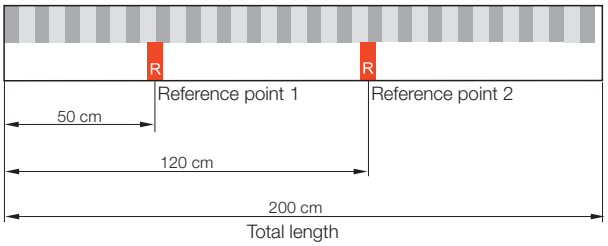
Ordering example for the tape shown below:
BML-M02-I45-A0-M0100-R0040/0000



Magnetic tape with two reference points, type BML-M...-R_ _ _ _ /_ _ _ _

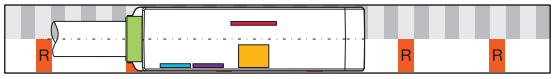
For the magnetic tape with two reference points, the reference point may be integrated as desired at any location. To determine the exact position, the reference run must cover the entire length of the tape up to the external selection switch. The external selection switch decides on the use of Z signals.

Ordering example for the tape shown below:
BML-M02-I46-A0-M0200-R0050/0120



Fixed-periodic reference signals

System consisting of:
- BML-S_B/E…-M41_-…
  or BML-S1F...-M31...
- Tape BML-M…-I_ _-…-C0006/_ _ _ _

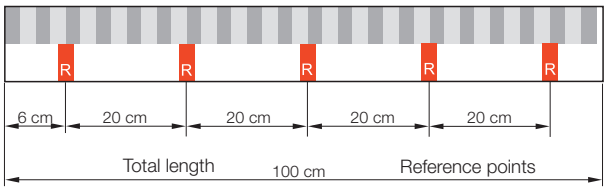


The sensor head with an additional reference point sensor can also be combined with a magnetic tape with fixed-periodic reference points. Here the reference points are integrated across the entire length of the tape at certain constant intervals, such as every 10 cm. To determine the exact position, the reference run must go to the external selection switch.

Magnetic tape with fixed-periodic reference points, type BML-M...-C0006/_ _ _ _

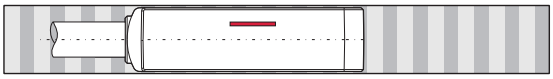
For magnetic tapes with fixed-periodic reference points, the reference points are integrated across the entire length of the tape at certain constant intervals, such as every 20 cm. To determine the exact position, the reference run must extend to the external selection switch, which decides on the use of the Z signals.

Ordering example for the tape shown below:
BML-M02-I34-A0-M0100-C0006/0020



No or pole-periodic reference signal

System consisting of:
- BML-S_B/C/E…-M40_-… (none)
  or BML-S_B/E…-M42_-… (pole-periodic)
  or BML-S1F...-M30...
  or BML-S1F...-M32...
- Tape BML-M…-I_ _-…-R0000

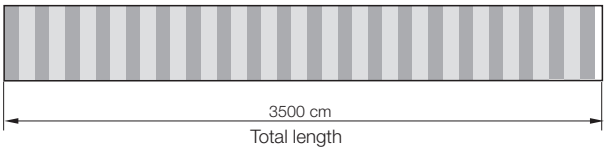


In the simplest position measuring system, the sensor head scans the magnetic periods with the incremental sensors. On the tape, there is a track with magnetic north and south poles. The position is determined by the controller by adding up the counted increments. With a pole-periodic reference point signal, with each magnetic pole, a reference point signal is output. In this case, an external reference switch has to be set on the selected reference point signal. The controller precisely evaluates the reference position when the switch and the reference point signal of the sensing head are active.

Pole-periodic magnetic tape, type BML-M...-R0000

The pole-periodic magnetic tape has alternating magnetic north and south poles, but no integrated reference point.

Ordering example for the tape shown below:
BML-M02-I34-A0-M3500-R0000



Maximum speed

The BML system enables the detection of rotary movements. The speed and the diameter of the magnetic ring determine the speed of the ring on the sensor head. The maximum travel speed that the sensor can still identify depends on the resolution and the edge separation of the sensor head. Resolution and edge separation can be selected. A maximum speed is then calculated using the following formula:

$$\text{Max. speed [rpm]} = \frac{60 \times \text{max. travel speed [m/s]}}{\pi \times \text{Magnetic ring diameter [m]}}$$

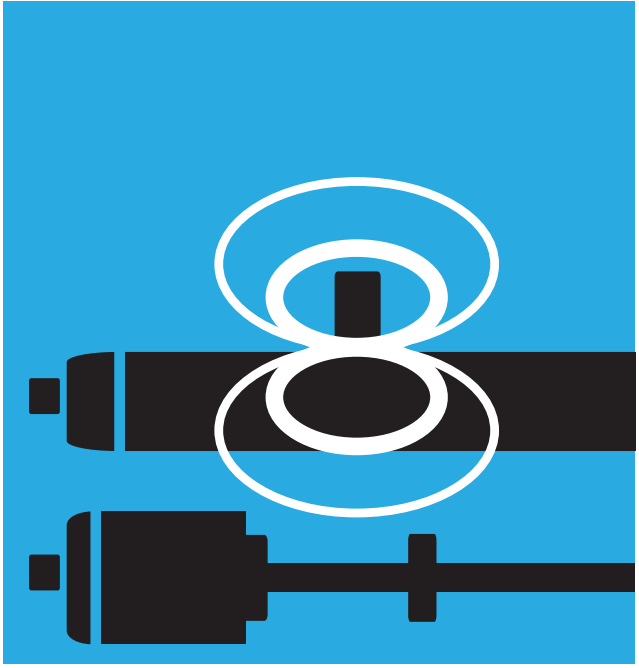
For the maximum travel speed and minimum edge separation, see table 1 on page 41 Recommendation: max. speed 10 % less than determined speed value.

Max. travel speed	RPM Outer diameter				
	31 mm	49 mm	72 mm	75.4 mm	122 mm
20 m/s	12,322	7795	5,305	5,066	3,131
14.75 m/s	9,087	5,749	3,913	3,736	2,309
10 m/s	6,161	3,898	2,653	2,533	1,565
8.8 m/s	5,422	3,430	2,334	2,229	1,378
8 m/s	4,929	3,118	2,122	2026	1,252
7.7 m/s	4,744	3,001	2042	1,950	1,205
6.5 m/s	4,005	2,533	1,724	1,646	1018
5 m/s	3,080	1949	1,326	1,266	783
4.2 m/s	2,588	1,637	1,114	1,064	657
3.95 m/s	2,434	1,540	1,048	1,001	618
3.25 m/s	2,002	**1267**[1)]	862	823	509
3 m/s	1,848	1169	796	760	470
1.8 m/s	1,109	702	477	456	282
1.7 m/s	1,047	663	451	431	266
1.5 m/s	924	585	398	380	235
0.95 m/s	585	370	252	241	149
0.9 m/s	554	351	239	228	141
0.75 m/s	462	292	199	190	117
0.65 m/s	400	253	172	165	102
0.395 m/s	243	154	105	100	62
0.375 m/s	231	146	99	95	59
0.26 m/s	160	101	69	66	41
0.195 m/s	120	76	52	49	31
0.13 m/s	80	51	34	33	20

[1)] see example below
Table 2: Maximum speed of rotary tape (magnetic ring)

Example

Sensor head BML-S2B… with a resolution of 5 µm (F) and a min. edge separation of 1 µs (G). From table 1 on page 41 for this sensor head, there is a max. travel speed of 3.25 m/s.
With a magnetic ring diameter of 49 mm = 0.049 m, according to the formula, a speed of 1,267 rpm can be reached (the value can also be read out in table 2 (column 49 mm/line 3.25 m/s)). Under consideration of the recommendation to stay 10 % below this, a speed of 1,140 rpm is not to be exceeded.



Micropulse Transducers

MICROPULSE®

Micropulse Transducers
Contents

Magnetostrictive position measuring systems are firmly entrenched in plant engineering and automation technology.
Areas of use in which high reliability and precision are in demand are typical application areas for magnetostrictive Micropulse Transducers. Integrated or compact versions with measuring lengths of 25 to 7,600 mm allow the position measuring systems to be used universally.
Non-contact, precise and absolute measuring are the critical features that have brought linear magnetostrictive sensors into widespread industrial use. The contactless and thus wear-free working method helps to prevent expensive service calls and the hassle of downtimes. The operating principle allows them to be installed in hermetically sealed housings, because the current position information is transferred to the sensor element on the inside without any contact using magnetic fields. The simultaneous measurement of multiple positions with one measuring system is also possible. Without inconvenient, high-effort and error-prone seal designs, magnetostrictive position measuring systems achieve a degree of protection from IP 67 to IP 67K. The high resistance with regard to shock and vibration stresses extend the industrial fields of application greatly into heavy machinery and system design. The measurement and position values, which are available as absolute values immediately after switching on the system, are required in many applications. Because the reference runs are omitted, machine availability is increased substantially.

MICROPULSE®

Accessories can be found on **page 233.**

Basic information and definitions can be found on **page 259.**

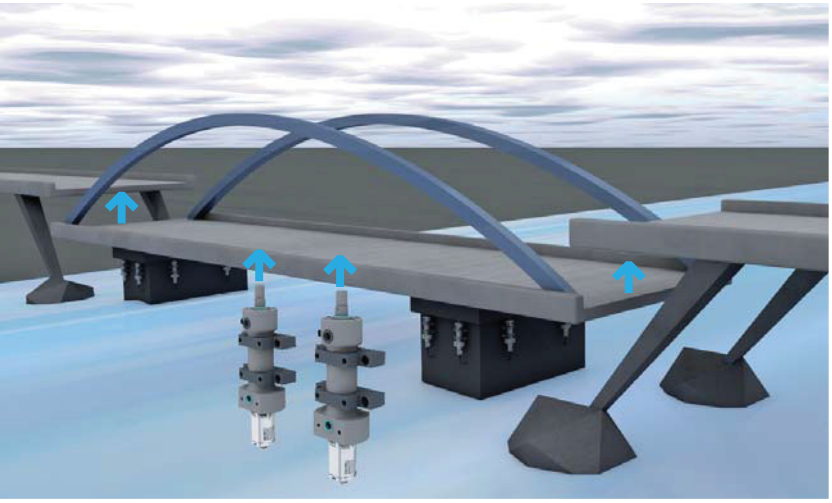
Micropulse Transducers
Applications

Areas of use in which high reliability and precision are in demand are typical application areas for Micropulse Transducers.
As integrated or compact versions with measuring lengths of 25 to 7,620 mm, Micropulse position measuring systems are able to be used universally.
The non-contact working principle of the systems guarantees complete freedom from wear and a virtually endless service life. The high-precision output signal serves as an absolute signal for the controller in a wide range of different interfaces.

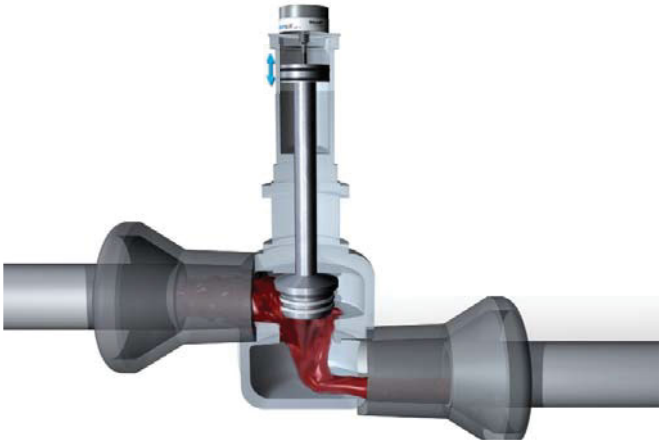
As a position measuring system for actual value recording, integrated in the pressure area of hydraulic cylinders, Micropulse Transducers are used in the most varied areas.

Areas of application
- Pitch adjustment on wind generators
- Positioning reflection channels on thermosolar power plants
- Large, hydraulically powered valves
- Casting and rolling mills
- Lift controls
- Flight simulators
- Foundries
- Logging machines
- Automation engineering
- Hydroelectric power stations
- Locks and floodgates
- Construction machinery
- Combine harvesters

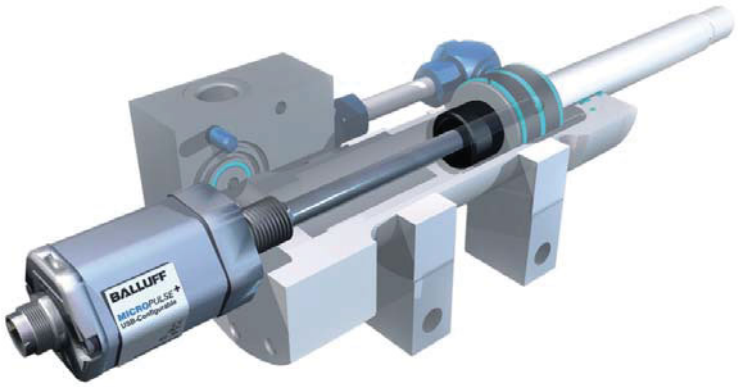
Industrial applications
- Pumps and compressors
- Elevator and lifting technology
- Forging presses
- High-pressure hydraulics



Heavy-duty cylinders raise the bridge to the planned road level after they are "floated" into position.



Large valve with controlled actuating drive

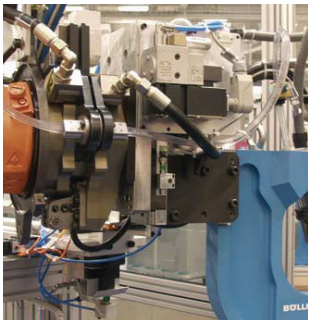


Industry: hydraulic cylinder

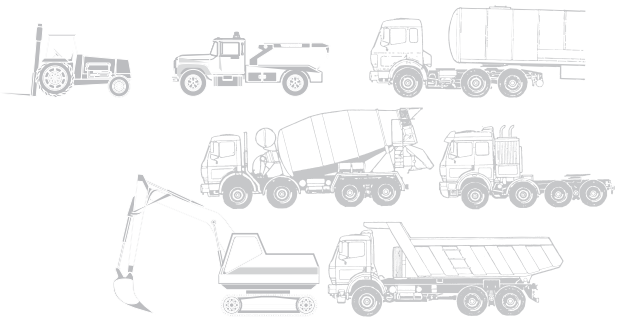
Mobile hydraulics

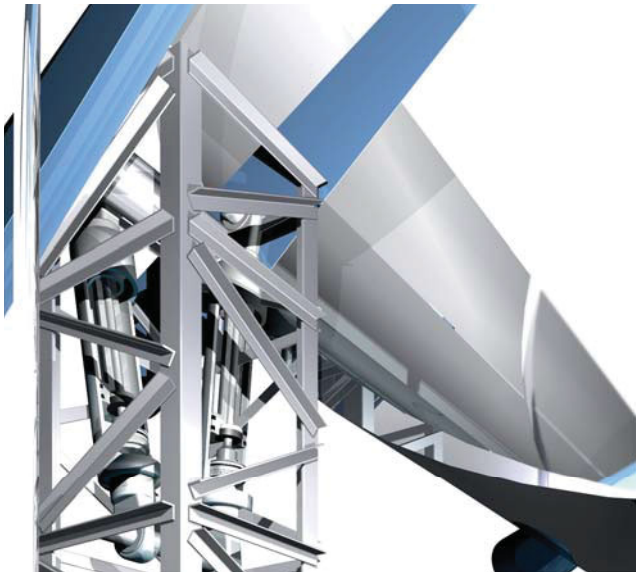
Wind power plant

Sawmill machinery



Hydraulic riveting system





Solar-thermal parabolic trough power plant

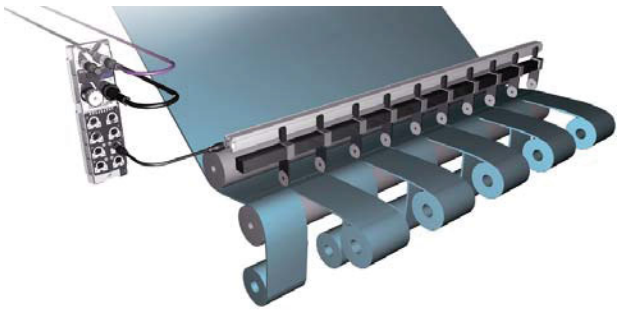
Solar-thermal parabolic trough power plant

Micropulse Transducers
Applications

In the automation of a wide range of different machine types, the high-priority requirements include maximum precision, no wear, easy installation, a high degree of protection and an advantageous price. Micropulse Transducers in a profile housing fulfill requirements in the automation industry 100%.

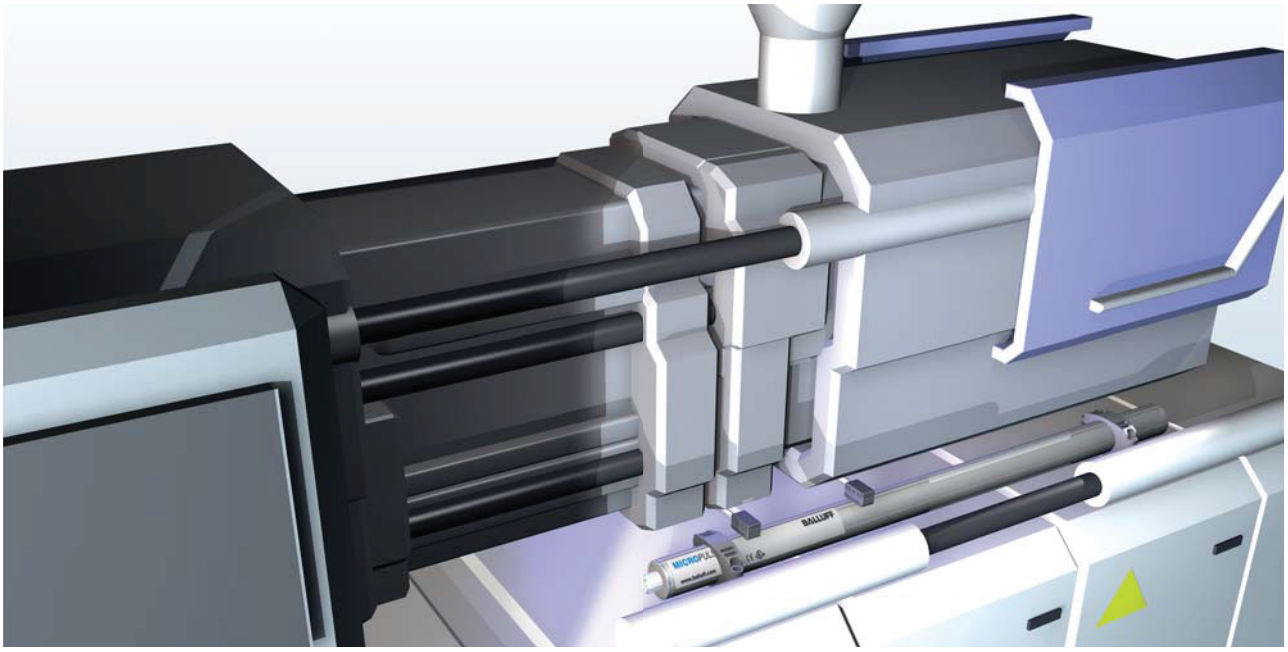
Areas of application

- Injection molding
- Pressing
- Handling systems
- Portal robots
- Woodworking machinery
- Packaging machinery
- Conveying
- Straightening machinery
- Surgical tables
- Concrete block making machinery

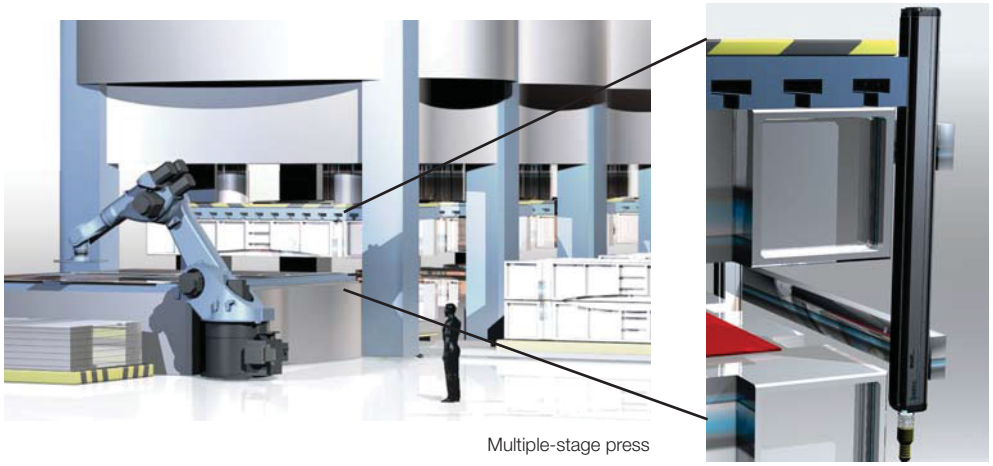


Film slitting machinery

Injection molding machinery

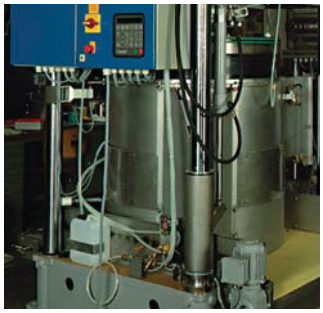


Injection molding machinery

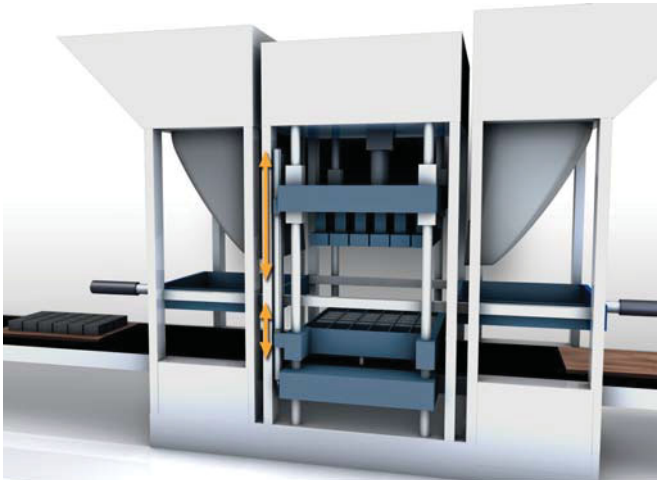


Multiple-stage press

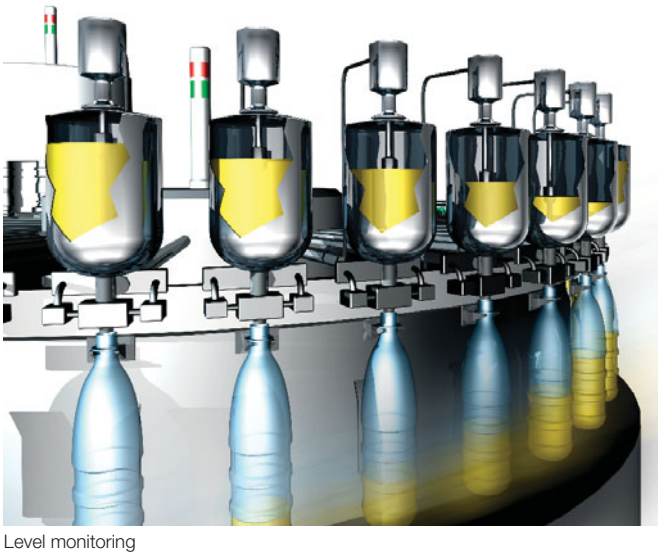
Automation engineering



Laundry press



Micropulse+ position measuring systems guarantee cost-effectiveness and quality in the manufacture of concrete blocks. In a concrete block machine, the Micropulse+ position measuring system simultaneously and reliably measures the axis position of load and molding stroke movement.



Level monitoring

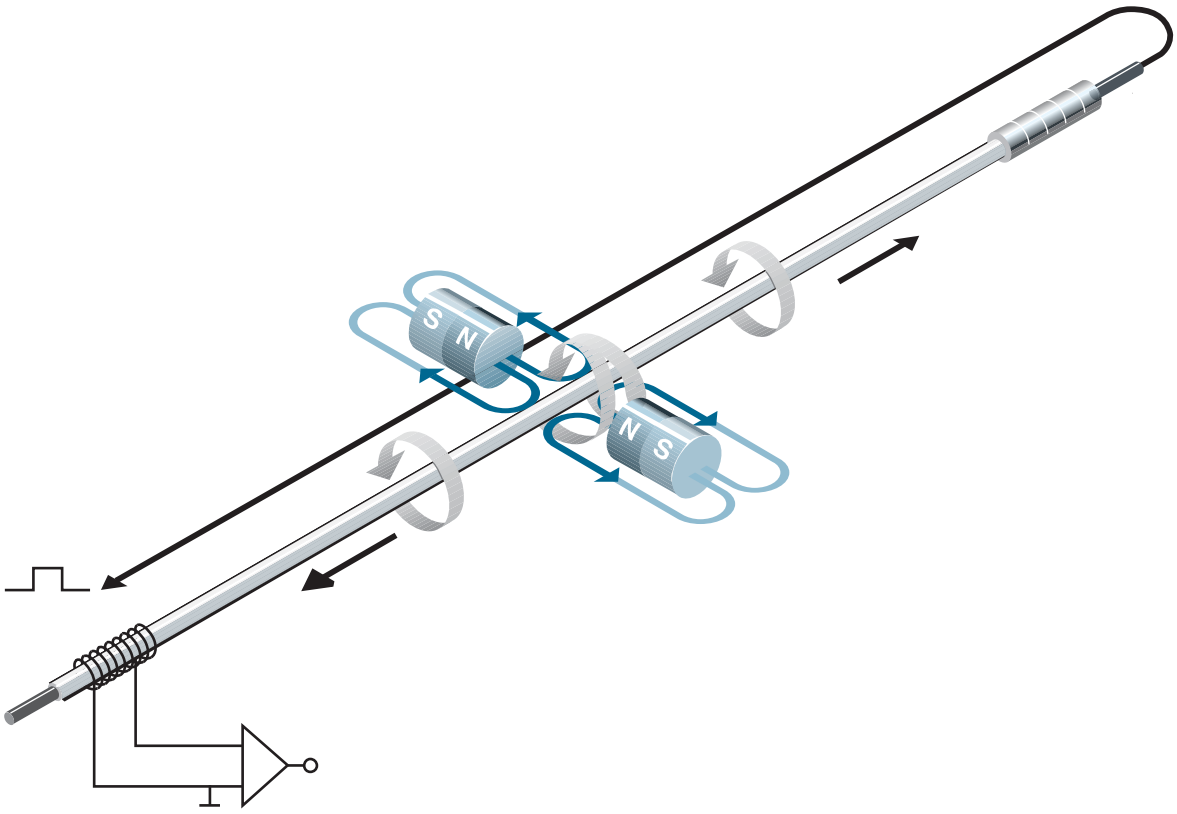
The non-contact magnetostrictive working principle is also ideal for special position measurement tasks.

Areas of application

- Process technology
- Filling of foodstuffs
- Level monitoring in milk tanks
- Filling units
- Perfume manufacturing
- Pharmaceuticals
- Producing alcohol

Operating principle

The measuring element, the waveguide, consists of a special nickel-iron alloy with 0.7 mm outer and 0.5 mm inner diameter. A copper conductor is threaded through this tube. A short current pulse triggers the measurement process. This current generates a circular magnetic field which, due to soft magnetic properties of the wave guide, is integrated into it. A permanent magnet at the point of measurement is used as the marker element, whose lines of field run at right angles to the pulsed magnetic field.
In the area of the wave guide, where both magnetic fields are superimposed, there is an elastic deformation in the micro range of the structure due to magnetostriction, which generates a mechanical wave that spreads on both sides.
The nominal propagation velocity of this wave in the waveguide is 2,830 m/s, and is almost completely insensitive to environmental effects such as temperature, shock and contamination.
The wave running to the end of the waveguide is damped out, while the wave running to the signal converter generates an electrical signal by reversing the magnetostrictive effect. The time the wave takes to travel from its point of origin to the signal converter is directly proportional to the distance between the permanent magnet and the signal converter. A time measurement then allows this distance to be calculated with extreme accuracy.



MICROPULSE®

Rod housings

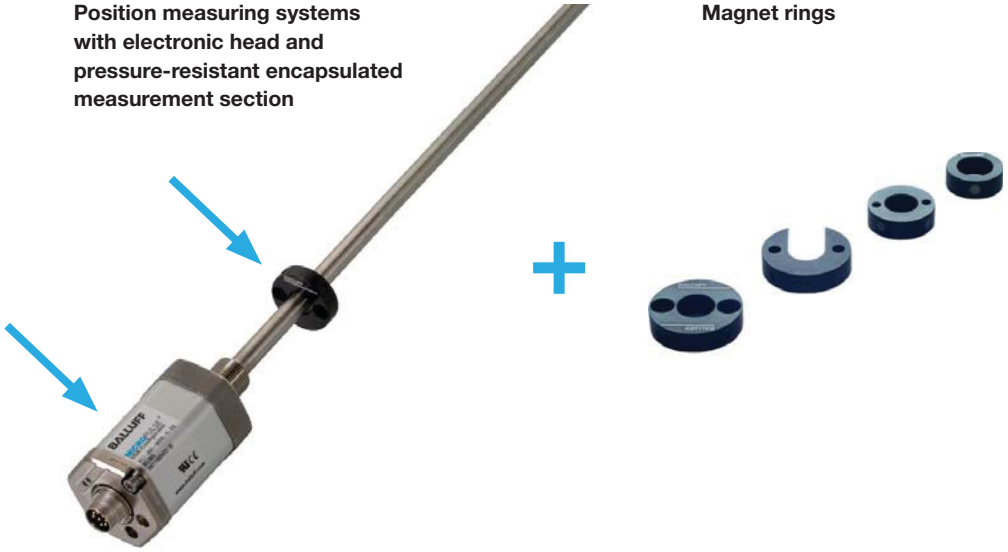
Rod housings are mainly used in hydraulic cylinder applications. When installed in the pressure section of the hydraulic cylinder, the displacement sensor requires the same pressure rating as the actual hydraulic cylinder. In practice, the sensor must be able to withstand pressures up to 1,000 bar. The electronics are integrated in an aluminum or stainless steel housing and the waveguide in a pressure-resistant tube made from nonmagnetic stainless steel that is sealed off at the front end with a welded plug. An O-ring seal in the flange at the opposite end seals off the high-pressure section. An magnet ring with magnets slides over the tube or rod with internal waveguide to mark the position prior to detection.

Rod system components

A position measuring system consists of the actual transducer, the magnet and wiring for the electronic evaluation unit.

Position measuring systems with electronic head and pressure-resistant encapsulated measurement section

Magnet rings



Profile housings

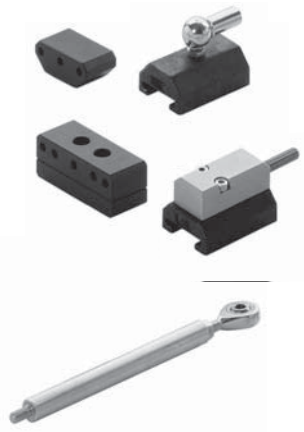
The electronics and the waveguide are housed in an aluminum profiled housing. The aluminum housing is sealed according to IP 67. The magnets act on the waveguide through the wall of the aluminum profile.
There are two different versions of magnet, namely captive and floating magnets. Floating magnets are secured directly on the moving machine part and move with the part above and along the profile at a specified distance. The advantage is that guide precision is not an issue with this type of sensor. The sensors tolerate an offset to the side and at the height of up to a few millimeters. If these generous tolerances are exceeded, you can always revert to using captive magnets. With captive magnets, the profile housing of the displacement sensor acts as a sliding rail along which the magnet travels. In this case, a control arm with spherical heads compensates for even highly unparallel movements.

Profile system components

A position measuring system consists of the actual transducer, the magnet and wiring for the electronic evaluation unit.

Position measuring system with integrated measurement section and electronics

Magnet



Floating and captive magnets

Maximum distance of **15 mm** between the position measuring system and the floating Magnet

Explosion-proof versions

Many applications require the use of displacement sensors in potentially explosive areas. Flameproof magnetostrictive Micropulse Transducers are available in a wide range of designs for use in zones 0 and 1.

Safety through redundancy

Magnetostrictive displacement sensors are ideal for applications requiring a high degree of safety or availability. The sensors often have a 2-times or even 3-times redundant design in order to ensure mutual monitoring or provide a reserve channel when required. A displacement sensor with a 3-times redundant design incorporates 3 adjacent waveguides offset by 120° and housed in a collective protective tube along which a magnet moves, in much the same way as on standard housings. The magnets on the magnet act on all three measurement sections simultaneously. The evaluation of the 3 positions is done by 3 independent sets of electronics which are integrated into the same housing. Application examples include ship propulsion drives, power stations and train inclination technology.

extremely rugged and reliable

Series	Profile style	Profile style	Profile AT	Profile BIW	Rod	Rod Compact	
Design	**P**	**PF**	**A1**	**P1**	**B, A, Z, Y**	**H, K, W**	
Installation version e.g. in hydraulic cylinders					■	■	
External fitting version e.g. on machine frames	■	■	■	■			
Filling level sensor e.g. device filling systems							
Special approvals							
Magnet	Floating/ captive	Floating/ captive	Floating	Captive push rod	Ring or float	Ring or float	
Multi-Magnet	■		■		■		
Interfaces							
Analog voltage 0...10 V, 10...0 V, –10 V...10 V	■	■	■	■	■	■	
Analog current 4...20 mA, 0...20 mA	■	■		■	■	■	
SSI	■				■	■	
SSI-SYNC	■				■	■	
CANopen	■				■	■	
DeviceNet	■						
Profibus DP	■				■		
Start/stop pulse interface	■		■		■		
VARAN			■				
EtherCAT	■		■		■		
IO-Link		■					
From page	76	104	116	130	136	170	

	Rod Pro Compact	Rod AR	Rod DEX	Rod J-DEXCTA12	Rod NEX	Rod PEX	Rod Redundant	Filling level sensor
	HB/WB	E2/E28	B/J	C	K, B, Z	B, Z	T	SF
	■	■	■	■	■	■		
		Vehicle approval	Potentially explosive operation	Potentially explosive operation	Potentially explosive operation	Potentially explosive operation		Certified for foodstuffs
		KBA, e1	Flameproof "d" zone 0, zone 1, ATEX, KOSHA, GOST, IECEX	Flameproof "d", zone 0, Zone 1, ATEX, NEC, CSA, IECEX	Protection type "n" zone 2	Dust protection zone 22	Increased safety 2 or 3 times redundant	Conforms with FDA, 3A, ECOLAB, EHEDG
	Ring or float	Ring or float	Ring or float	Ring or float	Ring or float	Ring or float	Ring or float	Float
	■	■	■	■	■		■	■
	■	■	■	■	■		■	■
	■		■	■				
			■	■				
	■			■				
				■				
	■	■	■	■	■	■	■	
	190	196	204	204	204	204	204	226

MICROPULSE®

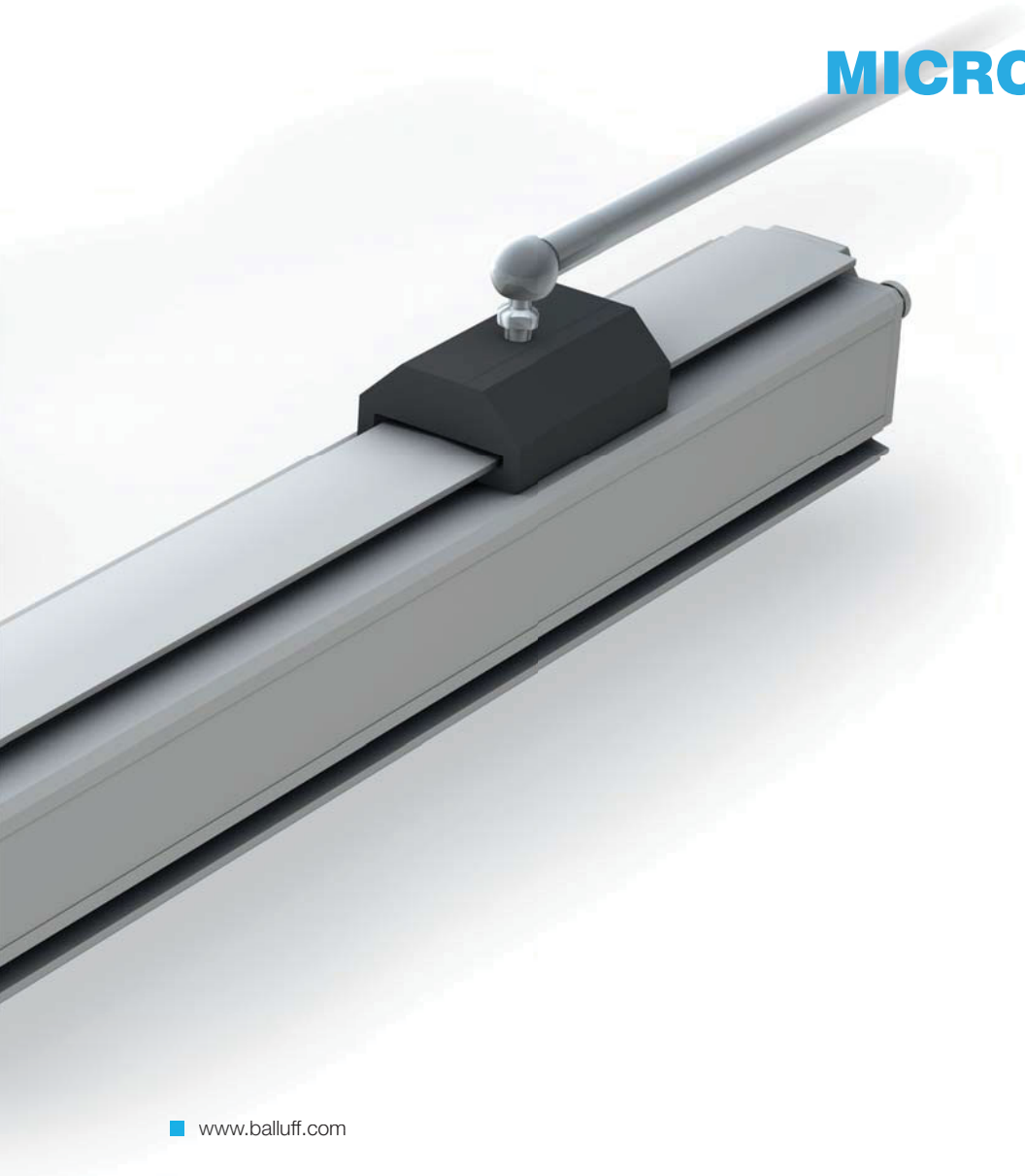
Micropulse Transducers

Profile P

- The universal standard series
- Stroke lengths up to 7,620 mm
- Programmable output signals – measuring range, inverting, configuring, documenting
- Floating and captive magnets
- Up to 15 mm distance between magnet and transducer – truly non-contact
- Measures position and speed
- Differential and synchronized measurement
- Available with analog signals, digital interfaces and fieldbuses

Contents

MICROPULSE®



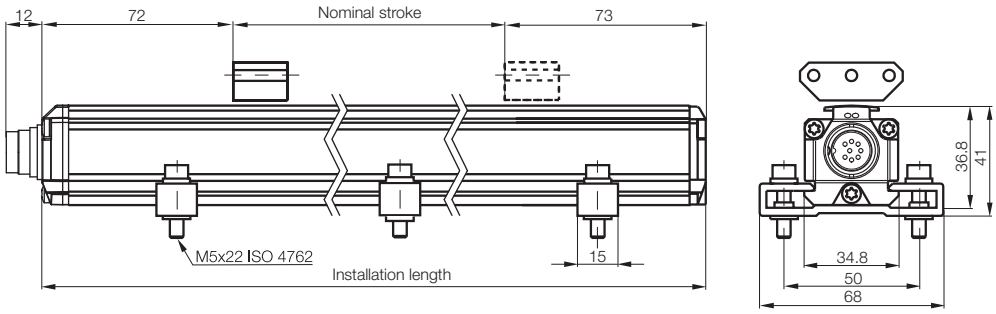
Series	**Profile P BTL7**
Shock load	150 g/6 ms as per IEC 60068-2-27
Continuous shock	150 g/2 ms as per IEC 60068-2-29
Vibration	20 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	to 36 V
Overvoltage protected	to 36 V
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC 60529	IP 68 with cable outlet, IP 67 with screwed-on plug connector BKS-S...
Housing material	Anodized aluminum
Housing attachment	Mounting clamps
Connection	Connectors/cables
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 3
Surge voltage	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
Standard nominal strokes [mm]	0050...7620 mm

- Non-contact detection of the actual position
- IP 67, insensitive to contamination
- Wear-free
- Insensitive to shock and vibration
- Absolute output signal
- Measurement length up to 7,620 mm
- One or two magnet operation
- Error and status LED

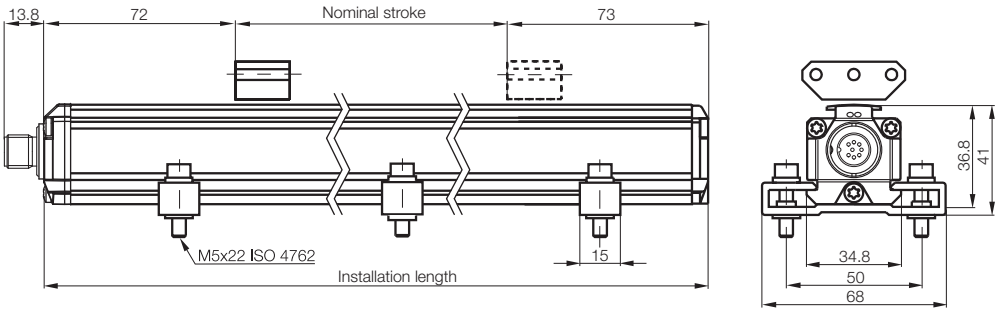
Scope of delivery
- Transducer (select your interface from page 80)
- Quick start instructions
- Mounting clamps with insulating sleeves and screws

Please order separately:
USB communication box, page 82
Magnet, page 100
Connectors, page 236

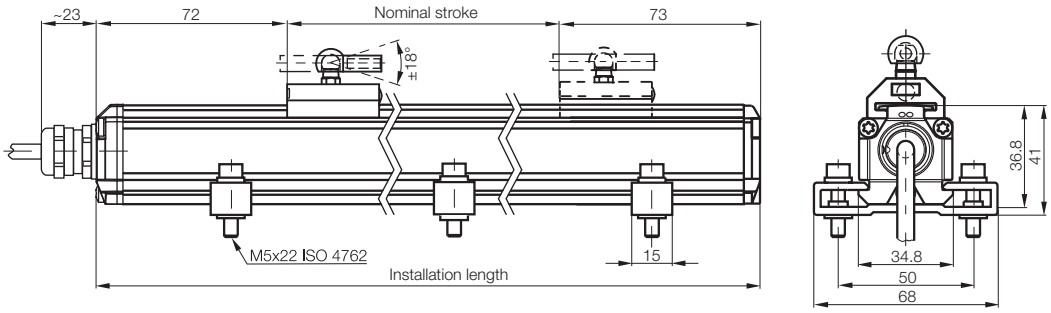
Transducer with floating magnet and S32 connection



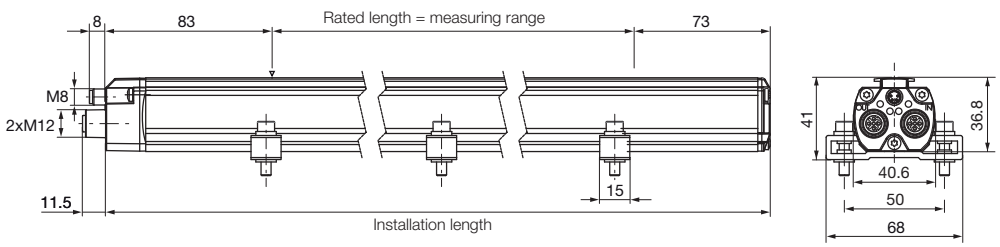
Transducer with floating magnet and S115 connection



Transducer with captive magnet and KA cable outlet



Transducer with EtherCAT connection C003



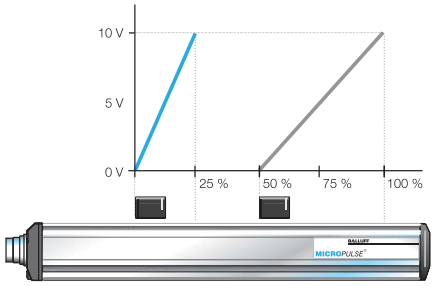
Stroke Lengths up to 7,620 mm

Micropulse+ USB-Configurable BTL7-A/E501
- Simple configuration and adjustment of the start and end point via the USB interface, fast startup
- "Easy Setup" for manual adjustment on-site
- Configurable dual output functions, position and speed
- Increased operating reliability with status LEDs for indicating the operating status and diagnostic information

Position and velocity
Two outputs can be assigned any position value and velocity signal using the USB interface.

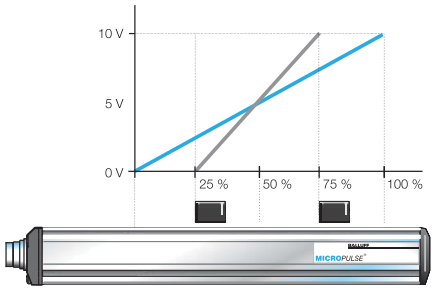
Series	
Output signal	
Transducer interface	
Position signal interface, customer device	
Part number	
Output signal factory setting	
Output signal can be adjusted via Configurable USB	
Load current	
Load resistance	
System resolution	
Current consumption at 24 V DC	
Hysteresis	
Repeat accuracy	
Sampling rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Polarity reversal protected	
Overvoltage protected	
Dielectric strength	
Operating temperature	

Operating mode: Double position indicator



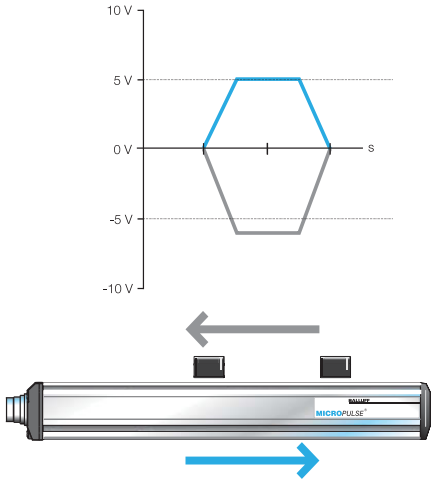
2 magnets, 2 movements, 2 output signals

Operating mode: Differential



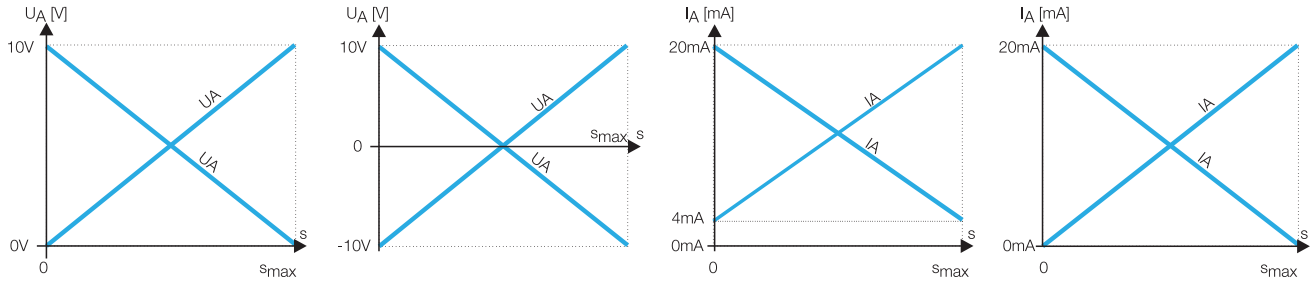
Differential signal between
2 magnets, position and difference possible.

Operating mode: Speed



Velocity output

	Profile P BTL7	**Profile P BTL7**
	analog	analog
	A	**E**
	analog	analog
	BTL7-**A501**-M_ _ _ _-P-_ _ _ _	BTL7-**E501**-M_ _ _ _-P-_ _ _ _
	0...10 V and 10...0 V	4...20 mA and 20...4 mA
	–10...10 V and 10...–10 V	0...20 mA and 20...0 mA
	Max. 5 mA	
		≤ 500 ohms
	≤ 0.33 mV	≤ 0.66 µA
	≤ 150 mA	≤ 180 mA
	≤ 10 µm	≤ 5 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm
	Max. 4 kHz	Max. 4 kHz
	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke
	±0.01% FS > 500...≤ 5500 mm nominal stroke	±0.01% FS > 500...≤ 5500 mm nominal stroke
	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke
	≤ 30 ppm/K	≤ 30 ppm/K
	10...30 V DC	10...30 V DC
	to 36 V	to 36 V
	to 36 V	to 36 V
	500 V AC (ground to housing)	500 V AC (ground to housing)
	–40...+85 °C	–40...+85 °C



Please enter code for output signal, nominal stroke and connection in the Part number.

Ordering example:

BTL7-_501-M_ _ _ _-P-_ _ _ _

Output signal

A 0...10 V and 10...0 V
E 4...20 mA and 20...4 mA

Standard Nominal stroke [mm]

0050...7620 mm

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches	mm	inches
0051	2	0762	30	2743	108	5486	216
0102	4	0914	36	3048	120	5791	228
0152	6	1067	42	3353	132	6096	240
0203	8	1220	48	3658	144	6401	252
0254	10	1372	54	3962	156	6706	264
0305	12	1524	60	4267	168	7010	276
0407	16	1829	72	4572	180	7315	288
0508	20	2134	84	4877	192	7620	300
0610	24	2438	96	5182	204		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

Connection

S115 Connector 8-Pin M12
S32 Connector 8-Pin M16 (DIN)
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m

USB configuration

System requirements
- Standard PC
- Operating system: Windows 2000/XP/Vista/7
- Screen resolution at least 1024 × 768 pixels
- 10 MB available hard disk space
- Install Java Runtime Environment (JRE) Version 1.4.2 or higher
  http://java.com/getjava
- USB port

Start, end value setting and configuration via USB
The Micropulse Configuration Tool software allows the quick and easy configuration of Balluff transducers of type BTL7-A/E501... on a PC. The most important features include:
- Online display of the current position of the magnet
- Graphic support for setting the functions and characteristics
- Display of information about the connected transducers
- Selectable number formats and units for display
- Reset to factory settings possible
- Demo mode without having a transducer connected

Connecting the USB communication box
For models BTL7-A/E501-M...-P-S32 and -S115 transducers, the communication box can be switched between the transducer and the controller. The communication box is connected to the PC using a USB cable.

USB communication box

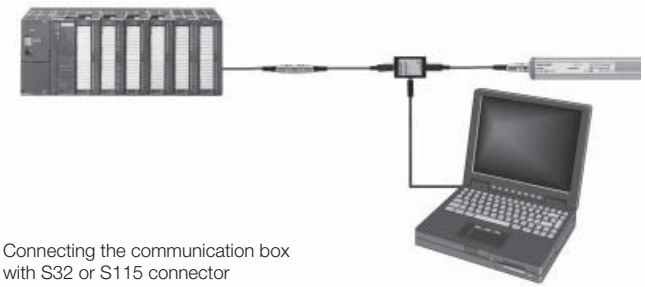
BTL7-A-CB01-USB-S32,
for BTL7-A/E501... with S32 connector

BTL7-A-CB01-USB-S115,
for BTL7-A/E501... with Connector S115

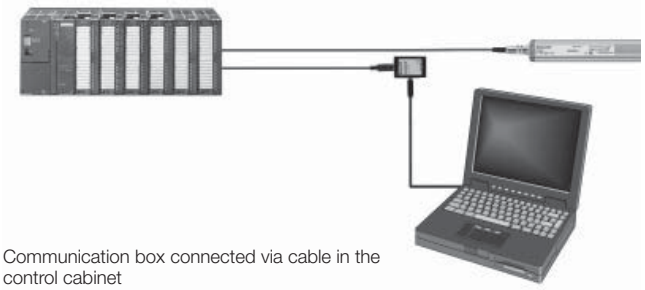
BTL7-A-CB01-USB-KA,
for BTL7-A/E501... with cable connection

Scope of delivery
- USB communication box
- Cable set
- Quick start instructions

The PC software and the corresponding manual are available on the Internet at **www.balluff.com/downloads-btl7**



Connecting the communication box with S32 or S115 connector

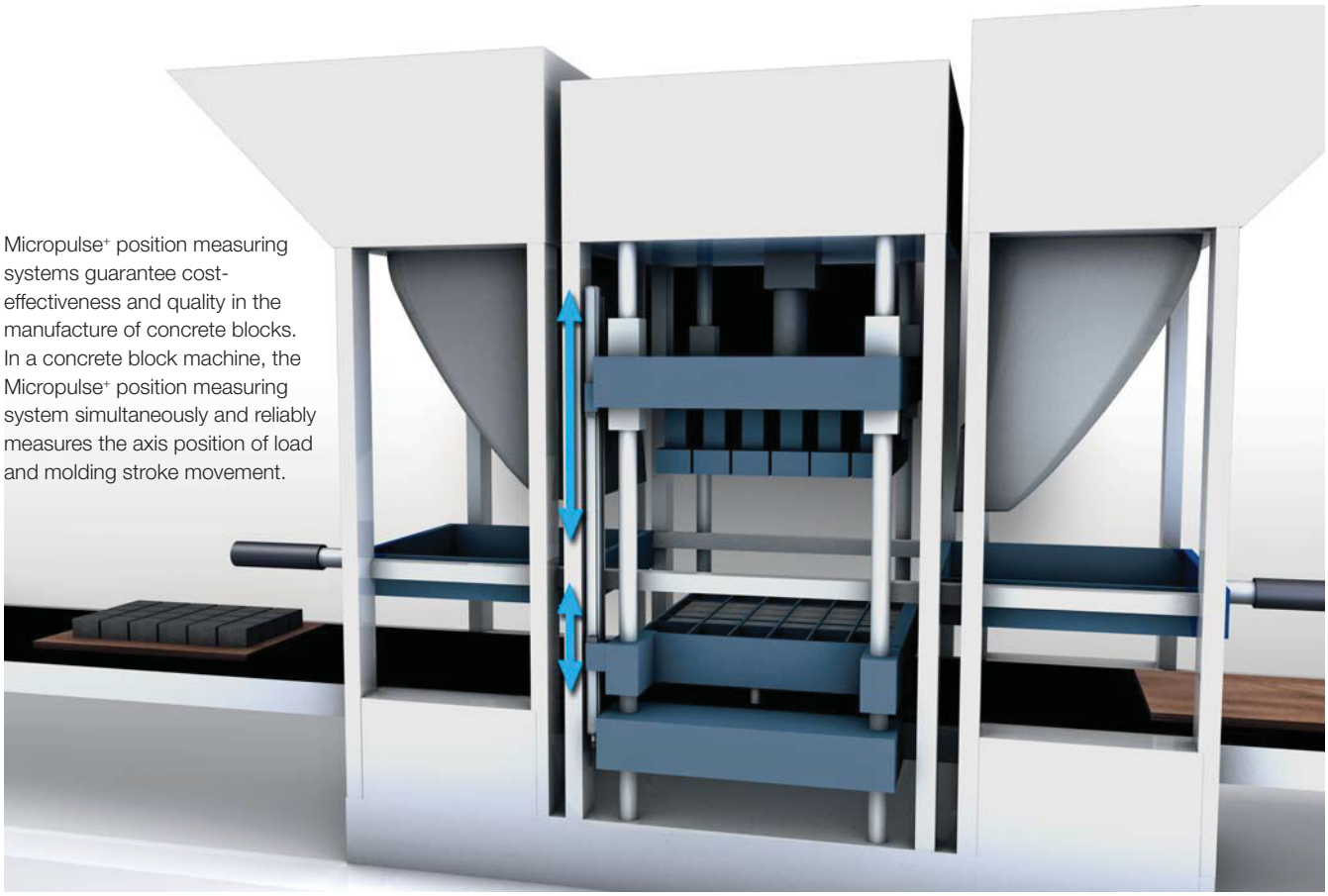


Communication box connected via cable in the control cabinet

Profile P BTL7 Micropulse+
Programming

Micropulse+ position measuring systems in a profile housing are non-contact, absolute measuring systems for accurately measuring one or more measurement paths. They impress with their robust design including IP 67 high degree of protection, ease of installation, and wear-free measurement principle with high accuracy. The current axis positions are marked by the position magnets through the wall of the aluminum profile. The position measuring systems tolerate a lateral offset as well as a height offset of up to 15 mm.

Features
- Non-contact measurement of the measuring position
- IP 67, insensitive to contamination
- Insensitive to shock and vibration
- Absolute output signal
- Measuring lengths up to 7,620 mm
- Two measurement paths per system
- Error and status LED
- Quick commissioning through USB configuration



Micropulse+ position measuring systems guarantee cost-effectiveness and quality in the manufacture of concrete blocks. In a concrete block machine, the Micropulse+ position measuring system simultaneously and reliably measures the axis position of load and molding stroke movement.

EtherCAT
EtherCAT is an Ethernet-based fieldbus. The open protocol is suitable for hard and soft realtime requirements in automation technology. The focal points in the development of EtherCAT are extremely short cycle times (≤ 100 µs), low jitter for exact synchronization (≤ 1 µs) and low hardware costs.

Modular device profile: absolute linear encoder
The BTL-V50E-… corresponds to the profile for absolute linear encoders and is configured as a modular device. The transducer represents a virtual module carrier, which has 16 slots for the position encoder. Various virtual modules can be plugged into each slot. These specify which data are assigned to the respective position encoder.

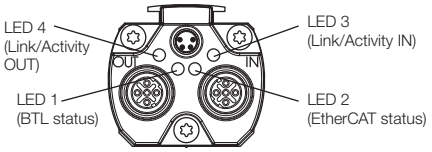
Synchronous operating mode
EtherCAT devices implement a high-precision time in hardware, more precisely, in the EtherCAT Slave Controller. These distributed clocks lend the EtherCAT synchronization mechanism its name, "Distributed Clocks" (DC).

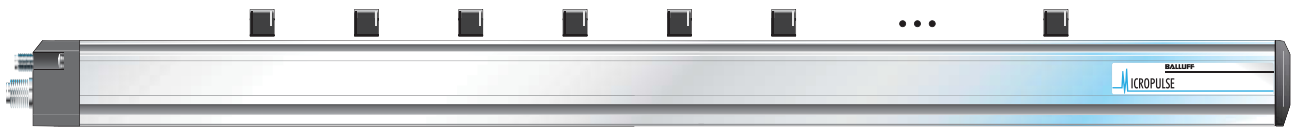
Cams/switching points
The BTL7-V50E-… can also be used as a cam switch. For this purpose there are four cams (Cam) available per position encoder (Magnet).

Advantages, features
- Multiposition detection – simultaneously detect 16 positions
- Easy evaluation – 4 cams or switching points per position
- Highly dynamic, because synchronous – synchronous operating mode through DC (Distributed Clocks)
- Flexibly installable – completely transferable system
- Reliability in the BUS – LED EtherCAT diagnostics
- Reliability in the measurement system – LED Micropulse system diagnostics

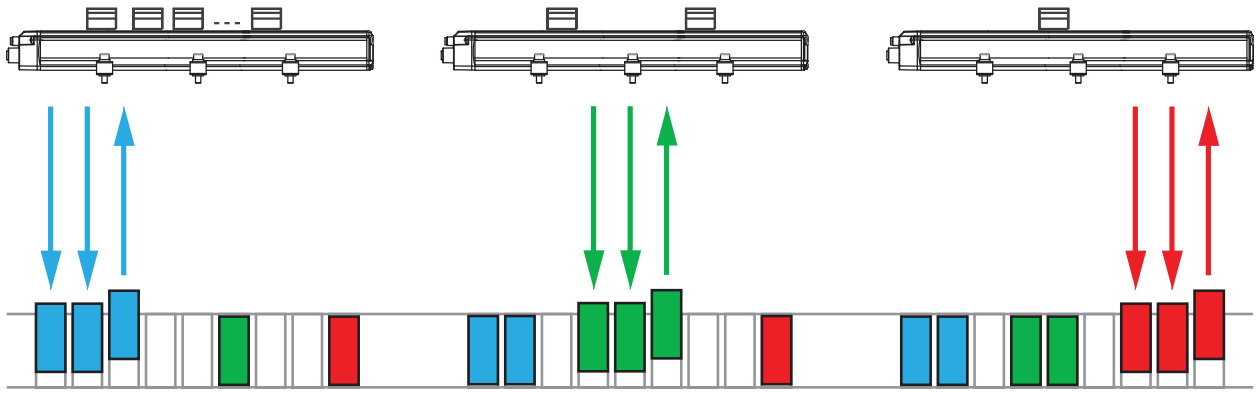
Series		
Output signal		
Transducer interface		
Position signal interface, customer device		
Part number		
EtherCAT interface		
Repeat accuracy		
System resolution, configurable	Position	
	Velocity	
Hysteresis		
Measurement rate		
Max. linearity deviation		
Temperature coefficient of overall system		
Supply voltage		
Current consumption		
Operating temperature		
Storage temperature		
ESI file		
Max. cable length		

LED 1	**Micropulse BTL7 diagnostics**
Green	**Normal function** The position encoder is within the limits.
Red	**Error** No position encoder, or position encoder is outside the limits.
LED 2 – 4	**EtherCAT – Bus diagnostics**





Profile P BTL7	
EtherCAT	
V50E	
EtherCAT	
BTL7-**V50E**-M_ _ _ _-P-C003	
Floating	
≤ 5 µm, (typically ±2.5 µm)	
1 µm	
0.1 mm/s increments configurable	
≤ ±10 µm	
$f_{STANDARD}$ = 1 kHz	
≤ 5500 ±30 µm, > 5500 ±0.002 % FS	
≤ 18 ppm/K (at 500 mm)	
10...30 V DC	
≤ 120 mA	
–40...+85 °C	
–40...+100 °C	
www.balluff.com	
< 100 m	



Function principle of the EtherCAT data transmission

Please enter code for output signal, rated length and connection in the part number.

Ordering example:

BTL7-V50E-M_ _ _ _-P-_ _ _ _

Ethernet Interface type

E EtherCAT

Standard Rated length [mm]

0050...7620 mm in 5-mm increments

Connection

C003 4-pin
1× M8 connector + 2× M12 connector
D-coded

Profile P BTL5
General data

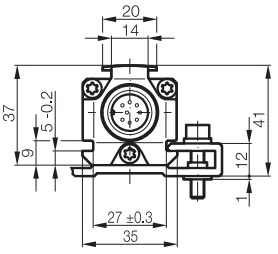
The structural design, high degree of protection and simple installation of Balluff Micropulse Transducers in a profile housing makes them an excellent alternative to linear transducers, e.g. potentiometers, glass scales and LVDTs. The linear sensing element is protected inside an extruded aluminum profile.
A passive magnet marks the measuring point on the measuring path without making contact. Measuring ranges between 50 and 5,000 mm are possible.

- Non-contact detection of the measurement position
- IP 67, insensitive to contamination
- Wear-free
- Insensitive to shock and vibration
- Absolute output signal
- Max. resolution of 0.001 mm (depending on the electronic evaluation unit)
- Direct signal evaluation or in conjunction with evaluation units for all control and regulating systems

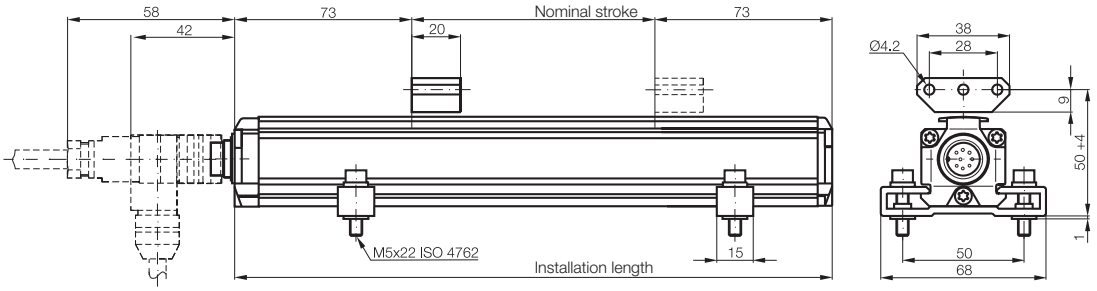
Series	**Profile P BTL5**
Shock load	100 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protected	TransZorb protection diodes
Dielectric strength	500 V (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached)
Housing material	Anodized aluminum
Housing attachment	Compression clamps
Connection	Connectors/cables
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 4
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3
Standard nominal strokes [mm]	0050...5500 mm depending on the interface

Scope of delivery
- Transducer (select your interface from page 88)
- Quick start instructions

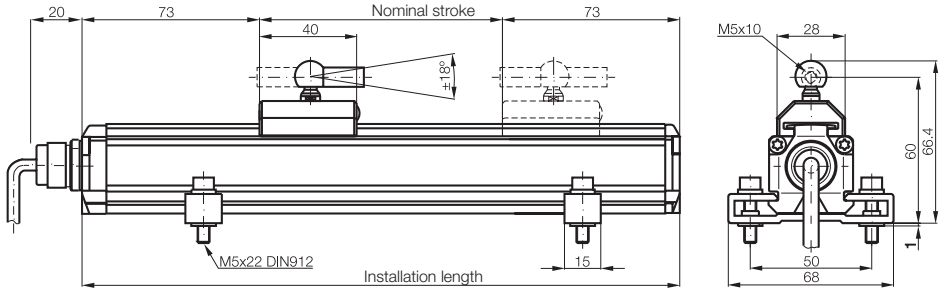
Please order separately:
Magnets, on page 100
Connectors, page 236
Mounting clamps with insulating sleeves and screws



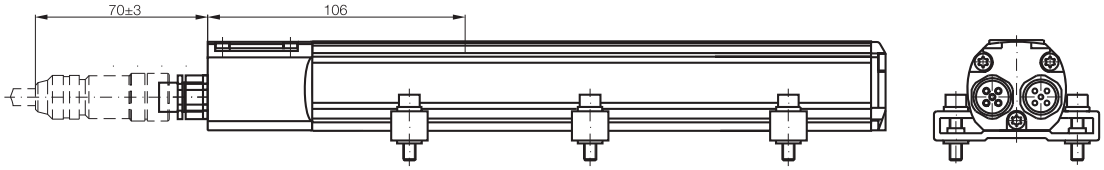
**Transducer with floating magnet, S 32 connection with BKS-S 32M/BKS-S 32M-C/
BKS-S 32M connector for transducers with analog interface, digital pulse interface and SSI interface, from page 232**



Transducers with captive magnets and cable outlet for transducers with analog interface, digital pulse interface and SSI interface, from page 232

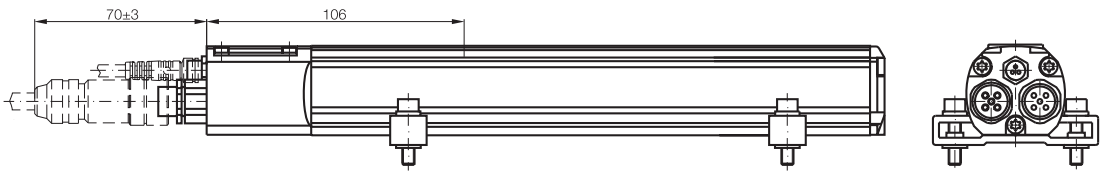


**CANopen connection S 94 with connectors BKS-S 94-00 and BKS-S 92-00 for transducers
with CANopen interface, page 236**



**CANopen connection S 92 with connector BKS-S 92-00 for transducers
with CANopen interface, page 236**

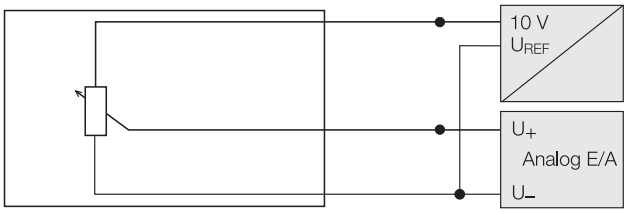
**DeviceNet connection S 93 with connectors BKS-S 92-00, BKS-S 93-00 and BKS-S -48-15-CP-_ _, page 236
Profibus DP connection S103 with connector BCC0715 and BCC0714, page 237 and BKS-S-48-15-CP-_ _ page 238**



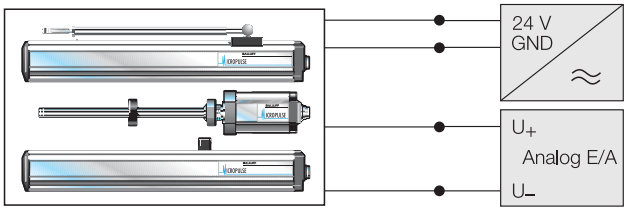
BTL transducers with analog outputs are available in the variants 0...0V, 4...20mA, 0...20mA and –10...10V, with rising and falling characteristics.

Series		
Output signal		
Transducer interface		
Customer device interface		
Part number		
Output voltage		
Output current		
Load current		
Max. residual ripple		
Load resistance		
System resolution		
Hysteresis		
Repeat accuracy		
Sampling rate		
Max. linearity deviation		
Temperature coefficient	Output voltage	
	Current output	
Supply voltage		
Current consumption		
Polarity reversal protected		
Overvoltage protected		
Dielectric strength		
Operating temperature		
Storage temperature		

Micropulse Transducers – a non-contact alternative to contacting transducers



Connection scheme potentiometer, block diagram

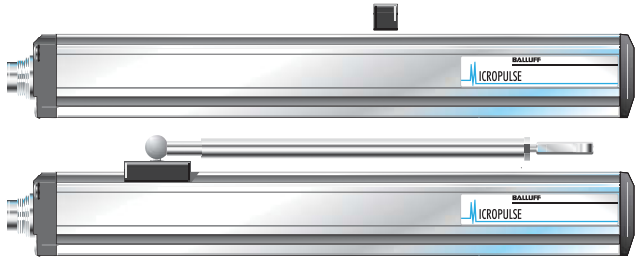


Micropulse Transducer connections, block diagram

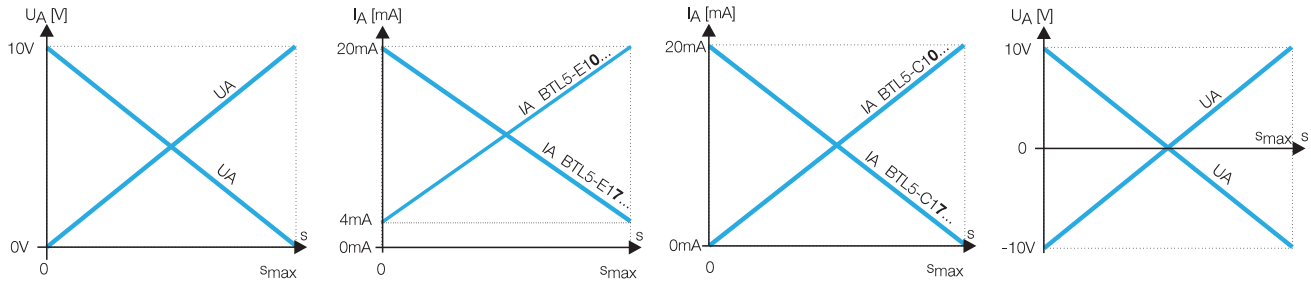
Please enter code for output signal and nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, on page 100
Connectors, page 236
Mounting clamps with insulating sleeves and screws



	Profile P BTL5	**Profile P BTL5**	**Profile P BTL5**	**Profile P BTL5**
	analog	analog	analog	analog
	A	**E**	**C**	**G**
	analog	analog	analog	analog
	BTL5-**A11**-M_ _ _ _-P-_ _ _ _	BTL5-**E**1_-M_ _ _ _-P-_ _ _ _	BTL5-**C**1_-M_ _ _ _-P-_ _ _ _	BTL5-**G**11-M_ _ _ _-P-_ _ _ _
	0...10 V and 10...0 V			**–10...10 V and 10...–10 V**
		4...20 mA or 20...4 mA	**0...20 mA or 20...0 mA**	
	Max. 5 mA			Max. 5 mA
	≤ 5 mV			≤ 5 mV
		≤ 500 ohms	≤ 500 ohms	
	≤ 0.1 mV	≤ 0.2 µA	≤ 0.2 µA	≤ 0.1 mV
	≤ 4 µm	≤ 4 µm	≤ 4 µm	≤ 4 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz
	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke
	±0.02% 500 to max. nominal stroke	±0.02% 500 to max. nominal stroke	±0.02% 500 to max. nominal stroke	±0.02% 500 to max. nominal stroke
	[150 µV/°C + (5 ppm/°C x P x U/L)] x ΔT			[150 µV/°C + (5 ppm/°C x P x U/L)] x ΔT
		[0.6 µA/°C + (10 ppm/°C x P x I/L)] x ΔT	[0.6 µA/°C + (10 ppm/°C x P x I/L)] x ΔT	
	20...28 V DC	20...28 V DC	20...28 V DC	20...28 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
	yes	yes	yes	yes
	TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes
	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)
	–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C
	-40...+100 °C	-40...+100 °C	-40...+100 °C	-40...+100 °C



Ordering example:

BTL5-E1_-M_ _ _ _-P-_ _ _ _

Output signal

A	0...10 V and 10...0 V
E	4...20 mA or 20...4 mA
C	0...20 mA or 20...0 mA
G	–10...10 V and 10...–10 V

Characteristic

1	rising and falling (at A and G)
0	rising (at C and E)
7	falling (at C and E)

Standard Nominal stroke [mm]

0050...4572 mm

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0762	30	2438	96
0102	4	0914	36	2743	108
0152	6	1067	42	3048	120
0203	8	1220	48	3353	132
0254	10	1372	54	3658	144
0305	12	1524	60	3962	156
0407	16	1829	72	4267	168
0508	20	2134	84	4572	180
0610	24				

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

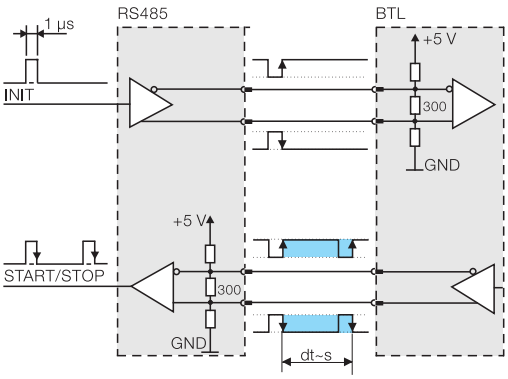
Connection

S32	Connector 80-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Profile P BTL5
Digital pulse interface

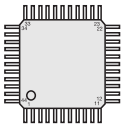
P Interface
The P-interface fits Balluff BTA/BTM evaluation units and controllers and modules of various manufacturers, e.g. Siemens, B & R, Phoenix Contact, Mitsubishi, Sigmatek, Esitron, and WAGO, among others. Secure signal transfer even with cable lengths of 500 m between the BTA evaluation unit and the BTL transducer guarantee the particularly interference-free RS485 differential driver and receiver. Noise signals are effectively suppressed.

M interface
The I and M interfaces are control-specific interface variations.

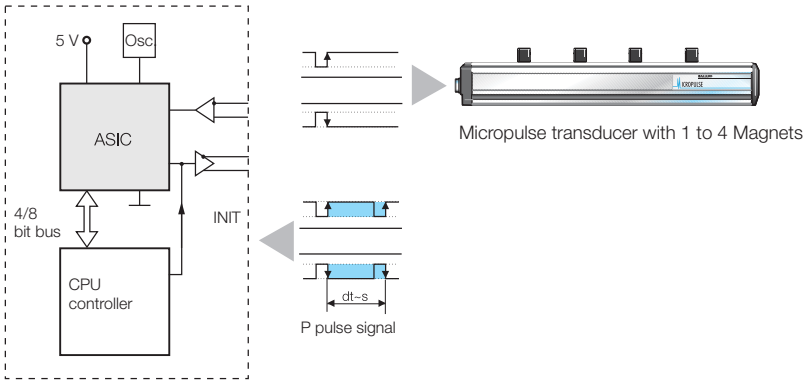


Block diagram of P interface

Highly precise digitizing of the P pulse signal
Companies developing their own electronic control and evaluation unit can create a highly accurate P interface cost-effectively and with minimum effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for Micropulse Transducers with P pulse interface.


Digitizing chip 44QFP

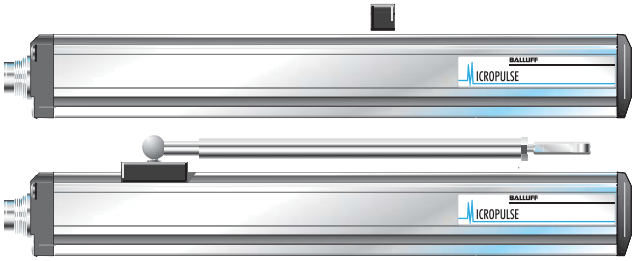
Benefits
- Position resolution 1 µm!
- The 1 µm resolution of the Micropulse position measuring system is achieved by the high resolution of the digitizing chip (133 pS) (clock frequency 2 or 20 MHz).
- Position data from 4 magnets can be processed simultaneously
- 4/8-bit processor interface



Controller or
electronic evaluation unit

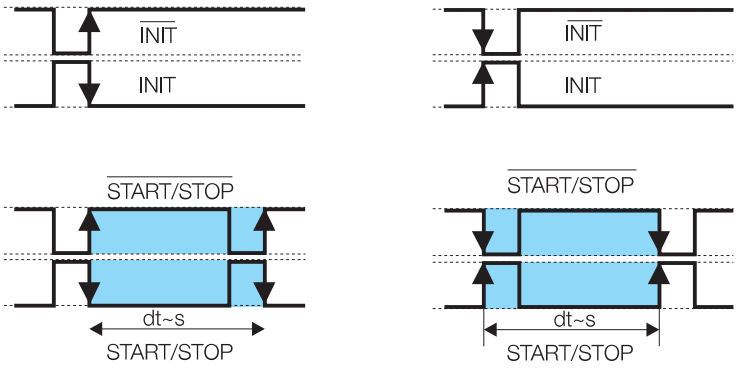
P pulse signal

Micropulse transducer with 1 to 4 Magnets



Profile P BTL5
Digital pulse interface

Series	**Profile P BTL5**	**Profile P BTL5**
Transducer interface	Pulse **P**	Pulse **M**
Customer device interface	Pulse **P**	Pulse **M**
Part number	BTL5-**P**1-M_ _ _ _-P-_ _ _ _	BTL5-**M**1-M_ _ _ _-P-_ _ _ _
System resolution	processing-dependent	processing-dependent
Repeat accuracy	2 µm or ±1 digit depending on electronic evaluation unit	2 µm or ±1 digit depending on electronic evaluation unit
Resolution	≤ 2 µm	≤ 2 µm
Hysteresis	≤ 4 µm	≤ 4 µm
Sampling rate	3 kHz...500 Hz depending on nominal stroke	3 kHz...500 Hz depending on nominal stroke
Max. linearity deviation	±100 µm up to 500 mm nominal stroke ±0.02% 500...5000 mm nominal stroke	±100 µm up to 500 mm nominal stroke ±0.02% 500...5000 mm nominal stroke
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C	(6 µm + 5 ppm × L)/°C
Supply voltage	20...28 V DC	20...28 V DC
Current consumption	≤ 90 mA	≤ 90 mA
Operating temperature	–40...+85 °C	–40...+85 °C
Storage temperature	–40...+100 °C	–40...+100 °C



Please enter the code for the nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, page 100
Connector, page 236
Mounting clamps with insulating sleeves and screws, page 100

Ordering example:

BTL5-P1-M_ _ _ _-P-_ _ _ _

Standard
Nominal stroke [mm]

0050...5500

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0762	30	2743	108
0102	4	0914	36	3048	120
0152	6	1067	42	3353	132
0203	8	1220	48	3658	144
0254	10	1372	54	3962	156
0305	12	1524	60	4267	168
0407	16	1829	72	4572	180
0508	20	2134	84	4877	192
0610	24	2438	96	5080	200

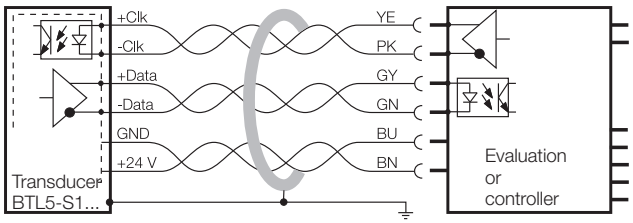
Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

Connection

S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

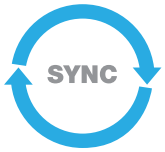
super linear and synchronous

Standard SSI interface
Synchronous serial data transmission works with controllers from various manufacturers, including Siemens, Bosch Rexroth, WAGO, B & R, Esitron, PEP and others, as well as for the Balluff BDD-AM 10-1-SSD and BDD-CC 08-1-SSD displays/controllers. Reliable signal transmission, even with cable lengths of up to 400 m between controller and BTL transducer, is assured by interruption-free RS485/422 differential line drivers and receivers. Any interference signals are effectively suppressed.



BTL5-S1... with evaluation/controller, connection example

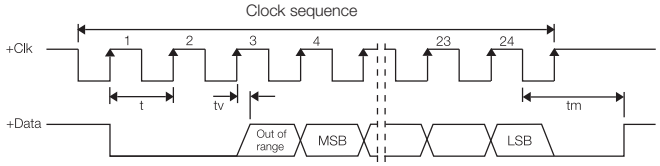
Synchronized SSI interface BTL5-S1_ _B-M_ _ _ _-P-_ _ _ _
Micropulse Transducers with synchronized SSI interface are well suited for dynamic control applications. Data acquisition in the transducer is synchronized using the external clock of the controller, allowing an optimum speed calculation to be performed in the regulator/controller. A prerequisite for this synchronous method of transducer operation is the time stability of the clock signal.
The **maximum sampling frequency f_A**, at which a new current value is generated for each sample, can be derived from the following table:



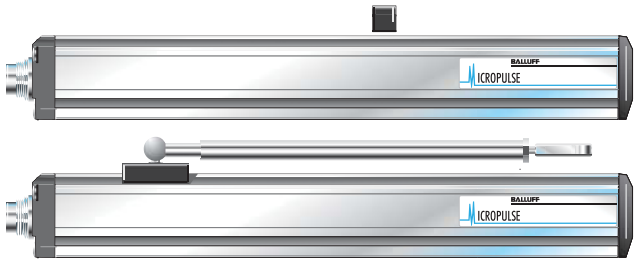
Nominal length area				Scan rate
< Nominal stroke	≤	100 mm	:	1500 Hz
100 mm < Nominal stroke	≤	1,000 mm	:	1,000 Hz
1,000 mm < Nominal stroke	≤	1,400 mm	:	666 Hz
1,400 mm < Nominal stroke	≤	2,600 mm	:	500 Hz
2,600 mm < Nominal stroke	≤	4,000 mm	:	333 Hz

The clock frequency depends on the cable length.

Cable length	Clock frequency
< 25 m	< 1000 kHz
< 50 m	< 500 kHz
< 100 m	< 400 kHz
< 200 m	< 200 kHz
< 400 m	< 100 kHz



Super-fast 2.5 kHz sampling rate



Profile P BTL5
SSI interface

Series	**Profile P BTL5**
Output signal	synchronous-serial
Transducer interface	**S**
Customer device interface	synchronous serial (SSI)
Part number	BTL5-**S**1_ _-M_ _ _ _-P-_ _ _ _
Part number synchronization	BTL5-**S**1_ _B-M_ _ _ _-P-_ _ _ _
System resolution depending on model (LSB)	1, 2, 5, 10, 20, 40 or 100 µm
Repeat accuracy	±5 µm
Hysteresis	≤ 4 µm or ≤ 1 digit
Sampling rate	$f_{STANDARD}$ = 2 kHz
Max. linearity deviation	±30 µm at ≤ 10 µm resolution or ≤ ±2 LSB at > 10 µm resolution
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C
Supply voltage	20...28 V DC
Current consumption	≤ 80 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

Please enter code for coding, system resolution and nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, page 100
Connectors, page 236
Mounting clamps with insulating sleeves and screws, page 100

Ordering example:

BTL5-S1_ _-M_ _ _ _-P-_ _ _ _ for asynchronous operation
BTL5-S1_ _-B-M_ _ _ _-P-_ _ _ _ for synchronous operation

Coding

0	Binary code rising (24-bit)
1	Gray code rising (24-bit)
6	Binary code rising (25-bit)
7	Gray code rising (25-bit)

System resolution

1	1 µm
2	5 µm
3	10 µm
4	20 µm
5	40 µm
6	100 µm
7	2 µm

Standard nominal stroke [mm]

0100...4000 mm

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0610	24	2134	84
0102	4	0762	30	2438	96
0152	6	0914	36	2743	108
0203	8	1067	42	3048	120
0254	10	1220	48	3353	132
0305	12	1372	54	3658	144
0407	16	1524	60	3962	156
0508	20	1829	72		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

Connection

S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

CANopen interface
Based on CAN (ISO/IEC 7498 and DIN ISO 11898), CANopen provides a Layer-7 implementation for industrial CAN networks. The serial data protocol of the CAN specification is defined according to the producer-consumer principle as opposed to most other fieldbus protocols. This eliminates target addressing of the process data. Each bus station decides for itself how the received data is processed.
The CANopen interface of the Micropulse Transducer is compatible with CANopen conforming with CiA Standard DS301 Rev. 3.0, and with CAL and Layer 2 CAN networks.

EDS
CANopen offers a high level of flexibility in configuration functionality and data exchange. Using a standard data sheet in the form of an EDS file, it is easy to link the Micropulse Transducers to any CANopen system.

Process Data Object (PDO)
Micropulse Transducers send their measured values optionally in one, two or four PDOs with 8 bytes of data each. The contents of the PDOs are freely configurable. The following information can be sent:
- The current magnet with a resolution in 5 µm increments
- Current speed of the magnet, with resolution selectable in 0.1mm/s increments
- The current status of the four freely programmable cams per magnet

Synchronization Object (SYNC)
SYNC serves as a network-wide trigger for synchronizing all network nodes. When the SYNC object is received, all Micropulse Transducers connected to the bus store their current position and velocity information and then send it sequentially to the controller. This assures time-synchronous acquisition of the measured values.

LED
Display of the CANopen status according to DS303-3

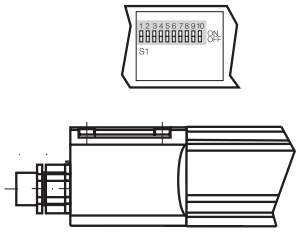
FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
So if only two magnets are positioned in the measuring area, a valid value is output for the first two positions and a defined error value for positions 3 and 4.

Emergency Object
This object is sent with the highest priority and is used, for example, for error messages when the cam states change.

Service Data Object (SDO)
Service Data Objects transmit the configuration parameters to the transducer. The transducer may be configured on the bus by the controller or offline with a bus analyzer/CANopen tool. The configuration is stored in the non-volatile memory of the transducer.

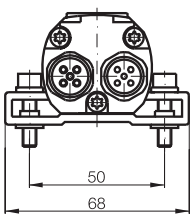
CiA 199911-301v30/11-009

Use of multiple magnets
The minimum distance between the magnets must be 65 mm.



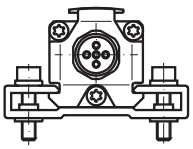
Position of the DIP switch S1,
only on BTL-H1_ _ _ _-P-S94

BTL5-H1_ _-M_ _ _ -P-S94



Node ID can be set by DIP switch.

BTL5-H1_ _-M_ _ _ -P-S92

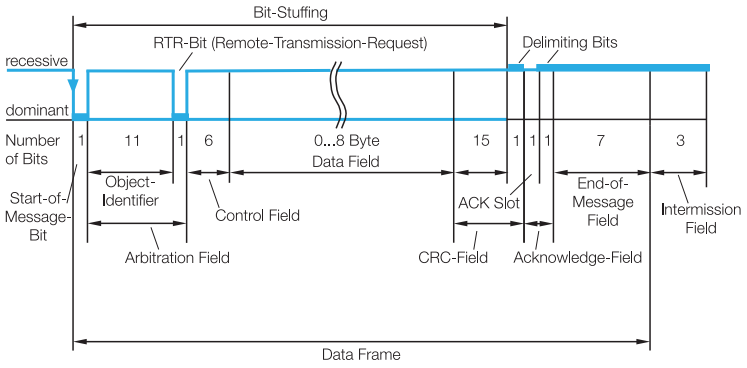


Profile P BTL5
CANopen® interface

Series		**Profile P BTL5**						
Output signal		CANopen						
Transducer interface		**H**						
Customer device interface		CANopen						
Part number		BTL5-**H**1_ _-M_ _ _ _-P-S92						
Part number		BTL5-**H**1_ _-M_ _ _ _-P-S94						
CANopen Version		DS301, DS406						
Repeat accuracy		±1 digit						
System resolution	Position	5 µm increments configurable						
Configurable	Speed	0.1 mm/s increments configurable						
Hysteresis		≤ 1 digit						
Sampling rate		$f_{STANDARD}$ = 1 kHz						
Max. linearity deviation		±30 µm at 5 µm resolution						
Temperature coefficient of overall system		(6 µm + 5 ppm × L)/°C						
Magnet travel speed		any						
Supply voltage		20...28 V DC						
Current consumption		≤ 100 mA						
Operating temperature		–40...+85 °C						
Storage temperature		–40...+100 °C						
Cable length [m] per CiA DS301		< 25	< 50	< 100	< 250	< 500	< 1,000	< 1,250	< 2,500
Baud rate [kbaud] per CiA DS301		1,000	800	500	250	125	100	50	20/10

Using the CANopen interface and cables up to 2500 m in length, the signal is sent at a length-dependent baud rate to the controller. The high interference immunity of the connection is achieved using differential drivers and by the data monitoring scheme implemented in the data protocol.

Please enter code for software configuration, baud rate and nominal stroke in the part number.



Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, page 100
Connectors, page 236
Mounting clamps with insulating sleeves and screws, page 100

Ordering example:

BTL5-H1_ _-M_ _ _ _-P-S92
BTL5-H1_ _-M_ _ _ _-P-S94

Software configuration

1	1 × Position and 1 × speed
2	2 × Position and 2 × speed

Baud rate

0	1 Mbaud
1	800 kbaud
2	500 kbaud
3	250 kbaud
4	125 kbaud
5	100 kbaud
6	50 kbaud
7	20 kbaud
8	10 kbaud

Standard nominal stroke [mm]

0050...4000

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches	mm	inches
0051	2	0407	16	1220	48	2743	108
0102	4	0508	20	1372	54	3048	120
0152	6	0610	24	1524	60	3353	132
0203	8	0762	30	1829	72	3658	144
0254	10	0914	36	2134	84	3962	156
0305	12	1067	42	2438	96		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

DeviceNet
DeviceNet is a manufacturer-independent open fieldbus standard used in automation technology for connecting programmable logic controllers (PLCs) to intelligent devices such as sensors, pushbuttons, I/O modules, basic user interfaces and drives via a single cable. DeviceNet is an application protocol (OSI layer 7) based on the Controller Area Network (CAN) principle. It offers high reliability for demanding applications with a high number of IO modules. The transmission speed is between 125 kbit/s and 500 kbit/s depending on type and length of the cable.

EDS
DeviceNet offers configuration of functionality and data exchange. Through a standard datasheet in the form of an EDS-file, a problem-free connection of the Micropulse Transducer to any DeviceNet systems is possible.

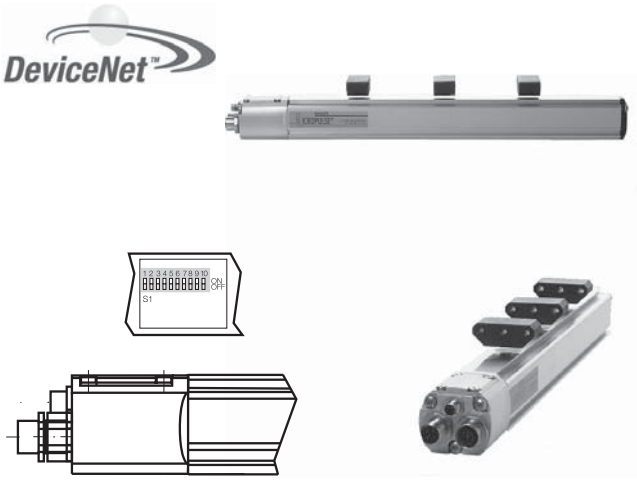
DeviceNet features:
- Linear topology
- Low-cost wiring with two-wire cable
- Fast response times
- High data security due to CRC checking
- Hamming distance of 6
- Potential-free data transmission (RS485)
- 125 Kb/s at cable length < 500 m
  250 Kb/s at cable length < 250 m
  500 Kb/s at cable length < 100 m
- Protocol limits number of nodes to 64

Position Sensor Object
The DeviceNet interface of the Micropulse Transducer is compatible with the CIP Common Specification Object Library "Position Sensor Object" of the ODVA.
The Micropulse Transducers transmit their measured values to an instance of the position sensor object as a 32-bit value.

The following information can be sent:
- Current magnet position with resolution in 5 µm increments
- Current magnet speed in increments of 0.1 mm/s
- The current status of the four freely programmable cams

Synchronization
Measurement can be triggered by the master I/O bit Strobe Command Message. On receiving this bit, the respective Micropulse Transducer saves its current position and velocity information and sends it back to the controller.

FMM
The sensor can be operated as a 1...4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
So if only two magnets are positioned in the measuring range, a valid value is output for the first two positions and a defined error value for positions 3 and 4.

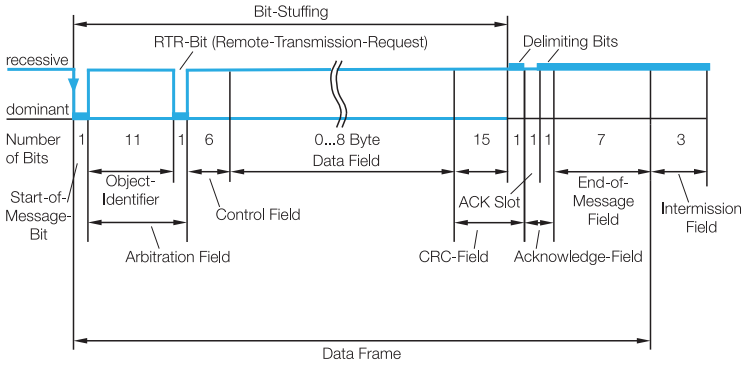


Position of the DIP switch S1,

Device address can be set by DIP switch

Use of multiple magnets
The minimum distance between the Magnets must be 65 mm.

Series		**Profile P BTL5**		
Output signal		DeviceNet		
Transducer interface		**D**		
Customer device interface		DeviceNet		
Part number plug version S103		BTL5-**D**1_ _-M_ _ _ _-P-S93		
Profibus version		Encoder profile		
Profibus interface		Potential-free		
Repeat accuracy		±1 digit		
System resolution	Position	Configurable in increments of 5 µm		
Configurable	Speed	0.1 mm/s increments configurable		
Hysteresis		≤ 1 digit		
Sampling rate		$f_{STANDARD}$ = 1 kHz		
Max. linearity deviation		±30 µm at 5 µm resolution		
Temperature coefficient of overall system		(6 µm + 5 ppm × L)/°C		
Magnet travel speed		any		
Supply voltage		20...28 V DC		
Current consumption		≤ 100 mA		
Operating temperature		–40...+85 °C		
Storage temperature		–40...+100 °C		
Address assignment		Mechanical switches or DeviceNet		
Cable length [m]		100	250	500
Baud rate [kbps]		500	250	100



Please enter code for software configuration, baud rate and nominal stroke in the Part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, page 100
Connectors, page 236
Mounting clamps with insulating sleeves and screws, page 100

Ordering example:

BTL5-D1_ _-M_ _ _ _-P-S93

Software configuration

1 Magnet FMM

Baud rate

2 500 kbaud
3 250 kbaud
4 125 kbaud

Standard nominal stroke [mm]

0050...4000

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches	mm	inches
0051	2	0407	16	1220	48	2743	108
0102	4	0508	20	1372	54	3048	120
0152	6	0610	24	1524	60	3353	132
0203	8	0762	30	1829	72	3658	144
0254	10	0914	36	2134	84	3962	156
0305	12	1067	42	2438	96		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

As the market leading standard for serial data transmission for process automation, Profibus DP is the ideal choice for implementing automation tasks with cycle times of > 5 ms.

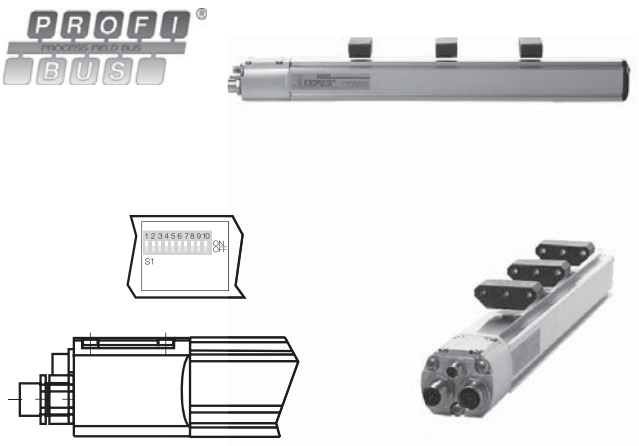
Data transmission
A Profibus telegram can contain up to 244 bytes of user data per telegram and node. The BTL5-T uses max. 32 bytes (max. 4 position values and max. 4 velocity values) for process data transmission.
Up to 126 active stations (addresses 0...125) can be connected on Profibus DP. User data cannot be sent with node address 126. This address is used as the default address for bus nodes that have to be configured by a Class 2 master (for setting the device address if there are no mechanical switches available). Each Profibus station has the same priority. Prioritizing of individual stations is not intended, but can be done by the master since the bus transmission only makes up a fraction of the process cycle anyway. At a transfer rate of 12 Mbaud, the transmission time for an average data telegram is in the 100 µs range.

GSD (device master data)
The length of the data exchangeable with a slave is defined in the Device Master Data file (GSD) and is checked by the slave with the configuration telegram and confirmed for correctness.
In modular systems, various configurations are defined in the GSD file. Depending on the desired functionality, one of these configurations can be selected by the user when the system is configured. The BTL5-T is a modular device with the possibility of selecting the number of magnets (position values).

Process data
Under Profibus DP, by default, the process data is to be sent from the master to slaves acyclically and for the slave data to then be queried. To ensure synchronization of multiple devices, the master may use the SYNC and FREEZE services.

DP/V1 and DP/V2 isochronous mode
Isochronous mode enables quick and deterministic data exchange by means of clock synchronicity on the bus system. A cyclical, equidistant clock signal is sent by the master to all bus nodes. This signal allows master and slaves to be synchronized irrespective of application – with an accuracy < 1 µs.

FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
So if only two magnets are positioned in the measuring range, a valid value is output for the first two positions and an error value is defined in positions 3 and 4.



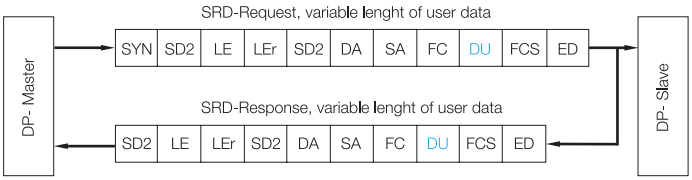
Position of the DIP switch S1

Device address can be set by DIP switch

Use of multiple Magnets
The minimum distance between the Magnets must be 65 mm.

Profile P BTL5
Profibus DP interface

Series		**Profile P BTL5**				
Output signal		Profibus DP				
Transducer interface		**T**				
Customer device interface		Profibus DP				
Part number plug version S103		BTL5-**T**1_ 0-M_ _ _ _-P-S103				
Profibus version		DPV1/DPV2 EN 50170, encoder profile				
Profibus interface		Potential-free				
Repeat accuracy		±1 digit				
System resolution	Position	5 µm increments configurable				
Configurable	Speed	0.1 mm/s increments configurable				
Hysteresis		≤ 1 digit				
Sampling rate		$f_{STANDARD}$ = 1 kHz				
Max. linearity deviation		±30 µm at 5 µm resolution				
Temperature coefficient of overall system		(6 µm + 5 ppm × L)/°C				
Magnet travel speed		any				
Supply voltage		20...28 V DC				
Current consumption		≤ 120 mA				
Operating temperature		–40...+85 °C				
Storage temperature		–40...+100 °C				
GSD file		BTL504B2.GSD				
Address assignment		Mechanical switches and Master Class 2				
Cable length [m]		< 100	< 200	< 400	< 1,000	< 1,200
Baud rate [kbps]		12000	1500	900	187.5	93.7/19.2/9.6



Please enter code for software configuration and nominal stroke in the Part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets, page 100
Connector, page 236
Mounting clamps with insulating sleeves and screws, page 100

Ordering example:

BTL5-T1_ 0-M_ _ _ _-P-S103

Software configuration

1	1 × Magnet 1 × Position 1 × Speed
2	2 × Position 2 × Speed

Standard nominal stroke [mm]

0050...4000

Commonly specified stroke lengths:

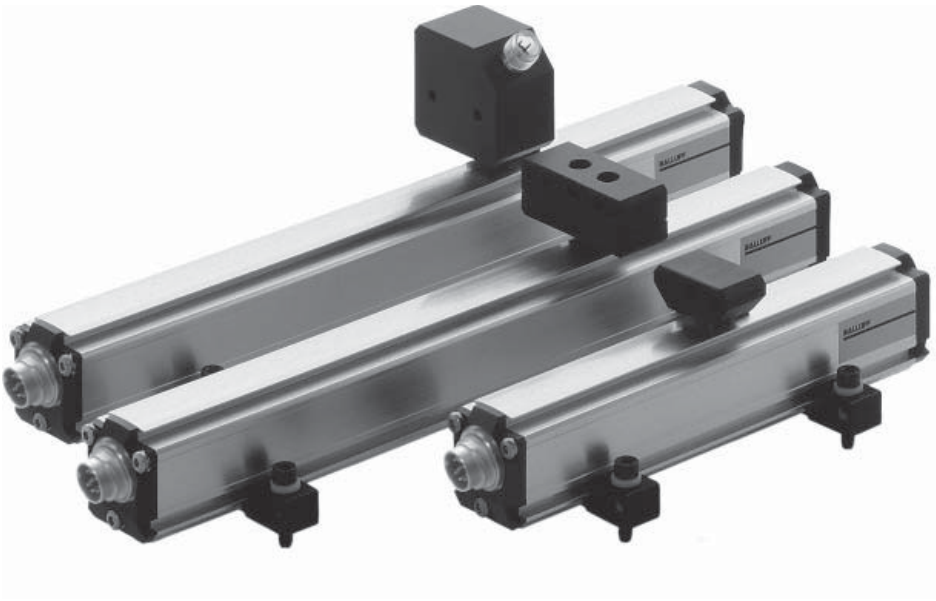
mm	inches	mm	inches	mm	inches
0051	2	0610	24	2134	84
0102	4	0762	30	2438	96
0152	6	0914	36	2743	108
0203	8	1067	42	3048	120
0254	10	1220	48	3353	132
0305	12	1372	54	3658	144
0407	16	1524	60	3962	156
0508	20	1829	72		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

Non-contact!
Distance up to 15 mm

Balluff magnets are available in captive or floating designs. Transducers with captive magnets guarantee the highest resolution and reproducibility.
The BTL5-P-4500-1 magnet is an electromagnet and requires an operating voltage of 24 V, which can be turned on and off for selective activation. This allows multiplex operation with multiple magnets on a single transducer.

Description	
for Series	
Version	
Ordering code	
Part number	
Housing material	
Weight	
Magnet travel speed	
Supply voltage	
Current consumption	
Operating temperature/Storage temperature range	
Scope of delivery	
Accessories (please order separately)	



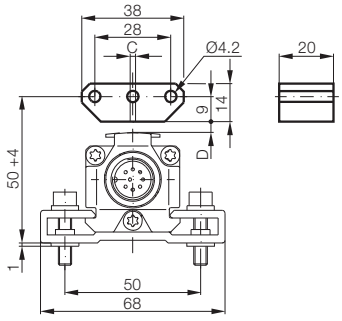
Length			Number of mounting clamp pairs
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
	more than	3251 mm	8

Mounting clamps with insulating sleeves and screws must be ordered separately.

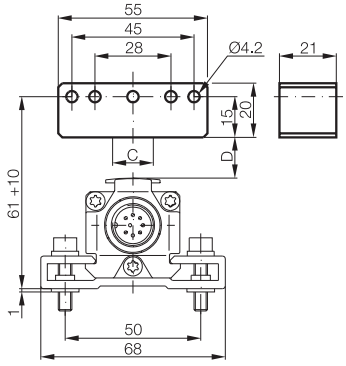
1 pair of mounting clamps:
BAM0204

Profile P
Floating magnet

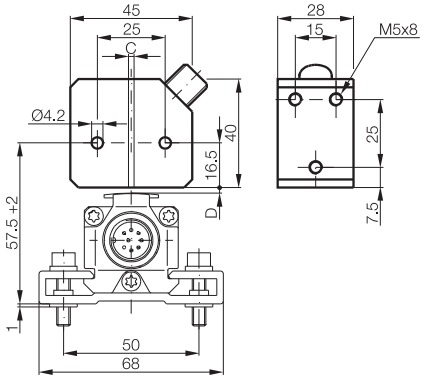
	Magnet	Magnet	Magnet
	Profile P BTL	Profile P BTL	Profile P BTL
	Floating	Floating	Floating
	BAM014M	**BAM014T**	**BAM014P**
	BTL5-P-3800-2	BTL5-P-5500-2	BTL5-P-4500-1
	Plastic	Plastic	Plastic
	approx. 12 g	Approx. 40 g	Approx. 90 g
	any	any	any
			24 V DC
			100 mA
	–40...+85 °C	–40...+85 °C	–40...+60 °C
	Magnet 2 fastening screws DIN 84 M4×35-A2 with washers and nuts	Magnet	Magnet
			Connector, straight* BCC M415-0000-1A-014-PS0434 Connector, angle* BCC M425-0000-1A-014-PS0434



Lateral offset:
C = ±2 mm
Distance of Magnet:
D = 0.1...4 mm

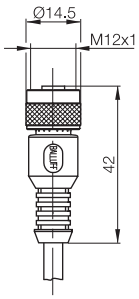


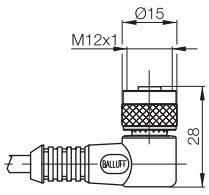
Lateral offset:
C = ±15 mm
Distance of Magnet:
D = 5...15 mm

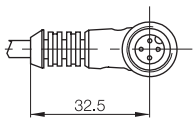


Lateral offset:
C = ±2 mm
Distance of Magnet:
D = 0.1...2 mm

* Please include the cable length code in the part number.
010 = 2 m, 050 = 5 m, 100 = 10 m

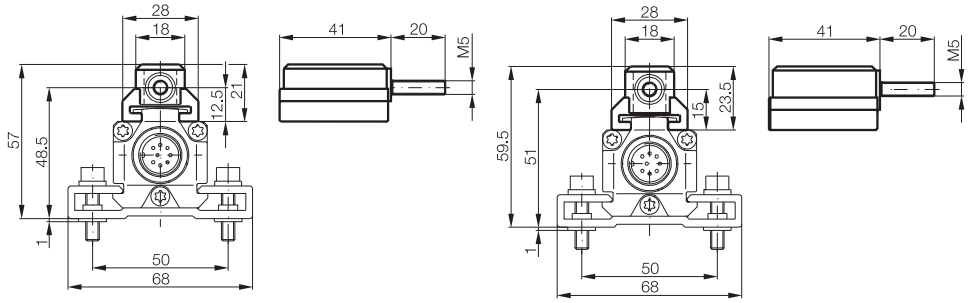


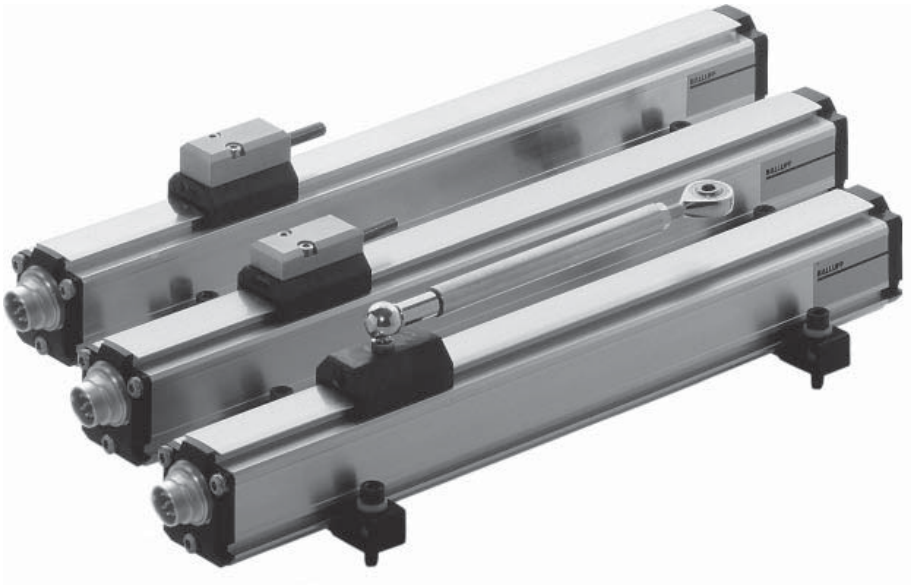




Profile P BTL
Captive magnet

Description		Magnet	Magnet
for Series		Profile P BTL	Profile P BTL
Version		Captive	Captive
Ordering code		**BAM014K**	**BAM014L**
Part number		BTL5-M-2814-1S	BTL5-N-2814-1S
Material	Housing	Anodized aluminum	Anodized aluminum
	Sliding surface	Plastic	Plastic
Weight		Approx. 32 g	Approx. 35 g
Magnet travel speed		any	any
Operating temperature/Storage temperature range		–40...+85 °C	–40...+85 °C



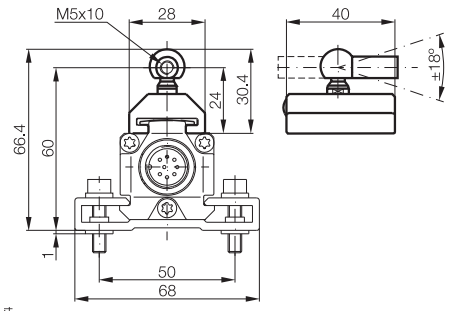


Length			Number of mounting clamp pairs
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
	more than	3251 mm	8

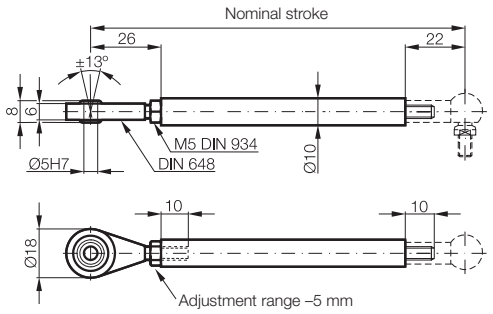
Mounting clamps with insulating sleeves and screws must be ordered separately.

1 pair of mounting clamps:
BAM0204

	Magnet
	Profile P BTL
	Captive
	BAM014H
	BTL5-F-2814-1S
	Anodized aluminum
	Plastic
	approx. 28 g
	any
	–40...+85 °C



Description	**Control arm with swivel eye and M5 threaded stud**
for Series	Profile P
Version	Captive
Part number	BTL2-GS10-_ _ _ _-A
Material	Aluminum
Weight	approx. 150 g/m



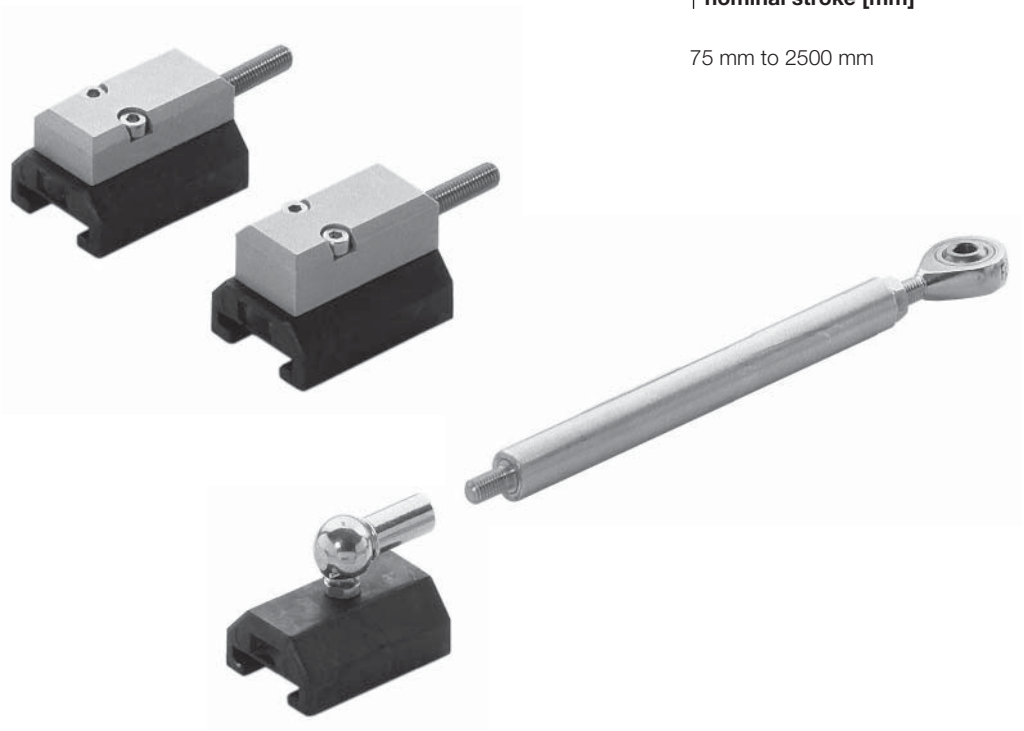
Please enter the code for the nominal stroke in the part number.

Ordering example:

BTL2-GS10-_ _ _ _-A

Standard nominal stroke [mm]

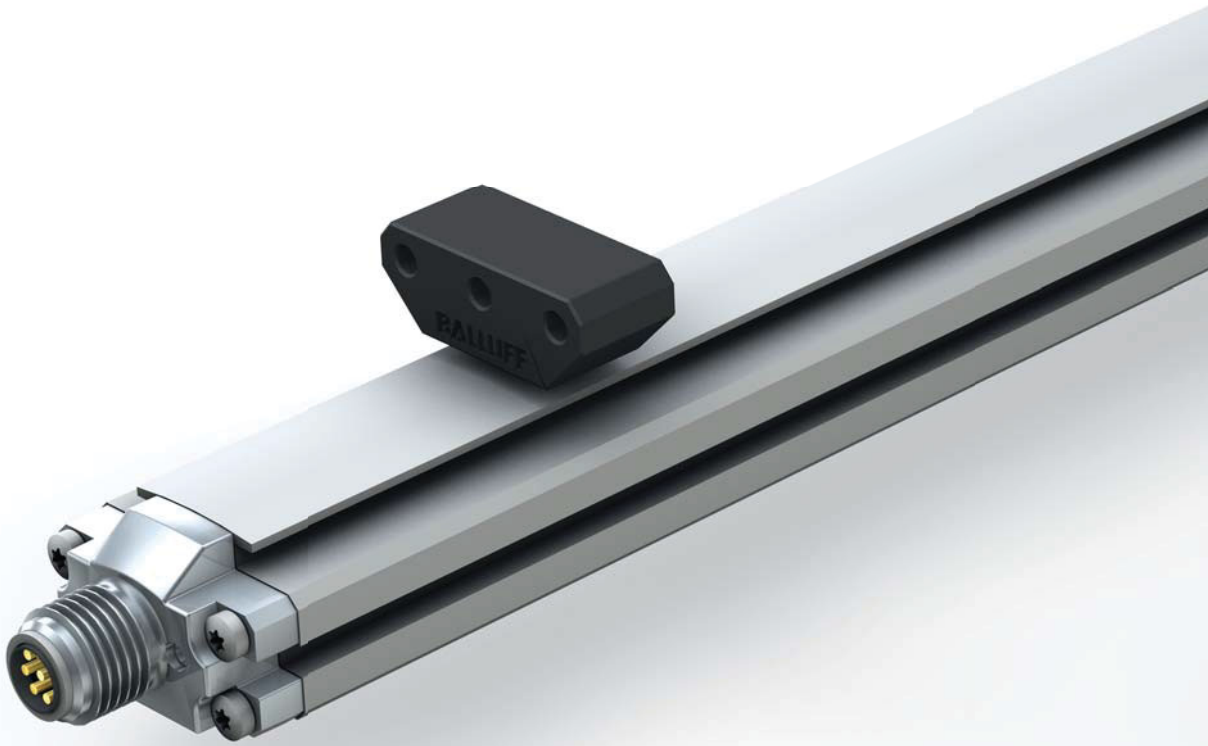
75 mm to 2500 mm



Micropulse Transducers

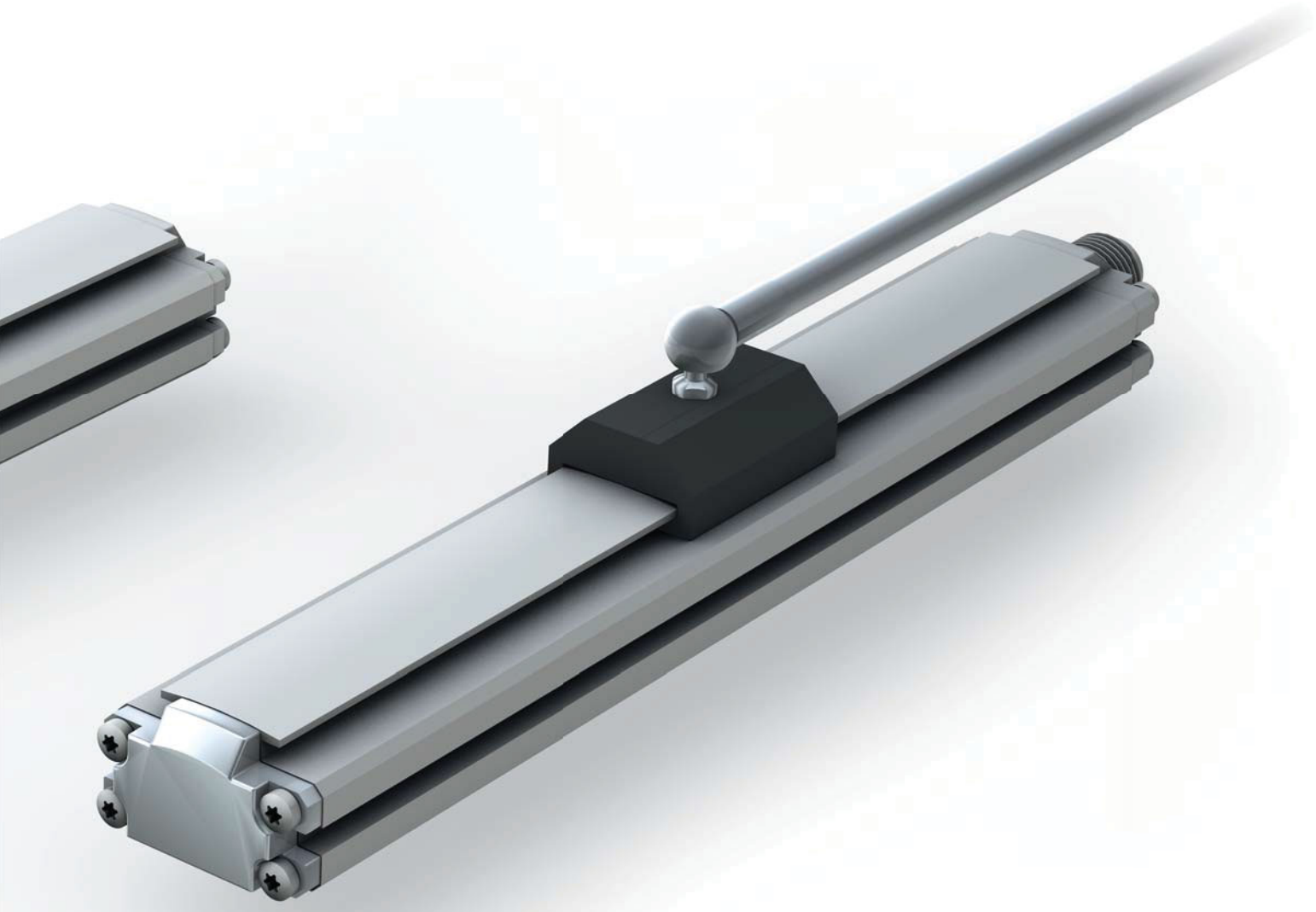
Profile PF

- Low-profile, flat housing
- Easy to install
- High degree of protection, IP 67 standard
- Up to 15 mm distance between magnet and system – truly non-contact
- Floating and captive ball joint arm magnets
- Available outputs:
  - Analog
  - IO-Link V1.1



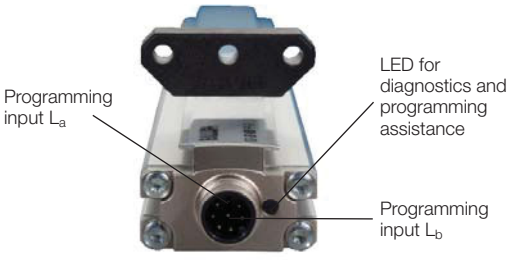
Contents

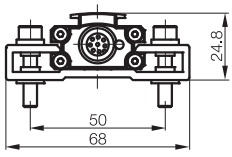
MICROPULSE®



The robust design, high degree of protection and simple installation of Balluff Micropulse Transducers in a profile housing makes them an excellent alternative to linear potentiometers, glass scales and LVDTs. The linear sensing element is protected inside an extruded aluminum profile.
A passive magnet marks the measuring point on the measuring path without making contact. Measuring ranges between 50 and 4572 mm are possible.

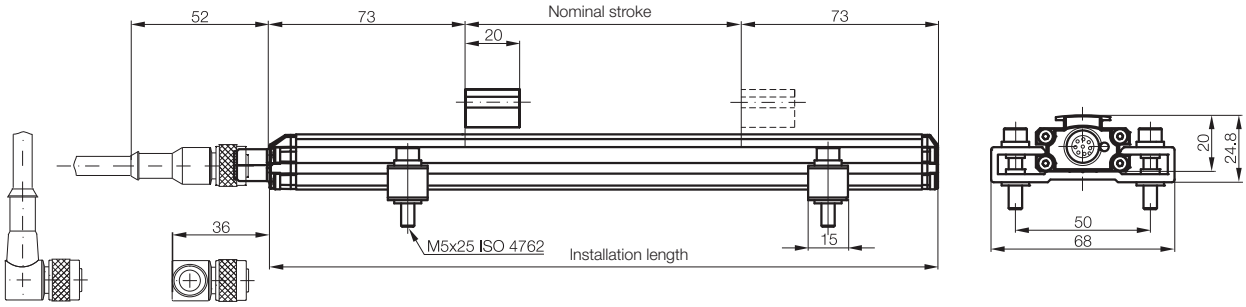
- Non-contact measurement principle
- IP 67, insensitive to contamination
- Wear-free
- Highly immune to shock and vibration
- Absolute output signal
- Max. resolution of 0.005 mm (depending on the electronic evaluation unit)
- Direct analog output – no conditioning electronics required





Series	**BTL6 profile PF**
Shock load	50 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	Yes (up to 36 V)
Overvoltage protected	to 36 V
Dielectric strength	500 VDC (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached)
Housing material	Anodized aluminum
Housing attachment	Compression clamps
Connection	Plug connector
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 3
Surge voltage	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
Standard nominal strokes [mm]	0050...4572

Transducers with floating magnet and connection S115 with BKS-S115/BKS-S116 connector



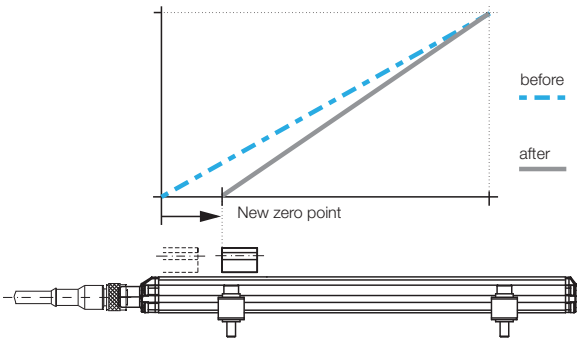
Scope of delivery
- Transducer (select your interface from page 108)
- Quick start instructions
- Mounting clamps with insulating sleeves and screws

Please order separately:
Magnets, on page 112
Mating connectors/cordsets, page 244

Adjustable with diagnostics

Output and measuring range setting
The measuring range and the output signal can be adapted to the relevant application requirements via programming inputs. In teach-in mode with inversion or reset function.

Teach-in
The factory-set zero and end point is replaced by a new zero and end point. The zero and end points can be set independently of each other, and the characteristic slope changes.

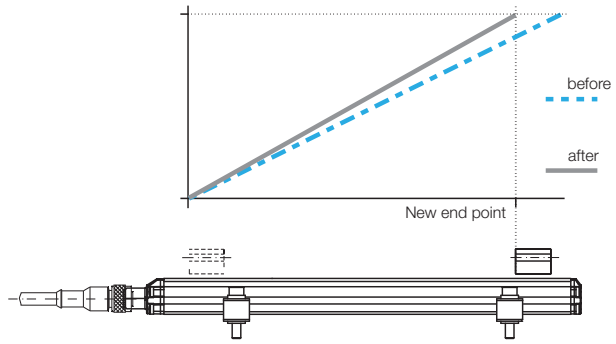


Read in new zero point

Inverting
The slope of the output (rising or falling) can be inverted by activating the programming inputs.

Reset
Restoring the transducer to its factory default settings.

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Max. residual ripple	
Load resistance (recommended)	
System resolution	
Sampling rate	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption	
Operating temperature	
Storage temperature	



Read in new end point

Calibration box

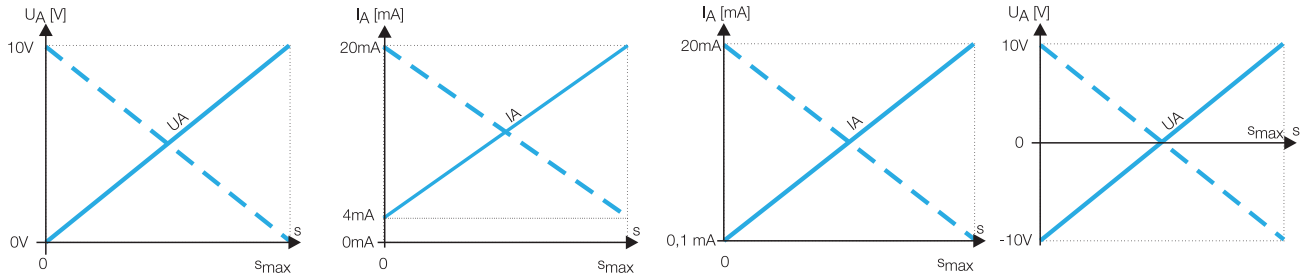
Calibration boxes with cable sets	
Part number	**Cable set**
BTL7-A-CB02	Cable connection
BTL7-A-CB02-S115	Connector S115
BTL7-A-CB02-S32	Connector S32

Micropulse Transducer BTL6 profile PF with Calibration Box BTL7-A-CB02

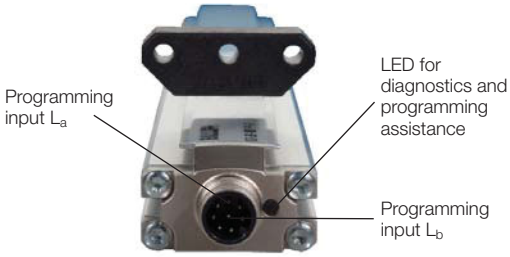
Electronic evaluation unit
Supply voltage

Set the output characteristic with the calibration box.
Zero and end point, measuring range, rising or falling characteristic.

	Profile PF BTL6	**Profile PF BTL6**	**Profile PF BTL6**	**Profile PF BTL6**
	Analog	Analog	Analog	Analog
	A	**E**	**C**	**G**
	Analog	Analog	Analog	Analog
	BTL6-**A**500-M_ _ _ _-PF-S115	BTL6-**E**500-M_ _ _ _-PF-S115	BTL6-**C**500-M_ _ _ _-PF-S115	BTL6-**G**500-M_ _ _ _-PF-S115
	0...10 V			–10...10 V
		4...20 mA	0.1...20 mA	
	Max. 5 mA			Max. 5 mA
	≤ 5 mV			≤ 5 mV
		≤ 500 ohms (500 ohms)	≤ 500 ohms (500 ohms)	
	≤ 0.35 mV	≤ 0.7 µA	≤ 0.7 µA	≤ 0.35 mV
	f_{max} = 2 kHz	f_{max} = 2 kHz	f_{max} = 2 kHz	f_{max} = 2 kHz
	±200 µm up to 500 mm nominal stroke	±200 µm up to 500 mm nominal stroke	±200 µm up to 500 mm nominal stroke	±200 µm up to 500 mm nominal stroke
	±0.04% 500... max. nominal stroke	±0.04% 500... max. nominal stroke	±0.04% 500... max. nominal stroke	±0.04% 500... max. nominal stroke
	30 ppm at 500 mm	30 ppm at 500 mm	30 ppm at 500 mm	30 ppm at 500 mm
	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
	–25...+70 °C	–25...+70 °C	–25...+70 °C	–25...+70 °C
	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C



Output signal can be inverted via programming inputs.



Please enter code for output signal and nominal stroke in the part number.

Scope of delivery
- Transducer
- Mounting clamps with insulating sleeves and screws
- Quick start instructions

Please order separately:
Magnets, on page 112
Connectors, page 244

Ordering example:

BTL6-_500-M_ _ _ _-PF-S115

Output signal | **Standard nominal stroke [mm]**

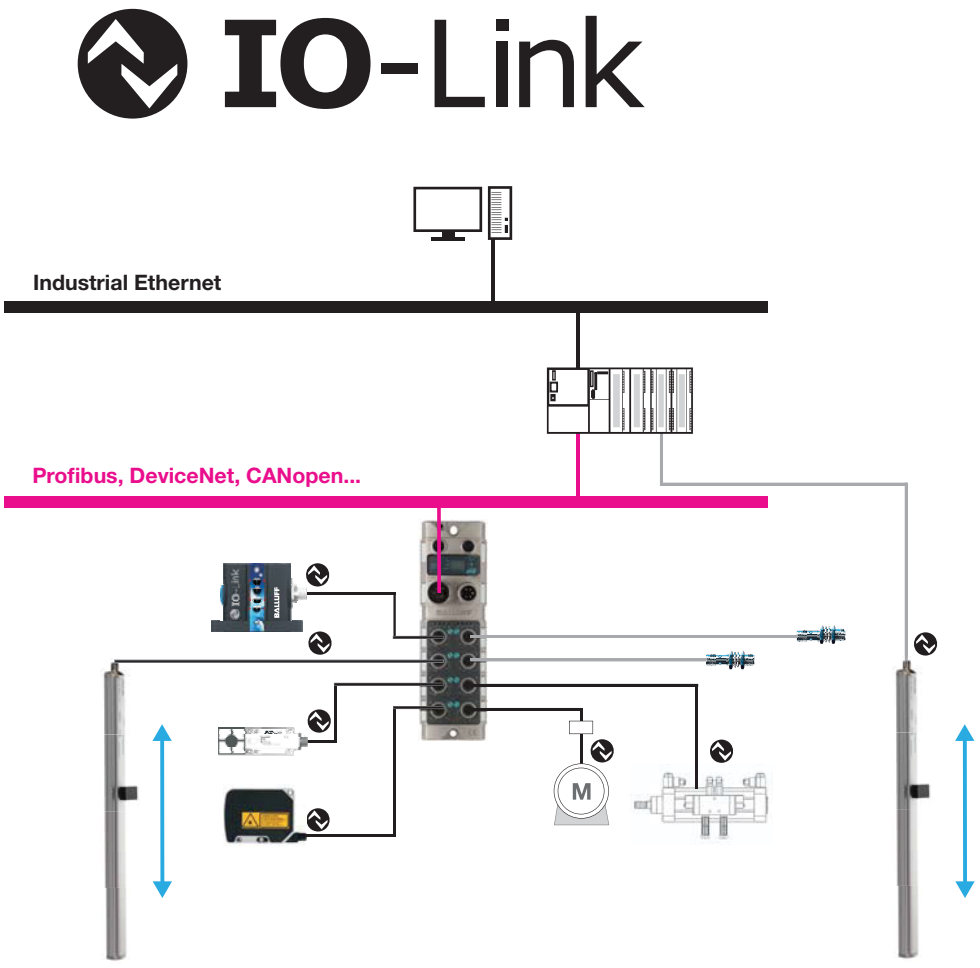
A	0...10 V	0050...4572
E	4...20 mA	
C	0.1...20 mA	
G	–10...10 V	

Non-contact position measurement technology with IO-Link
The Micropulse PF IO-Link is an absolute and non-contact position measuring system that continuously provides measurements in µm in the 1-ms cycle. These measured values are directly transferred digitally via IO-Link.
IO-Link is a point-to-point connection within any number of networks. An IO-Link system consists of an IO-Link device such as a sensor or actuator, an IO-Link master and the wiring. The IO-Link master is either an integrated/modular IP20 module for central operation in the control cabinet or as a remote I/O module in IP 65/67 form of protection for hard usage directly in the field. Master modules are available with all current field bus protocols. The Micropulse PF IO-Link device is coupled to the master via a maximum 20 m long standard sensor/actuator line. The Micropulse PF IO-Link works with the communication speed COM3 (230kB), which achieves a process data cycle of 1 ms with a 1.1 master. Data transmission between the master and the device utilizes three-conductor physics well-known in the world of standard sensor/actuators. A standard UART protocol is used. The exact nature of the data packets defines the IO-Link protocol. Via IO-Link, the user interface can be mapped based on an IODD (IO Device Description) in the engineering system. Due to the continuous flow of information, all data are centrally and consistently saved, so that a configuration is possible and reproducible at any time.

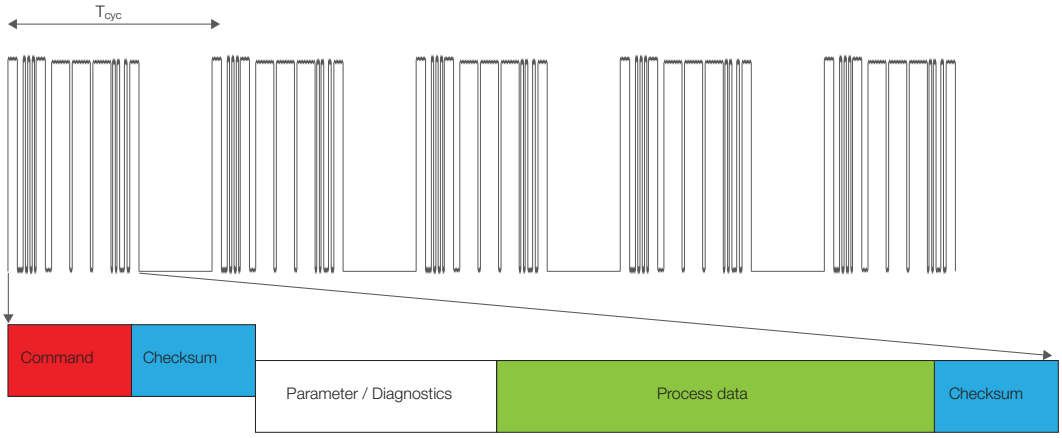
- Simple configuration, time-saving installation and startup
- OTF, automatic configuration in running operation (on the fly)
- Continuous monitoring and diagnostics
- High transfer rate, quick process data cycle
- Cost-effective wiring with standard, unshielded M12 cable connector
- Simple control integration via standard IO-Link modules
- For use in rough industrial environments, with IP-67 IO-Link master modules from Balluff
- Process data 32 bit signed integer
- Output resolution 1 µm/digit
- Diagnostics + error value recognition

Additional information
About IO-Link: www.io-link.com

You can find the compact IO-Link product line in the **Industrial Networking and Connectivity** catalog.



Series	**Profile PF BTL6**
Output signal	IO-Link V1.1
Transducer interface	U110
Part number	BTL6-U110-M_ _ _ _-PF-S4
System resolution	5 µm
Repeat accuracy	≤ 30 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz (< 1300 mm)
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke ±0.04 %
Supply voltage	18...30 V DC
Current consumption	≤ 150 mA
Polarity reversal protected	yes
Operating temperature	–25...+70 °C
Storage temperature	–40...+100 °C
Mode	COM 3
Transmission rate	230.4 kbaud
Process data cycle	1 ms
Process data	Position value in µm
Parameters	Measuring range, zero point
Diagnostics	Magnet in the measuring range, below, above, no magnet



Please enter the code for the nominal stroke in the part number.

Scope of delivery
- Transducer
- Mounting clamps with insulating sleeves and screws
- Quick start instructions

Please order separately: Magnet, page 112

Ordering example:

BTL6-U110-M_ _ _ _-PF-S4

Standard nominal stroke [mm]

0050...4572 mm

Double-ended Mating Cables

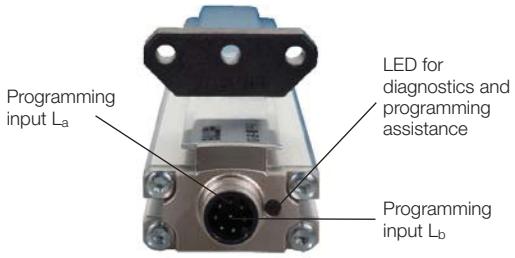
Ordering code	Part number	Description
BCC05LH	BCC M415-M413-3A-300-VX43T2-010	Molded cordset, M12 male, straight to M12 female, straight, PVC jacket, 1-meter length
BCC0AFN	BCC M415-M413-3A-300-VX43T2-020	Molded cordset, M12 male, straight to M12 female, straight, PVC jacket, 2-meter length
BCC0AFR	BCC M415-M413-3A-300-VX43T2-050	Molded cordset, M12 male, straight to M12 female, straight, PVC jacket, 5-meter length
BCC0AFT	BCC M415-M413-3A-300-VX43T2-100	Molded cordset, M12 male, straight to M12 female, straight, PVC jacket, 10-meter length

For additional cable and connector options, refer to the Balluff Industrial Networking and Connectivity catalog.

non-contact
Distance up to 15 mm

Balluff magnets are available in captive or free-floating designs. Transducers with captive magnets guarantee the highest resolution and reproducibility.
The BTL5-P-4500-1 magnet is an electromagnet and requires an operating voltage of 24 V, which can be turned on and off for selective activation. This allows multiplex operation with multiple magnets on a single transducer.

Description	
for Series	
Version	
Ordering code	
Part number	
Housing material	
Weight	
Magnet travel speed	
Supply voltage	
Current consumption	
Operating temperature/Storage temperature range	
Scope of delivery	
Accessories (please order separately)	

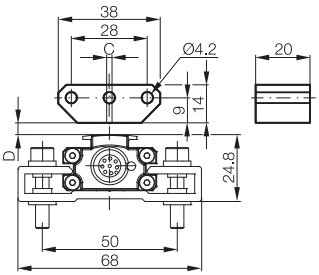


Length			Number of mounting clamp pairs
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
3251	to	3750 mm	8
3751	to	4250 mm	9
	more than	4251 mm	10

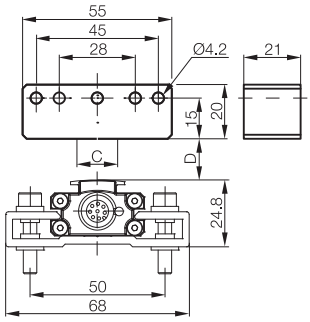
Mounting clamps with insulating sleeves and screws included in the scope of delivery of the transducer.

Replacement:
BTL6-A-MF07-A-PF/M5 1 pair of brackets and screws, Ordering code: **BAM01N3**

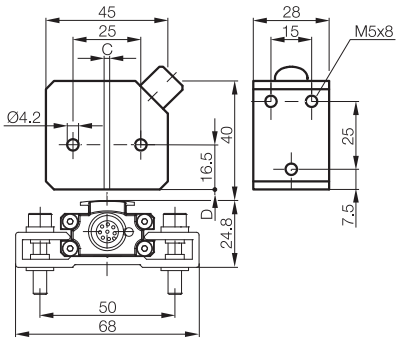
	Magnet	Magnet	Magnet
	Profile PF BTL	Profile PF BTL	Profile PF BTL
	Floating	Floating	Floating
	BAM014M	**BAM014T**	**BAM014P**
	BTL5-P-3800-2	BTL5-P-5500-2	BTL5-P-4500-1
	Plastic	Plastic	Plastic
	approx. 12 g	approx. 40 g	Approx. 90 g
	any	any	any
			24 V DC
			100 mA
	–40...+85 °C	–40...+85 °C	-40...+60 °C
	Magnet 2 fastening screws DIN 84 M4×35-A2 with washers and nuts	Magnet	Magnet
			Connector, straight* BCC M415-0000-1A-014-PS0434 Connector, angle* BCC M425-0000-1A-014-PS0434



Lateral offset:
C = ±2 mm
Distance of magnet:
D = 0.1...4 mm

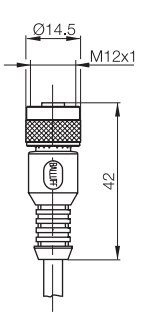


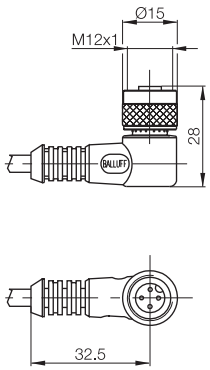
Lateral offset:
C = ±15 mm
Distance of magnet:
D = 5...15 mm



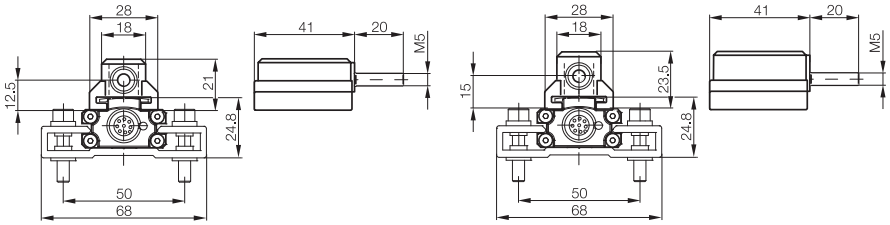
Lateral offset:
C = ±2 mm
Distance of magnet:
D = 0.1...2 mm

* Please include the cable length code in the part number.
010 = 2 m, 050 = 5 m, 100 = 10 m





Description		**Magnet**	**Magnet**
for Series		Profile PF BTL	Profile PF BTL
Version		Captive	Captive
Ordering code		**BAM014K**	**BAM014L**
Part number		BTL5-M-2814-1S	BTL5-N-2814-1S
Material	Housing	Anodized aluminum	Anodized aluminum
	Sliding surface	Plastic	Plastic
Weight		Approx. 32 g	Approx. 35 g
Magnet travel speed		any	any
Operating temperature/Storage temperature range		–40...+85 °C	–40...+85 °C

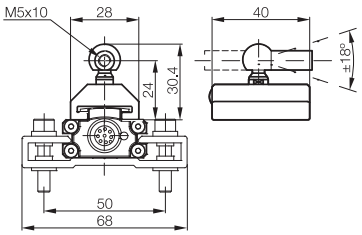


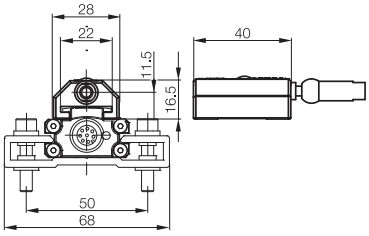
Length			**Number of mounting clamp pairs**
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
3251	to	3750 mm	8
3751	to	4250 mm	9
	more than	4251 mm	10

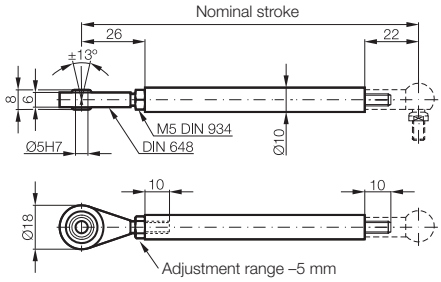
Mounting clamps with insulating sleeves and screws included in the scope of delivery of the transducer.

Replacement:
BTL6-A-MF07-A-PF/M5 1 pair of brackets and screws,
Ordering code: **BAM01N3**

	Magnet	Magnet	Control arm
	Profile PF BTL	Profile PF BTL	Profile PF BTL
	Captive	Captive	Captive
	BAM014H	**BAM01FC**	
	BTL5-F-2814-1S	BTL5-T-2814-1S	BTL2-GS10-_ _ _ _-A
	Anodized aluminum	Anodized aluminum	Aluminum
	Plastic	Plastic	
	approx. 28 g	approx. 28 g	approx. 150 g/mg
	any	any	
	–40...+85 °C	–40...+85 °C	







Please enter the code for the nominal stroke in the part number.

Ordering example:

BTL2-GS10-_ _ _ _-A

Standard nominal stroke [mm]

0075 mm to 2500 mm

Micropulse Transducers

Profile AT

- In a robust 30-mm tubular housing for universal installation
- The cost-effective, non-contact position measuring solution
- With analog output signal and Real-Time Ethernet

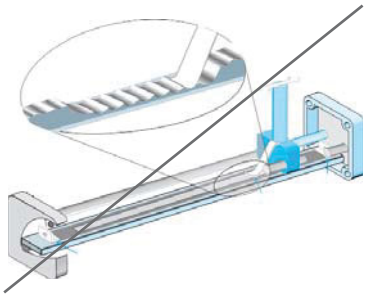
Contents

MICROPULSE®

Micropulse Transducers – a non-contact alternative to contacting transducers

The structural design, high degree of protection and simple installation of non-contact Balluff Micropulse AT transducers in a profile housing makes them an excellent alternative to contacting potentiometers. The linear sensing element is protected inside an extruded aluminum profile.

A passive magnet with no power supply marks the measuring point on the measuring path without making contact. Measuring ranges between 50 and 1,524 mm are possible.



- Non-contact detection of the measurement position
- IP 67, insensitive to contamination
- Wear-free
- Insensitive to shock and vibration
- Absolute output signal
- Direct signal evaluation or in conjunction with evaluation units for all control and closed-loop systems

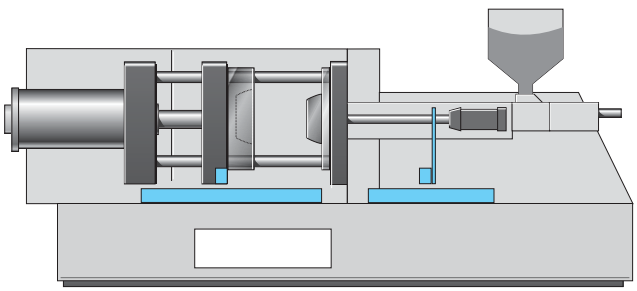
This product is certified according to File No. E227256.

From optional to standard

Micropulse Transducers have long been standard in the plastics machinery industry on high-precision machines and offered on standard machines as a non-contact option for potentiometric systems. The only thing that has stood in the way of more widespread use has been the comparatively high price.

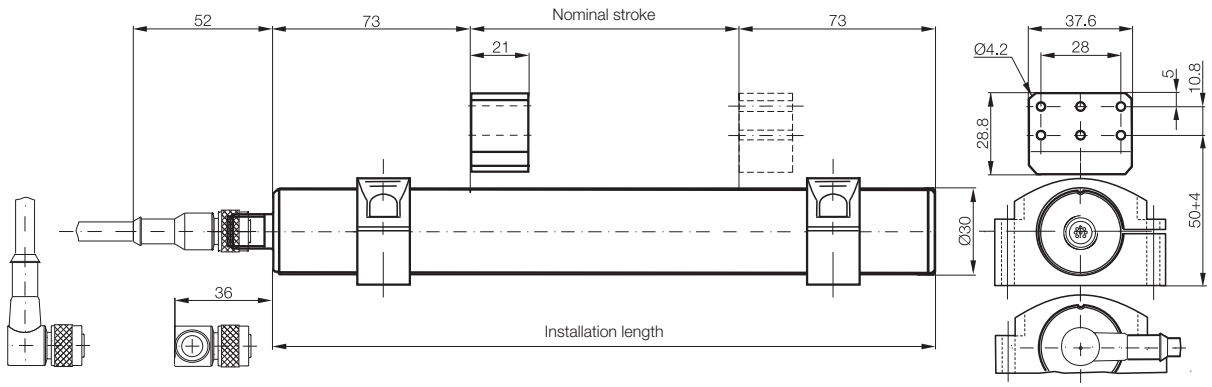
The Micropulse AT has been designed in cooperation with development engineers from the plastics machinery industry and represents a system that is competitively priced and meets all the technical demands of the industry.

With the Micropulse AT position feedback system, now even standard machines can feature the benefit of minimum downtime provided by non-contact transducer systems.



Series	**BTL6 Profile A1**
Part number	BTL6-_ _ _-M_ _ _ _-A1-S115
Part number	BTL6-**A**301-M_ _ _ _-A1-S115
Shock load	50 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 10...2,000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protected	yes
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached)
Housing material	Anodized aluminum
Housing attachment	Mounting clamps
Connection	Connector M12, 8-pin standard
EMC testing	
Radio interference emission	EN 55016-2-3 (industry and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 3
Conducted interference	EN 61000-4-6 Severity level 3
induced by high-frequency fields	EN 61000-4-8 Severity level 4

Transducers with floating magnet and connection S115 with connector BKS-S115/BKS-S116
for transducer with analog interface, digital pulse interface and VARAN Bus interface on page 122

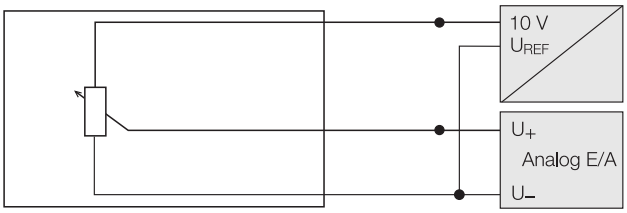


Scope of delivery
- Transducer (select your interface from page 120)
- Quick start instructions

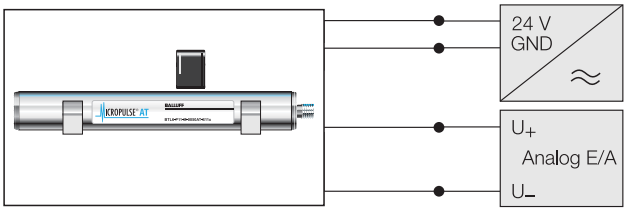
Please order separately:
Magnet, page 129
Mounting clamps/cuff, page 128
Mating connectors/cordsets, page 244

Profile AT
Analog interface

The analog outputs of the standard series BTL6-A110 are non-floating. BTL6 transducers exist in the variants 0...10 V and –10...10 V with rising and falling characteristics. The version –10...10 V generally has floating output signals.



Potentiometer connections, block diagram



Micropulse Transducer connections, block diagram

Please enter code for output signal and nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet, page 129
Mounting clamps/cuff, page 128
Mating connectors/cordsets, page 244

Ordering example:

BTL6-_ _ _ _-M_ _ _ _ _-A1-S115

Output signal

A110	0...10 V	Grounded, non-flooring
	10...0 V	Grounded, non-flooring
G310	–10...10 V	Unground, flooring
	–10...10 V	Unground, flooring

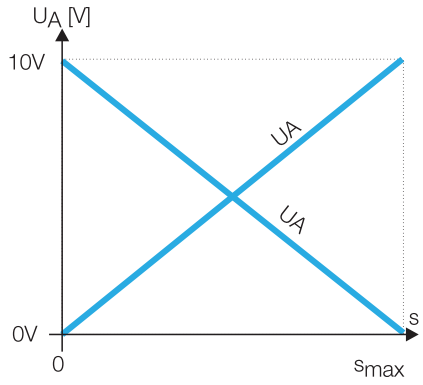
Standard available stroke lengths (specify stroke length in millimeters):

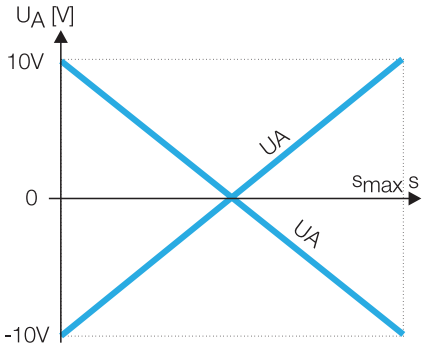
inch-equivalent lengths

0102 (4")	0127 (5")	0152 (6")	0178 (7")	0203 (8")	0230 (9")	0254 (10")
0280 (11")	0305 (12")	0330 (13")	0381 (15")	0407 (16")	0457 (18")	0508 (20")
0533 (21")	0560 (22")	0610 (24")	0661 (26")	0711 (28")	0762 (30")	0813 (32")
0914 (36")	1016 (40")	1067 (42")	1220 (48")	1270 (50")	1372 (54")	1524 (60")

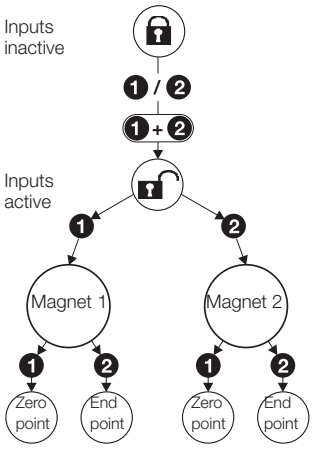
Non-standard (metric) stroke lengths also available (consult factory)
Inch to millimeter conversion: Inches x 25.4 = millimeters

Series	**Profile A1 BTL6**	**Profile A1 BTL6**
Output signal	Analog	Analog
Transducer interface	**A**	**G**
Customer device interface	Analog	Analog
Part number	BTL6-A110-M_ _ _ _-A1-S115	BTL6-G310-M_ _ _ _-A1-S115
Output voltage	**0...10 V and 10...0 V**	**–10...10 V and 10...–10 V**
Load current	Max. 5 mA	Max. 5 mA
Max. residual ripple	≤ 5 mV	≤ 5 mV
System resolution	≤ 10 µm	≤ 10 µm
Repeat accuracy	≤ 10 µm	≤ 10 µm
Reproducibility	≤ 20 µm	≤ 20 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke typ. ±0.02%, max. ±0.04% 500...1500 mm nominal stroke	≤ ±200 µm up to 500 mm nominal stroke typ. ±0.02%, max. ±0.04% 500...1500 mm nominal stroke
Supply voltage	20...28 V DC	20...28 V DC
Current consumption	≤ 70 mA	≤ 70 mA
Polarity reversal protected	yes	yes
Operating temperature	0...+70 °C	0...+70 °C
Storage temperature	–40...+100 °C	–40...+100 °C





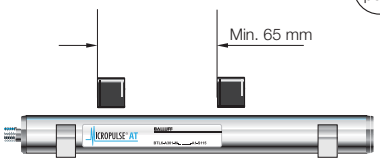
BTL6-A301-... Two become one
Two moving members on a machine often travel in the same direction. Each axis normally requires a separate feedback sensor.
With the Micropulse AT, it is now possible to detect two movements at the same time using just one transducer with two analog outputs.
The position of the respective zero and end points can be set individually using programming inputs.
The two measuring ranges can be adjacent, can partially overlap, and can be programmed for a rising or falling characteristic. The transducer can be operated using one or two magnets. If one magnet leaves the measuring range or if only one is present, the position is indicated on Output 1. Output 2 then indicates an error value.



Example: Programming steps for setting the measuring range

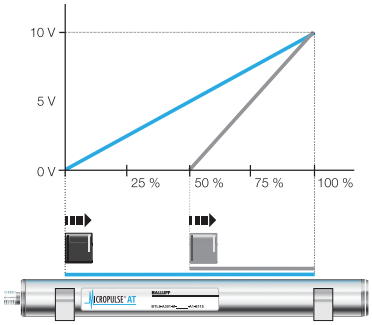
Teach-in
The zero and end points set at the factory are to be replaced by the new zero and end points. First, the magnet must be brought to the new zero point and then to the new end position, and the respective values stored by pressing the button.

Mode selection
The standard function is the separate measurement of two positions. The programming inputs are used to switch the mode.

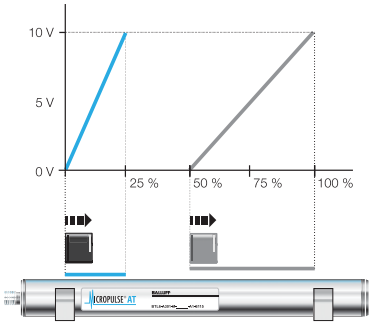


The separation between two magnets should not generally be less than 65 mm.

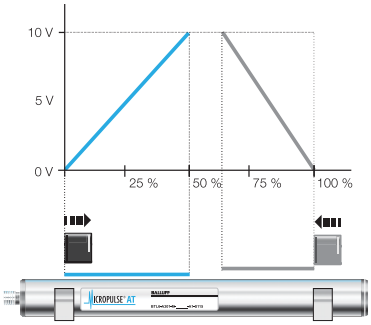
Mode 1: Single measurement of 2 positions (single measurement default setting 100%/50%)



Basic default setting

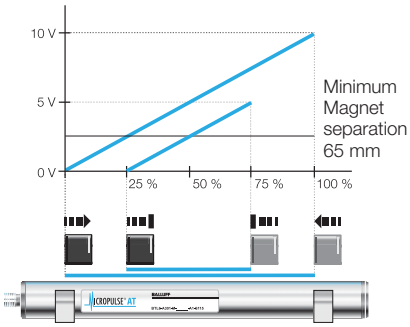


Programming example:
Output 1: 25% nominal stroke, signal rising
Output 2: 50% nominal stroke, signal rising

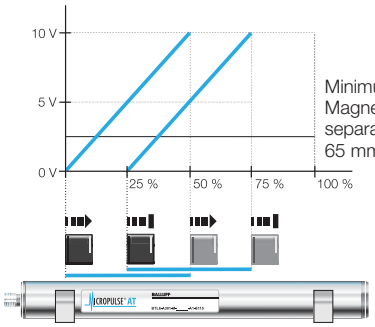


Programming example:
Output 1: 50% nominal stroke, signal rising
Output 2: 37.5% nominal stroke, signal falling

Mode 2: Differential measurement between 2 magnets

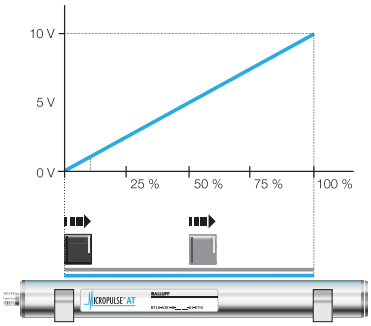


Default setting: Differential measurement
Output 1: Standard displacement signal (not shown)
Output 2: Differential signal 100% nominal stroke = 10 V
Programming example:
Differential displacement 50% nominal stroke = 5 V differential signal



Programming example: Differential displacement 50% nominal stroke = 10 V differential signal

Mode 3: Single measurement (both magnets 0...100%)

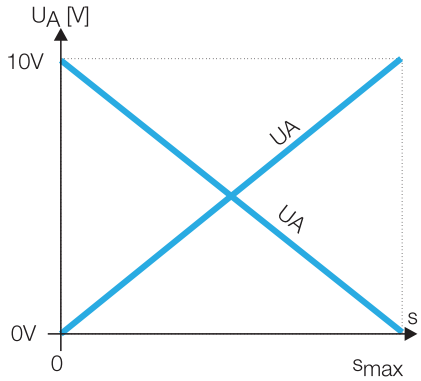


Operating modes

Features of Micropulse BTL6-A
- 100% setting range of the analog signals
- Error signal value, no magnet in the measuring range, transducer in setting mode
- LED display for programming support
- Separate teach-in of all zero and end points
- Freely selectable single position or differential measurement

Measure two motions with one system
- One transducer measures two movements simultaneously.
- Substantial cost reduction, because installation costs are halved.
- Two 0...10 V Analog output

Series	**Profile A1 BTL6**
Output signal	Analog
Transducer interface	**A**
Customer device interface	Analog
Part number	BTL6-**A**301-M_ _ _ _-A1-S115
Output	Potential-free
Output voltage	**0...10 V programmable**
Load current	Max. 5 mA
Max. residual ripple	≤ 5 mV
System resolution	≤ 10 µm
Repeat accuracy	≤ 10 µm
Reproducibility	≤ 20 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz (< 850 mm)
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke typ. ±0.02%, max. ±0.04% 500...1500 mm nominal stroke
Supply voltage	18...30 V DC
Current consumption	≤ 100 mA
Polarity reversal protected	yes
Operating temperature	0...+70 °C
Storage temperature	–40...+100 °C



Please enter the code for the nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet, page 129
Mounting clamps/cuff, page 128

Ordering example:

BTL6-A301-M_ _ _ _-A1-S115

Characteristic

Floating
2 analog outputs
Single or differential measurement, rising, falling, zero and end point programmable

Standard nominal stroke [mm]

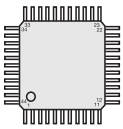
0160 0175 0200 0225 0250 0275 0300
0325 0350 0360 0375 0400 0425 0450
0475 0500 0550 0600 0650 0700 0750
0800 0850 0900 0950 1000 1100 1200
1250 1300 1400 1500
in 25 mm increments on request

Standard nominal stroke (mm)
0050, 0100, 0130, 0150 for single magnet only

P110 interface
The P110 interface works with Balluff BTA evaluation units and controllers and modules from various manufacturers, e.g. Siemens, B & R, Bosch, Phoenix Contact, Mitsubishi, Sigmatek, Esitron, WAGO and others.
Reliable signal transmission, even over cable lengths up to 500 m, between the BTA evaluation unit and the transducer is guaranteed by the particularly interference-free RS485 differential drivers and receivers. Interference signals are effectively suppressed.

P110 replaces P1 and M1
Based on differing philosophies, two controller-specific interfaces have been established for the digital pulse versions.
The difference lies in how the edges are processed. The falling edges are processed in the P interface and the rising edges in the M interface. To reduce the number of different models to a minimum, the P110 interface was created as a universal pulse interface which combines both functions. The reference point for the propagation time measurement is the start pulse.

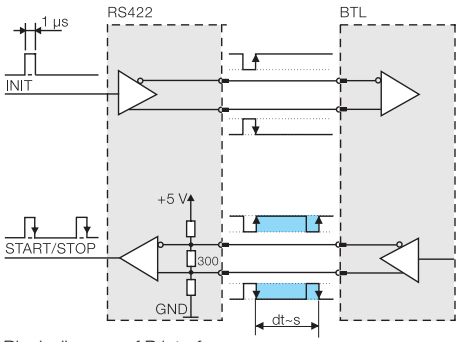
Extremely precise digitizing chip for P110 pulse interface
Companies developing their own electronic control and evaluation unit can create a highly accurate P interface cost-effectively and with minimum effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for Micropulse Transducers with P interface.



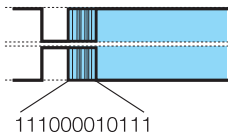
Digitizing chip 44QFP

P111 interface – Cost savings using DPI/IP for start-up and installation
DPI/IP is a protocol for direct data interchange between a controller and transducer. The signal lines are used to send additional information such as manufacturer, measuring length and waveguide gradient. This allows start-up or replacement of a transducer without having to make manual changes to the controller parameters.

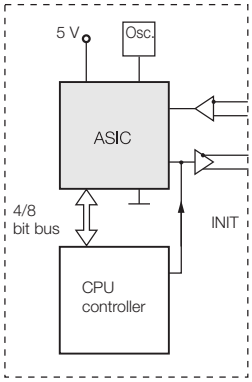
Features
- Bi-directional communication
- Position measuring system controller using Init and start/stop signals
- Integrated diagnostic functions
- Plug and Play
- Automatic configuration reduces downtimes.
- Transmission of sensor type, measuring length, specific parameters
- Measurement length up to 3,250 mm



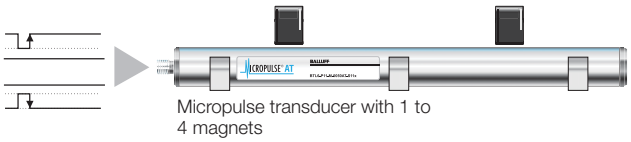
Block diagram of P interface



Advantages:
- High resolution: the actual 1 µm of the BTL position measuring system is fully supported by the 133 ps resolution of the chip (at low clock frequency 2 or 20 MHz).
- Position data from 4 magnets can be processed simultaneously
- 4/8-bit processor interface



Controller or electronic evaluation unit



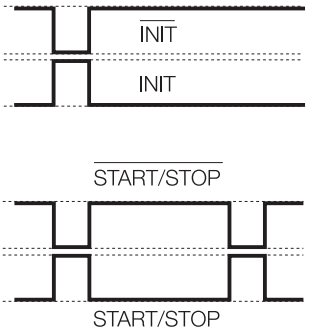
P pulse signal

Micropulse transducer with 1 to 4 magnets

ASIC INFO:
+49 7158 173-370

Series	**Profile A1 BTL6**
Transducer interface	Pulse **P11_**
Customer device interface	Pulse **P11_**
Part number	BTL6-**P11_**-M_ _ _ _-A1-S115
System resolution	processing-dependent
Repeat accuracy	≤ 10 µm
Reproducibility	≤ 20 µm
Resolution	≤ 10 µm
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke typ. ±0.02%, max. ±0.04%, 500...1500 mm nominal stroke
Supply voltage	20...28 V DC
Current consumption	≤ 60 mA (at 1 kHz)
Operating temperature	0...+70 °C
Storage temperature	–40...+100 °C

The rising and falling edges can be evaluated.



Please enter code for data protocol and nominal stroke in the Part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet, page 129
Mounting clamps/cuff, page 128
Connectors, page 236

Ordering example:

BTL6-P11_-M_ _ _ _-A1-S115

Data protocol

0 without DPI/IP* (standard)
1 with DPI/IP

Standard nominal stroke [mm]

0050 0075 0100 0130 0150 0160 0175
0200 0225 0250 0300 0350 0360 0400
0450 0500 0550 0600 0650 0700 0750
0800 0850 0900 0950 1000 1100 1200
1250 1300 1400 1500 1700 2000 2100
2500 2800 3000 3250
in 25 mm increments on request

*the version without DPI/IP is only available up to a nominal stroke of 1,500

Micropulse position measuring system BTL6-V11_ Profile AT with Industrial Ethernet

Precision measurement of the travel path of primary and secondary axes!
Micropulse position measuring systems in a profile housing are non-contact, absolute measuring systems for accurately measuring one or more measurement paths. The position measuring systems are characterized by a stable structure, high degree of protection, simple installation and wear-free measuring principle with a high degree of accuracy. One significant advantage is an economical single plug solution. which in terms of system costs incurred for materials and installation, scores well compared to expensive three-plug models.

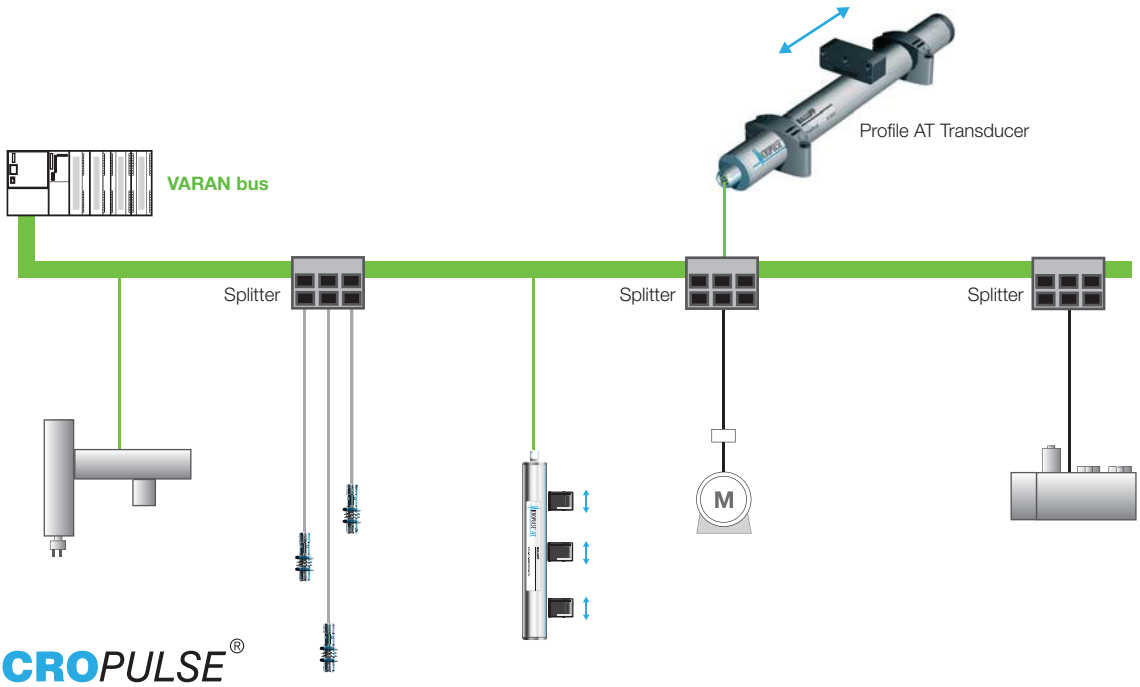
Up to four axes with one transducer
Up to four passive magnets "mark" the measuring positions on the measuring path without making contact, with measuring ranges from 50 to 4000 mm.

Features
- Non-contact detection of the measurement position
- IP 67, insensitive to contamination
- Insensitive to shock and vibration
- Absolute output signal
- Stroke lengths up to 4000 mm
- Up to 4 magnets per transducer
- Fast, simple mounting
- Single-plug solution saves system costs
- Secure data transmission

Additional information
For VARAN, see www.varan-bus.net
or for EtherCAT, see www.ethercat.org

EtherCAT®

VARAN



MICROPULSE®

Series	**Profile A1 BTL6**	**Profile A1 BTL6**
Output signal	VARAN	EtherCAT
Transducer interface	**V11V**	**V11E**
Customer device interface	VARAN	EtherCAT
Part number	BTL6-**V**11V-M_ _ _ _-A1-S115	BTL6-**V**11E-M_ _ _ _-A1-S115
System resolution	≤ 15 µm	≤ 15 µm
Repeat accuracy	≤ 20 µm	≤ 30 µm
Reproducibility	≤ 30 µm	≤ 30 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz (< 850 mm)	$f_{STANDARD}$ = 1 kHz (< 850 mm)
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke ±0.04% 500...1500 mm nominal stroke	≤ ±200 µm up to 500 mm nominal stroke ±0.04% 500...1500 mm nominal stroke
Supply voltage	20...28 V DC	20...28 V DC
Current consumption	≤ 75 mA	≤ 100 mA
Polarity reversal protected	yes	yes
Operating temperature	0...+70 °C	0...+70 °C
Storage temperature	–40...+100 °C	–40...+100 °C

Please enter the code for the nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet, page 129
Mounting clamps/cuff, page 128

Ordering example:

BTL6-V11_-M_ _ _ _-A1-S115

Interface

V	VARAN
E	EtherCAT

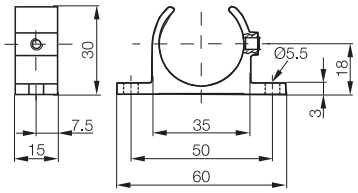
Standard Nominal stroke [mm]

0160	0175	0200	0225	0250	0275	0300
0325	0350	0360	0375	0400	0425	0450
0475	0500	0550	0600	0650	0700	0750
0800	0850	0900	0950	1000	1100	1200
1250	1300	1400	1500			

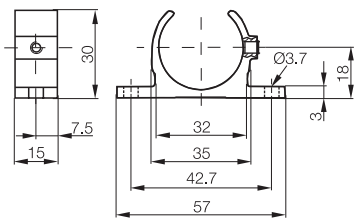
in 25 mm increments on request

The BTL6-A-3800-2 Magnet can be operated at a distance of 4...8 mm from the profile surface.
In conjunction with mounting clamp BTL6-A-MF01-A-50 and mounting cuff BTL6-A-MF03-K-50, the mechanical installation is compatible with series BTL5-...-P-S32 with magnet BTL5-P-3800-2 or BTL5-P-5500-2.
As a result, large measurement lengths or transducers with a bus connection, for example, can be implemented optionally without requiring mechanical modifications.

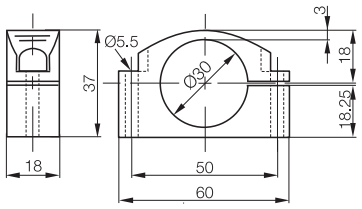
Mounting clamps/cuff



Mounting clamp
Ordering code: **BTL6-A-MF01-A-50**
Includes: 1 clamp



Mounting clamp
Ordering code: **BTL6-A-MF01-A-43**
Includes: 1 clamp

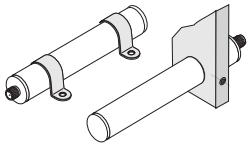


Mounting cuff
Ordering code: **BTL6-A-MF03-A-50**
Includes: 1 cuff

When extreme shock and vibration loads are present, we recommend spacing mounting clamps every 250 mm.

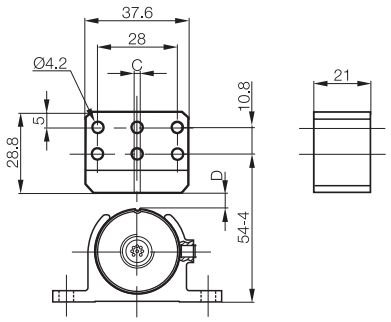
Length			Number of mounting clamp pairs
	to	250 mm	1
251	to	750 mm	2
751	to	1250 mm	3
1251	to	1750 mm	4
1751	to	2250 mm	5
2251	to	2750 mm	6
2751	to	3250 mm	7
	more than	3251 mm	8

Customer-specific mounting options

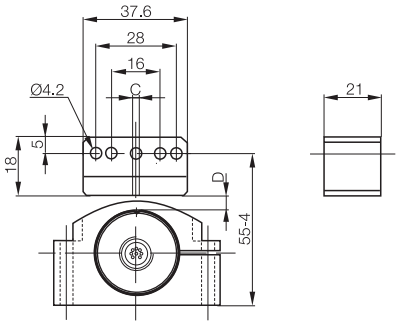


For connector accessories, see page 232

Description	**Magnet**	**Magnet**
for Series	BTL profile A1	Profile A1 BTL
Ordering code	**BAM014W**	**BAM014Z**
Part number	BTL6-A-3800-2	BTL6-A-3801-2
Housing material	Plastic	Plastic
Weight	Approx. 30 g	Approx. 25 g
Magnet travel speed	any	any
Operating temperature/Storage temperature range	–40...+85 °C	–40...+85 °C
Scope of delivery	Magnet	Magnet



Lateral offset: C = ±5 mm
Distance of magnet:
D = 4...8 mm



Lateral offset: C = ±5 mm
Distance of magnet:
D = 4...8 mm

Micropulse Transducers

Profile BIW

- Non-contact replacement for troublesome linear potentiometers
- Fast update rate for quick movements
- Analog voltage and current output versions available

Contents

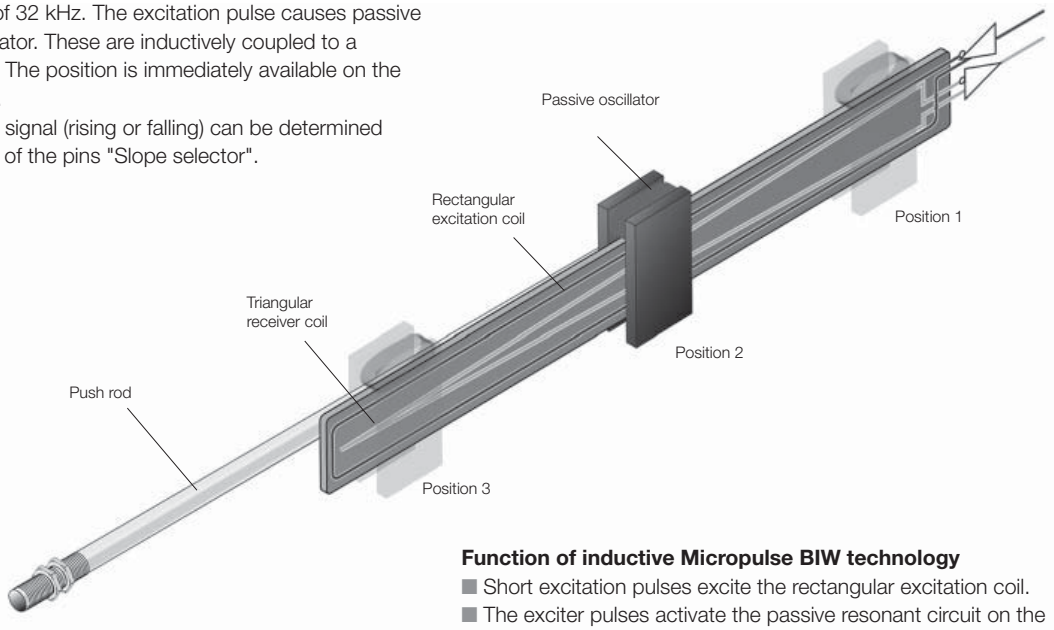
MICROPULSE®

Non-contact measurement technology

The inductive BIW transducer is based on a new, patented operating principle which detects the actual position without making contact.

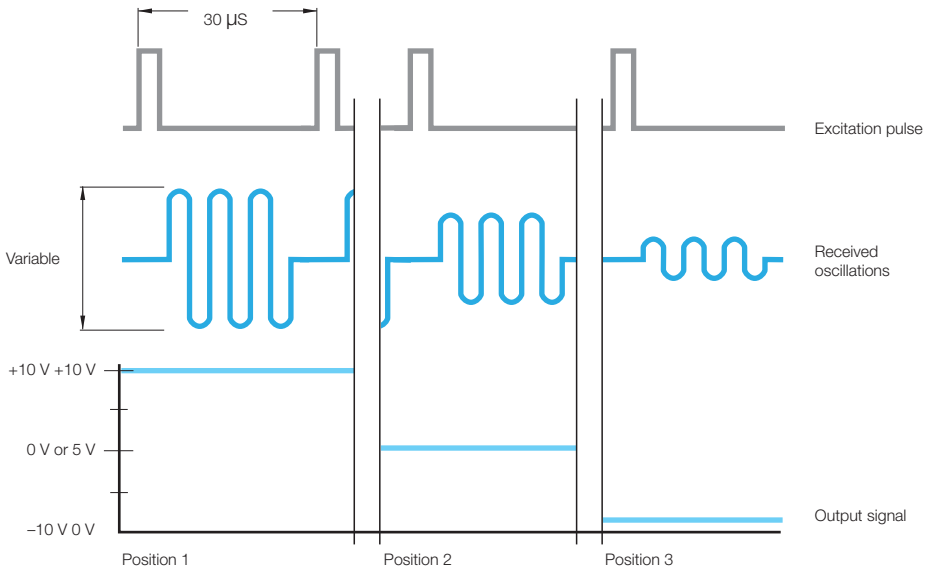
The BIW transducer contains a transmitter/receiver sensor element and a resonant circuit, all protected by an extruded aluminum housing. The resonant circuit is attached to a connecting rod, which is secured on the part of the machine whose position needs to be determined. A momentary excitation pulse is applied to the rectangular excitation coil at a sampling rate of 32 kHz. The excitation pulse causes passive oscillations in the resonator. These are inductively coupled to a triangular receiving coil. The position is immediately available on the output, and is absolute.

The slope of the output signal (rising or falling) can be determined through the connection of the pins "Slope selector".

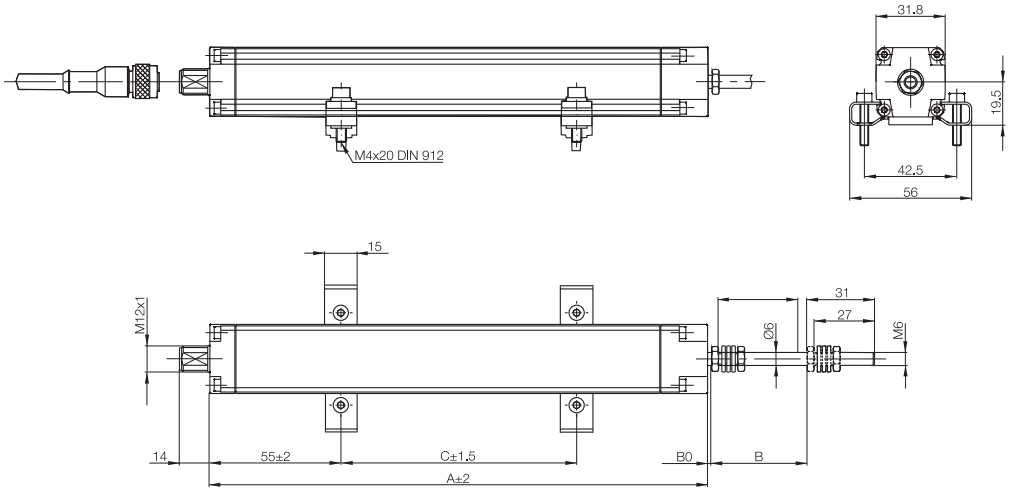


Function of inductive Micropulse BIW technology

- Short excitation pulses excite the rectangular excitation coil.
- The exciter pulses activate the passive resonant circuit on the magnet via the excitation coil.
- The resonant circuit on the magnet transmits the frequency inductively to the triangular receiver coil without making contact.
- The amplitude level varies according to the position of the magnet resonant circuit. Comparable to the amplitude level, the electronics integrated in the Micropulse BIW issue a standard analog voltage or current signal.



Series	**Profile P1 BIW**
Shock load	100 g/2 ms
Vibration	12 g, 10...2000 Hz
Dielectric strength	500 V (GND to housing)
Degree of protection as per IEC 60529	IP 54
Housing material	Anodized aluminum
Fasteners	Mounting clamps
Connection	Connector M12, 8-pin standard
Standard nominal strokes [mm]	0075, 0100, 0130, 0150, 0175, 0225, 0260, 0300, 0360, 0375, 0400, 0450, 0500, 0600, 0650, 0750, 0775



Housing length	A = nominal stroke + 100 mm
Mechanical zero point	B0 = 0 + 2 mm
Electrical zero point	B0 + 5 mm
Electrical stroke = mechanical stroke	B = nominal stroke + 10 mm
Recommend clamp distance	
Nominal stroke ≤ 300 mm	C = nominal stroke – 20 mm
Nominal stroke 300 mm to ≤ 600 mm	C = nominal stroke – 15 mm
Nominal stroke > 600 mm	C = nominal stroke – 10 mm

Calculation example:

BIW1-...-M0100-P1-S115
Nominal stroke 100
A = 200
B = 110
C = 80

Scope of delivery
- Transducer
- Quick start instructions
- 2 mounting clamps BIW-A-MF01-M-43

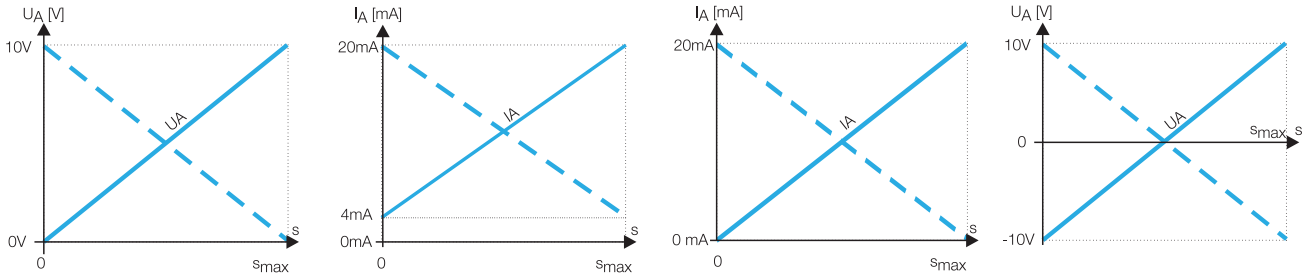
Please order separately:
Connectors, page 236

Sampling rate 32 kHz

Properties
BIW transducers have these outstanding features:
- High resolution and repeatability
- Resistance to shock, vibration and EMI
- Absolute rising or falling analog output signal
- Captive sensor element
- Update rate 32 kHz
- Potential-free output signal
- Non-contact measuring principle

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage U_{out}	
Output current I_A	
Max. current load per output	
System resolution	
Repeat accuracy	
Sampling rate	
Max. linearity deviation	
Supply voltage	
No-load current consumption	
Operating temperature	
Storage temperature	
Shock load	
Vibration	
Dielectric strength	
Degree of protection as per IEC 60529	
Housing material	
Fasteners	
Connection	
Housing length A	
Mechanical stroke B	

	Profile P1 BIW	**Profile P1 BIW**	**Profile P1 BIW**	**Profile P1 BIW**
	Analog	Analog	Analog	Analog
	A	**E**	**C**	**G**
	Analog	Analog	Analog	Analog
	BIW1-**A**310-M_ _ _ _-P1-S115	BIW1-**E**310-M_ _ _ _-P1-S115	BIW1-**C**310-M_ _ _ _-P1-S115	BIW1-**G**310-M_ _ _ _-P1-S115
	0...10 V			–10...10 V
		4...20 mA	0...20 mA	
	6 mA			6 mA
	5 µm	5 µm	5 µm	5 µm
	10 µm	10 µm	10 µm	10 µm
	typ. 32 kHz	typ. 32 kHz	typ. 32 kHz	typ. 32 kHz
	≤ 0.02%	≤ 0.02%	≤ 0.02%	≤ 0.02%
	18...30 V DC	18...30 V DC	18...30 V DC	18...30 V DC
	≤ 80 mA	≤ 80 mA	≤ 80 mA	≤ 80 mA
	–20...+85 °C	–20...+85 °C	–20...+85 °C	–20...+85 °C
	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C
	100 g/2 ms	100 g/2 ms	100 g/2 ms	100 g/2 ms
	12 g, 10...2000 Hz	12 g, 10...2000 Hz	12 g, 10...2000 Hz	12 g, 10...2000 Hz
	500 V (GND to housing)	500 V (GND to housing)	500 V (GND to housing)	500 V (GND to housing)
	IP 54	IP 54	IP 54	IP 54
	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum
	Mounting clamps	Mounting clamps	Mounting clamps	Mounting clamps
	Connector M12, 8-pin standard	Connector M12, 8-pin standard	Connector M12, 8-pin standard	Connector M12, 8-pin standard
	Nominal stroke + 100 mm	Nominal stroke + 100 mm	Nominal stroke + 100 mm	Nominal stroke + 100 mm
	Nominal stroke + 10 mm	Nominal stroke + 10 mm	Nominal stroke + 10 mm	Nominal stroke + 10 mm



Output signal can be inverted via programming inputs.

Please enter code for output signal and nominal stroke in the part number.

Scope of delivery
- Transducer
- Quick start instructions
- 2 mounting clamps BIW-A-MF02-M

Please order separately:
Connectors, page 236

Ordering example:

BIW1-_ 310-M_ _ _ _-P1-S115

Output signal

A	0...+10 V
G	–10...+10 V
E	4...20 mA
C	0...20 mA

Standard nominal stroke [mm]

0075	0100	0130	0150
0175	0225	0260	0300
0360	0375	0400	0450
0500	0600	0650	0750
0775			

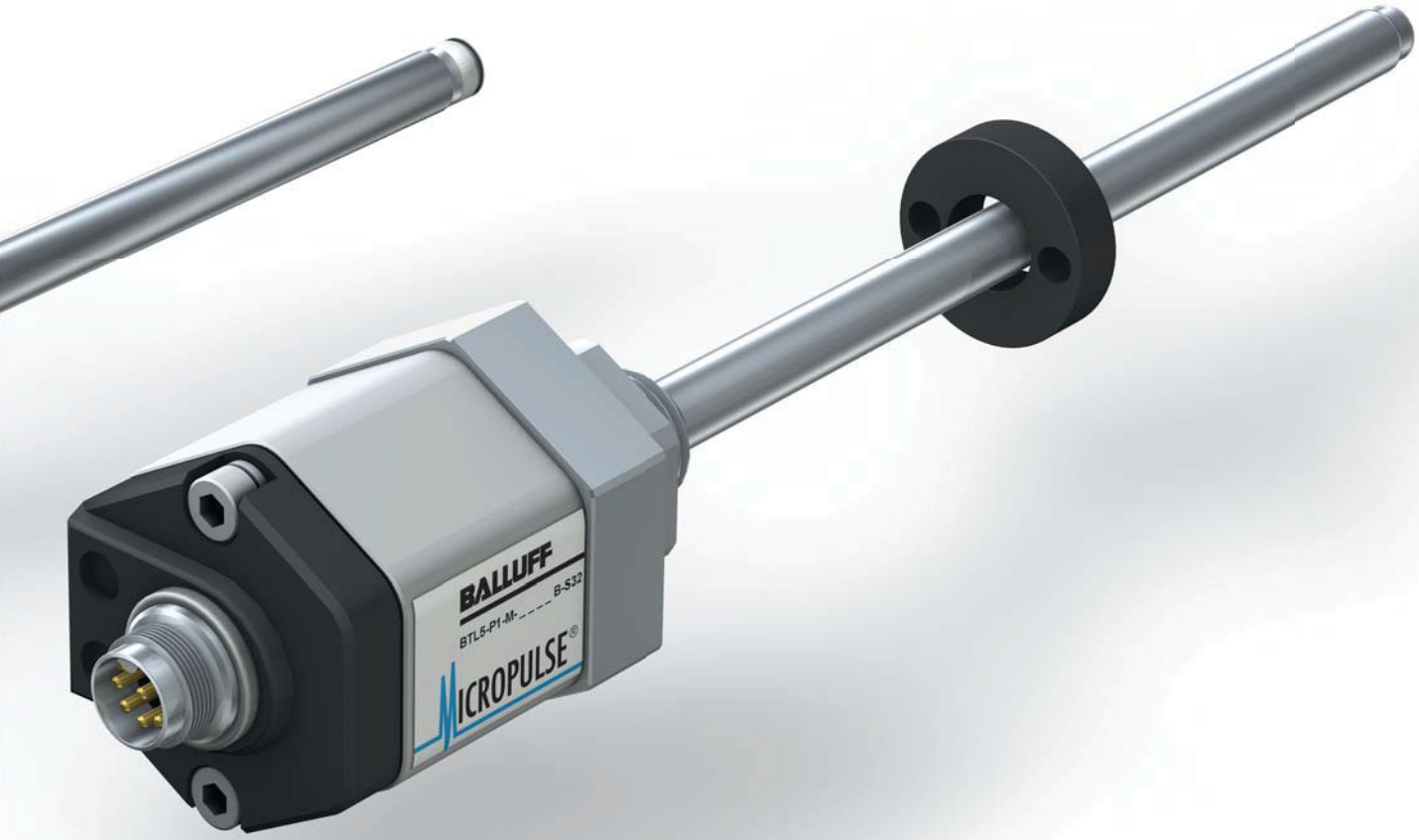
Micropulse Transducers

Rod

Rod style transducers are mainly used in hydraulic cylinder applications. When installed in the pressure section of the hydraulic cylinder, the displacement sensor requires the same pressure rating as the actual hydraulic cylinder. In practice, the sensor must be able to withstand pressures up to 1000 bar. The electronics are integrated in an aluminum or stainless steel housing and the waveguide in a pressure-resistant tube made from nonmagnetic stainless steel that is sealed off at the front end with a welded plug. An O-ring seal in the flange at the opposite end seals off the high-pressure section. An magnet ring with magnets slides over the tube or rod with internal waveguide to mark the position prior to detection.

Contents

MICROPULSE®



Stroke lengths up to 7620 mm

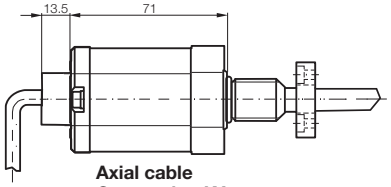
Pressure-resistant to 600 bar (8700 psi), high repeatability, non-contact, robust

The Micropulse BTL7 Transducer is a robust position feedback system for measuring ranges between 25 and 7620 mm as well as for use under extreme ambient conditions.

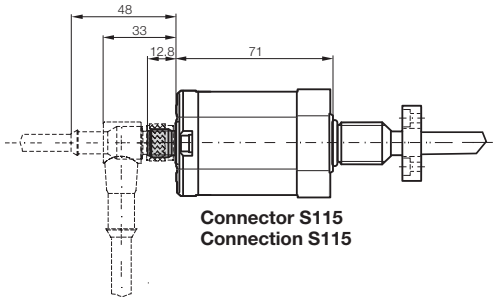
The actual measurement section is protected inside a high-pressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

Series	**Rod BTL7**
Shock load	150 g/6 ms as per EN 60068-2-27
Vibration	20 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protected	TransZorb protection diodes
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC 60529	IP 68 with cable outlet, IP 67 with screwed-on connector BKS-S...
Housing material	Anodized aluminum/1.4571 stainless steel outer tube, 1.3952 stainless steel cast flange
Fasteners	Style B thread M18×1.5, style Z 3/4"-16UNF
Pressure rating	
with 10.2 mm protective tube	600 bar (8700 psi) with installation in hydraulic cylinder
with 8 mm protective tube	250 bar (3600 psi) installed in hydraulic cylinder
Connection	Connector or cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 3
Surge voltage	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
Standard nominal strokes [mm] with 8 mm outer tube, the max. nominal stroke is 1016 mm	0025...7520 mm in 1 mm increments

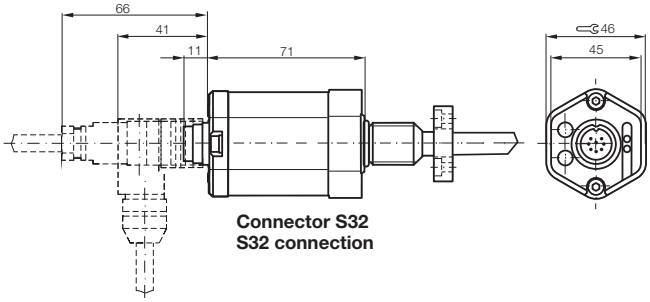
Please order separately:
USB communication box, page 150



Axial cable
Connection KA



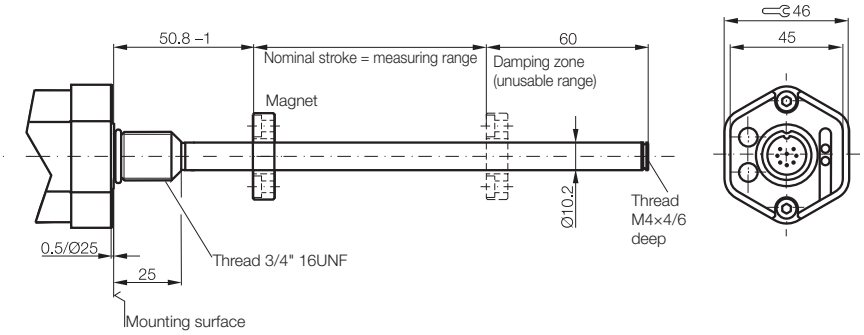
Connector S115
Connection S115



Connector S32
S32 connection

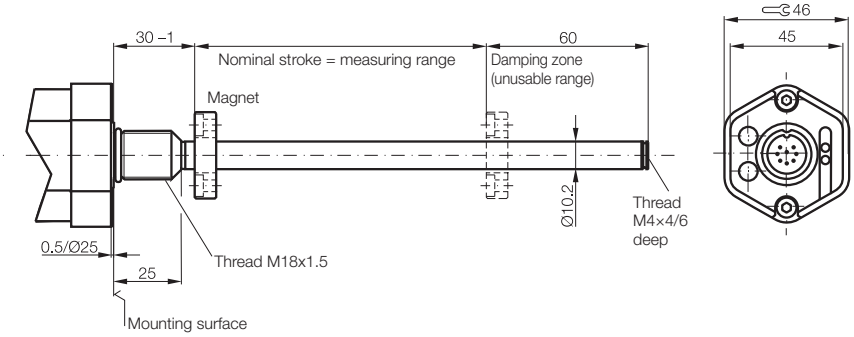
Style Z
(standard design)
BTL7_ _ _ _-Z-_ _ _ _

3/4" UNF mounting thread



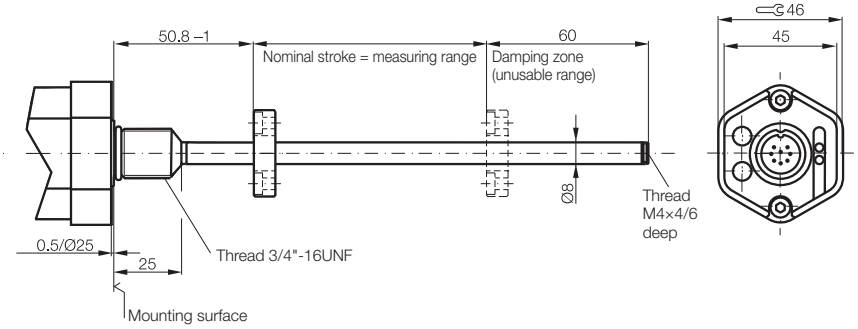
Style B

BTL7_ _ _ _-B-_ _ _ _
Metric
mounting thread M18×1.5



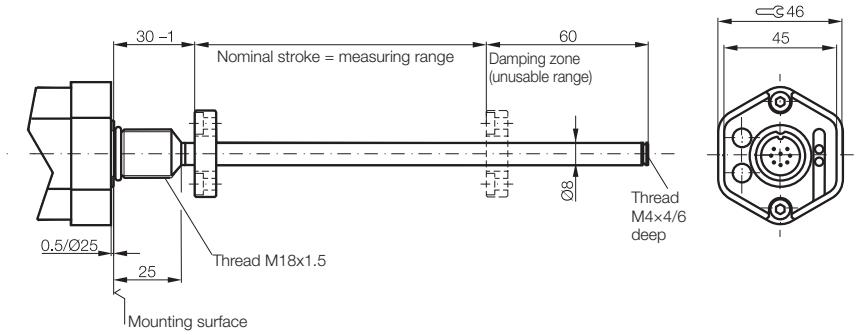
Style Z8
BTL7_ _ _ _-Z8-_ _ _ _

3/4" UNF mounting thread
8 mm protective tube
Max. 1016 mm nominal stroke



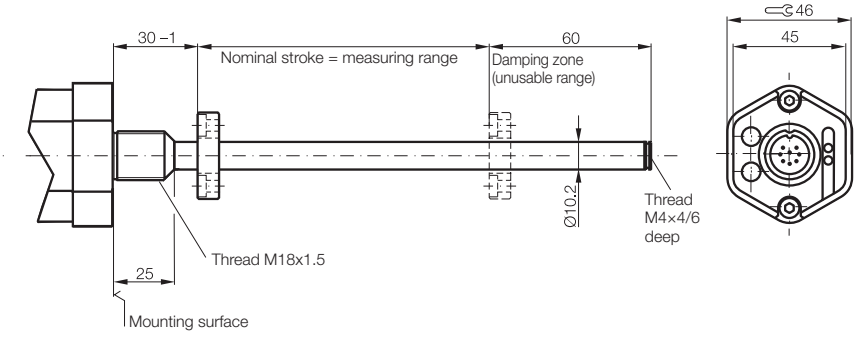
Style B8
BTL7_ _ _ _-B8-_ _ _ _

Metric mounting thread
M18×1.5
8 mm protective tube
Max. 1016 mm nominal stroke



Style A
BTL7-_ _ _ _-A-_ _ _ _

Metric mounting thread
M18×1.5
Flange without
0.5/Ø 25 mm mounting surface



Rod BTL7
Analog interface (standard version)

Backward compatible with BTL5

Features of Micropulse BTL7-A/C/E/G...B, Z, A
- Status LEDs for indicating operating status and diagnostics
- Extended application range due to high degree of protection IP 68 (cable version)
- Compact housing, saves space
- Error signal, no magnet within measuring range

Flexible measuring range
The start and end point of the measuring range can be adapted to the application. The points are set using the included calibration device directly on the unit or remotely, see page 144.

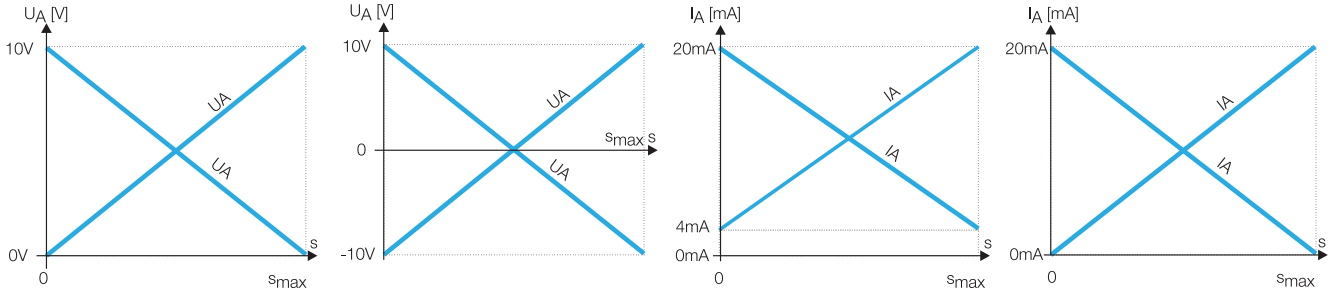
Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Max. residual ripple	
Load resistance	
System resolution	
Hysteresis	
Repeat accuracy	
Sampling rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption at 24 V DC	
Polarity reversal protected	
Overvoltage protected	
Dielectric strength	
Operating temperature	

Please enter code for output signal, nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Calibration device
- Quick start instructions

Please order separately:
USB communication box, page 150
Magnets/floats, page 166
Mounting nuts, page 167
Connectors, starting page 236

	Rod BTL7	Rod BTL7	Rod BTL7	Rod BTL7
	Analog	Analog	Analog	Analog
	A	**G**	**E**	**C**
	Analog	Analog	Analog	Analog
	BTL7-**A**510-M_ _ _ _-_-_ _ _ _	BTL7-**G**510-M_ _ _ _-_-_ _ _ _	BTL7-**E**5_0-M_ _ _ _-_-_ _ _ _	BTL7-**C**5_0-M_ _ _ _-_-_ _ _ _
	0...10 V and 10...0 V	–10...10 V and 10...–10 V		
			4...20 mA or 20...4 mA	0...20 mA or 20...0 mA
	Max. 5 mA	Max. 5 mA		
	≤ 5 mV_{pp}	≤ 5 mV_{pp}		
			≤ 500 ohms	≤ 500 ohms
	≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA
	≤ 5 µm	≤ 5 µm	≤ 5 µm	≤ 5 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	Max. 4 kHz	Max. 4 kHz	Max. 4 kHz	Max. 4 kHz
	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke
	±0.01% 501...5500 mm nominal stroke	±0.01% 501...5500 mm nominal stroke	±0.01% 501...5500 mm nominal stroke	±0.01% 501...5500 mm nominal stroke
	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke
	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K
	20...28 V DC	20...28 V DC	20...28 V DC	20...28 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
	yes	yes	yes	yes
	yes	yes	yes	yes
	500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)
	–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C



Ordering example:

BTL7-_ _ _0-M_ _ _ _-_-_ _ _ _

Output signal

A 0...10 V and 10...0 V
G –10...10 V and 10...–10 V
E 4...20 mA or 20...4 mA
C 0...20 mA or 20...0 mA

Operating voltage

5 10...30 V

Characteristic

1 rising and falling (output types A and G only)
0 rising (output types C and E only)
7 falling (output types C and E only)

Standard nominal stroke [mm]

0025...7620 in 1 mm increments

Design

Z = Standard, 3/4"-16 UNF mounting threads
ZM = Standard, Rapid Replacement Module (RRM) option. See page 148
B = Metric, M18x1.5 mounting threads
BM = Metric, Rapid Replacement Module (RRM) option. See page 148
Additional designs on page 139

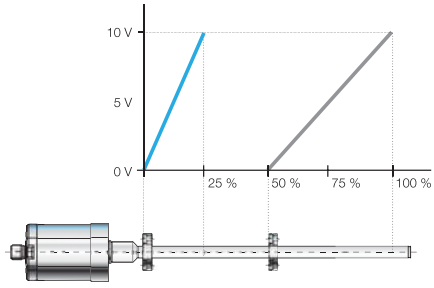
Connection

S115 Connector 8-Pin M12
S32 Connector 8-Pin M16 (DIN)
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m

Position and velocity
Two outputs can be assigned any position value and velocity signal using the USB interface.

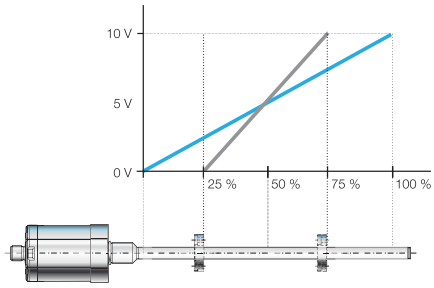
Mode examples:

Double magnet



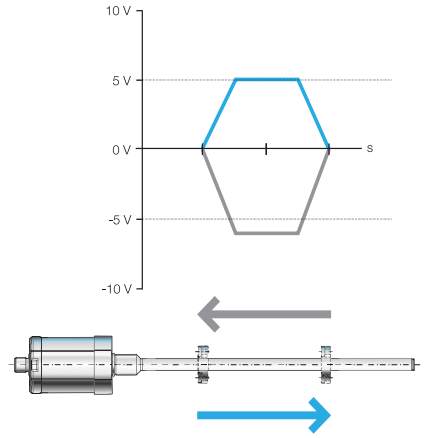
2 magnets, 2 movements, 2 output signals

Differential



Differential signal between 2 magnets, position and difference possible

Velocity



Velocity output

Series	
Output signal	
Transducer interface	
Position signal interface, customer device	
Part number	
Output signal default setting	
Output signal can be adjusted via Configurable USB	
Load current	
Max. residual ripple	
Load resistance	
System resolution	
Current consumption at 24 V DC	
Hysteresis	
Repeat accuracy	
Sampling rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Polarity reversal protected	
Overvoltage protected	
Dielectric strength	
Operating temperature	

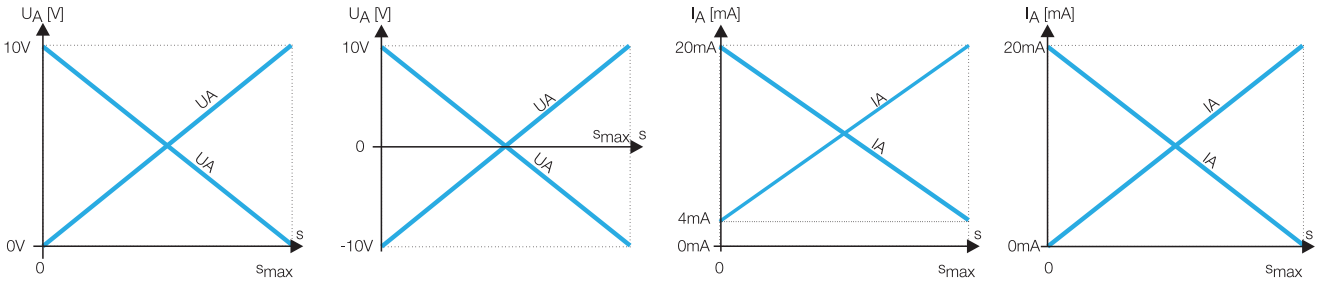
Micropulse⁺ USB configurable BTL7-A/E501
- Simple configuration and adjustment of the start and end point via the USB interface, quick startup
- "Easy Setup" for manual adjustment on-site
- Configurable dual output functions, position and speed
- Increased operating reliability with status LEDs for indicating the operating status and diagnostic information
- Extended application range due to high degree of protection IP 68 (cable version)
- Compact housing
- Error signals, no magnet within measuring range

Please enter code for output signal, nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Calibration device
- Quick start instructions

Please order separately:
USB communication box, page 145
Magnets/floats, page 166
Mounting nuts, page 167
Connectors, page 236

	Rod BTL7	Rod BTL7
	Analog	Analog
	A	**E**
	Analog	Analog
	BTL7-**A501**-M_ _ _ _-_-_ _ _ _	BTL7-**E501**-M_ _ _ _-_-_ _ _ _
	0...10 V and 10...0 V	4...20 mA and 20...4 mA
	–10...10 V and 10...–10 V	0...20 mA and 20...0 mA
	Max. 5 mA	
	≤ 5 mV_{pp}	
		≤ 500 ohms
	≤ 0.33 mV	≤ 0.66 µA
	≤ 150 mA	≤ 180 mA
	≤ 5 µm	≤ 5 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm
	Max. 4 kHz	Max. 4 kHz
	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke
	±0.01% FS > 500...5500 mm nominal stroke	±0.01% FS > 500...≤ 5500 mm nominal stroke
	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke
	≤ 30 ppm/K	≤ 30 ppm/K
	10...30 V DC	10...30 V DC
	yes	yes
	yes	yes
	500 V AC (ground to housing)	500 V AC (ground to housing)
	–40...+85 °C	–40...+85 °C



Ordering example:

BTL7-_501-M_ _ _ _-_-_ _ _ _

Output signal

A	0...10 V and 10...0 V
E	4...20 mA and 20...4 mA

Standard nominal stroke [mm]

0025...7620 in 1 mm increments

Design

Z = Standard, 3/4"-16 UNF mounting threads
ZM = Standard, Rapid Replacement Module (RRM) option. See page 148
B = Metric, M18x1.5 mounting threads
BM = Metric, Rapid Replacement Module (RRM) option. See page 148
Additional designs on page 139

Connection

S115	Connector 8-Pin M12
S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Setting options for the start and end point

	BTL7 Standard	BTL7-A/E501... Micropulse+ USB configurable
1. Calibration device	■	■
Teach-in	■	
Adjusting	■	
Online setting	■	
Easy Setup		■
2. Remote setup	■	
3. USB configuration		■

1. Calibration device

100% start and end point calibration
The start and end points of the analog signal can be set to the optimal position at the touch of a button. Depending on the application, "teach-in" or “adjust” mode is used, and can be selected by pressing a combination of buttons. Two-color LED indicators assist the procedure.

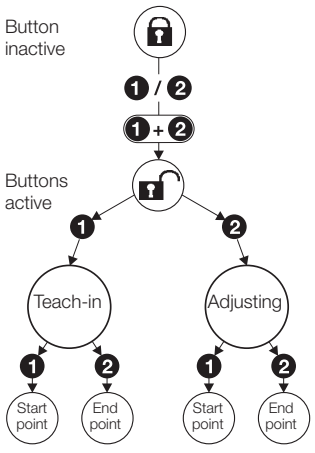
“Easy Setup”
For BTL7-A/E501 **MICRO***PULSE*+ only. Simple programming mode for adjusting the start and end point of the transducer to the current application in just a few steps. The magnet is brought into the new position. Confirm by pressing a button. The “Adjust” function allows the new value to be fine-tuned for a stationary magnet. No error value is output during the setup procedure.

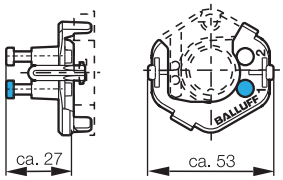
Adjusting
Here you can adjust to a new start and end value. This may be required when you cannot physically move the magnet to the start and/or end point. Move the magnet to the new start and end position, and adjust the displayed value by pressing the button until the desired output values are reached.

Online setting
This programming function allows you to set the start and end point while in run mode, such as in a closed loop configuration. No error value is output during the setup procedure. The calibration range is limited to ±25%.

Teach-in
The beginning and end points set at the factory are to be replaced by the new beginning and end points.
In addition, the magnet must first be brought into the new beginning position and then into the new end position, and the respective values stored by pressing the button.

Set start and end points using the BTL7-A/EH01 calibration device, included in the scope of delivery.



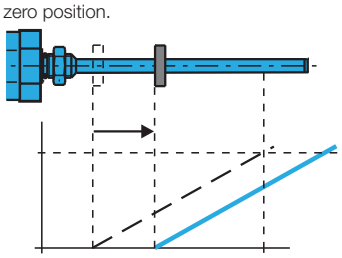


Procedure for teach-in, rising signal

before
after

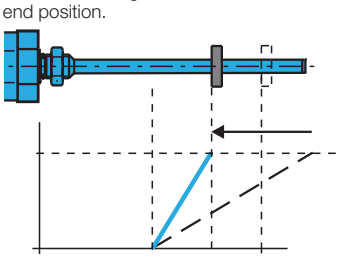
Selecting the calibration procedure BTL7 Standard

1. Move the magnet into the new zero position.



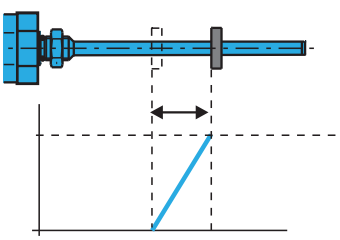
Take over new zero value

2. Move the magnet into the new end position.



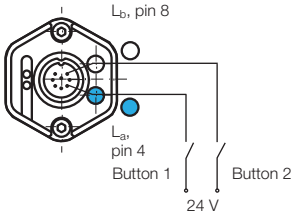
Take over new end value

3. Newly set measurement path



2. Remote setup aid

Remote setting of the start and end points using programming inputs
If the transducer is located in an inaccessible place or a hazardous area, the start and end point can be adjusted remotely. Teach-in, adjustment and online setting are identical to programming with the calibration device. Button 1, blue, corresponds to programming input La and button 2, gray, to input Lb.



3. USB configuration

Start, end value setting and configuration via USB
The Micropulse Configuration Tool software allows the quick and easy configuration of Balluff transducers of type BTL7-A/E501... on a PC.
The most important features are:
- Online display of the current position of the magnet
- Graphical support for setting the functions and characteristics
- Display of information about the connected transducer
- Selectable number formats and units for display
- Reset to factory settings possible
- Calibration device can be disabled
- Demo mode without having a transducer connected

System requirements
- Standard PC
- Operating system: Windows 2000/XP/Vista/7
- Screen resolution at least 1024 × 768 pixels
- 10 MB available hard disk space
- Install Java Runtime Environment (JRE) Version 1.4.2 or higher **http://java.com/getjava**
- USB port

Connecting the USB communication box
For model BTL7-A/E501-M...-S32/S115 transducers, the communication box can be switched between the transducer and the controller. The communication box is connected to the PC using a USB cable.

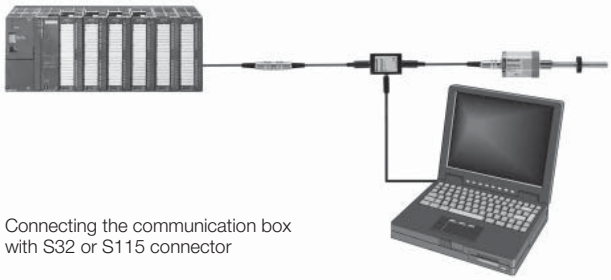
USB communication box

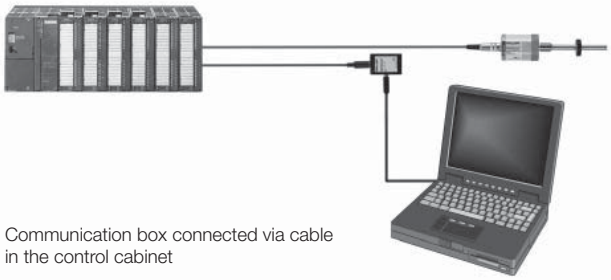
BTL7-A-CB01-USB-S32,
for BTL7-A/E501... with S32 connector

BTL7-A-CB01-USB-S115,
for BTL7-A/E501... with Connector S115

BTL7-A-CB01-USB-KA,
for BTL7-A/E501... with cable connection

Scope of delivery
- USB communication box
- Cable set
- Quick start instructions


Connecting the communication box with S32 or S115 connector


Communication box connected via cable in the control cabinet

Accurate closed-loop feedback

SSI interface Micropulse standard for asynchronous operation
BTL7-S5_ _-M_ _ _ _-B-_ _ _ _
Synchronous serial data transmission suitable for controllers from different manufacturers.
Reliable signal transmission, even with cable lengths of up to 400 m between the controller and the BTL transducer, is assured by interruption-free RS485/422 differential drivers and receivers. Any interference signals are effectively suppressed.

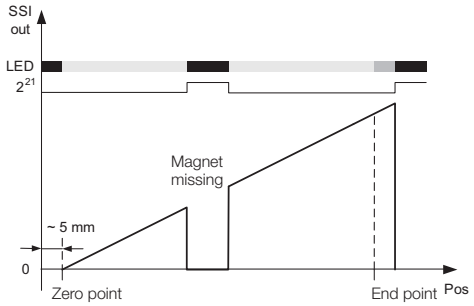
SSI interface Micropulse Plus for asynchronous operation
BTL7-S510-M_ _ _ _-B-_ _ _ _
Functions, interface parameters and measurement range can be set via an integrated USB interface.

SSI interface Micropulse Standard for synchronous operation
BTL7-S5_ _B-M_ _ _ _-B-_ _ _ _
Micropulse Transducers with synchronized SSI interface are well suited for dynamic control applications. Data acquisition in the transducer is synchronized using the external clock of the controller, allowing an optimum speed calculation to be performed in the regulator/controller.
Prerequisite for this synchronous method of transducer operation is time stability of the clock signal.
The **maximum sampling frequency f_A**, with which a new, current value is available on each sampling, can be approximated from the set-up. An exact diagram can be found in the current user's guide.

SSI interface Micropulse Plus for synchronous operation
BTL7-S510B-M_ _ _ _-B-_ _ _ _
Via an integrated USB interface, functions, Functions, interface parameters and measurement range can be set via an integrated USB interface.

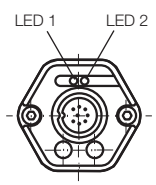
The clock frequency depends on the cable length.

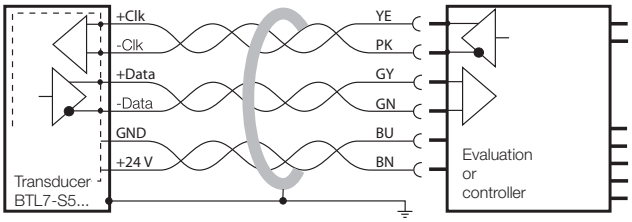
Behavior of LED 1 and the error value over the entire range



Behavior of LED 1 and error value BTL 5 µm

LED indicator





BTL7-S5... with evaluation/controller, connection example

SYNC

Nominal stroke area						Scan rate
25 mm	<	Nominal stroke	≤	150 mm	:	4050 Hz
150 mm	<	Nominal stroke	≤	300 mm	:	3250 Hz
300 mm	<	Nominal stroke	≤	500 mm	:	2200 Hz
500 mm	<	Nominal stroke	≤	1000 mm	:	1200 Hz
1000 mm	<	Nominal stroke	≤	2000 mm	:	650 Hz
2000 mm	<	Nominal stroke	≤	7620 mm	:	170 Hz

Cable length	Clock frequency
< 20 m	< 1000 kHz
< 50 m	< 600 kHz
< 100 m	< 330 kHz
< 200 m	< 180 kHz
< 400 m	< 90 kHz

LED 1	
Green	**Normal function** The magnet is within the limits
Red	**Error** No magnet, or magnet is outside the limits

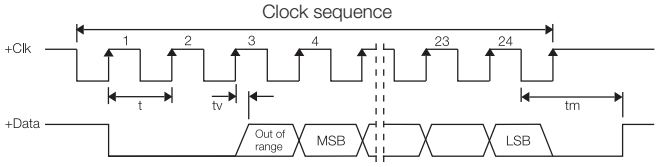
LED 2	
Green	**Synchronous operation** Internal measurement is synchronous with SSI query
Off	**Asynchronous operation** Internal measurement is asynchronous with SSI query
Red	**SSI communication error** T_0 or T_m event has occurred
Flashing green	**Programming mode** Only with BTL7-S510(B)-...

Series	**Rod BTL7**
Output signal	Synchronous-serial
Transducer interface	**S**
Customer device interface	Synchronous-serial
Part number - Standard version, Asynchronous	BTL7-S5_ _-M_ _ _ _-_-_ _ _ _
Part number - USB Configurable version, Asynchronous	BTL7-S510-M_ _ _ _-_-_ _ _ _
Part number - Standard version, Synchronous	BTL7-S5_ _**B**-M_ _ _ _-_-_ _ _ _
Part number - USB Configurable version, Synchronous	BTL7-S510**B**-M_ _ _ _-_-_ _ _ _
System resolution depending on model (LSB)	1, 2, 5, 10, 20, 40, 50 or 100 µm
Repeat accuracy	≤ 11 µm, typical ±2 µm
Hysteresis	≤ 7 µm
Max. linearity deviation	±30 µm with 5 and 10 µm resolution or ≤ ±2 LSB
Temperature coefficient, typical	≤ 15 ppm/K
Operating voltage, stabilized	10...30 V DC
Current consumption	≤ 120 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

Scope of delivery
- Transducer
- Quick start instructions

Please enter code for output format, resolution, nominal stroke, design and connection in the part number.

Clock sequence



Order example BTL7-S standard:

BTL7-S5_ _-M_ _ _ _-_-_ _ _ _ for asynchronous operation
BTL7-S5_ _B-M_ _ _ _-_-_ _ _ _ for synchronous operation

Output format

0	Binary code rising (24-bit)
1	Gray code rising (24-bit)
6	Binary code rising (25-bit)
7	Gray code rising (25-bit)
A	Binary code rising (26-bit)
B	Gray code rising (26-bit)

Resolution

1	1 µm
2	5 µm
3	10 µm
4	20 µm
5	40 µm
6	100 µm
7	2 µm
8	50 µm

Standard nominal stroke [mm]

0025...7620 mm
in 1 mm increments

Design

Z = Standard, 3/4"-16 UNF mounting threads
ZM = Standard, Rapid Replacement Module (RRM) option. See page 148
B = Metric, M18x1.5 mounting threads
BM = Metric, Rapid Replacement Module (RRM) option. See page148
Additional designs on page 139

Connection

S115	Connector 8-Pin M12
S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Order example BTL7-S Plus (USB Configurable):

BTL7-S510-M_ _ _ _-_-_ _ _ _ for asynchronous operation
BTL7-S510B-M_ _ _ _-_-_ _ _ _ for synchronous operation

Standard nominal stroke [mm]

0025...7620 mm
in 1-mm increments on request

Design

Z = Standard, 3/4"-16 UNF mounting threads
ZM = Standard, Rapid Replacement Module (RRM) option. See page 148
B = Metric, M18x1.5 mounting threads
BM = Metric, Rapid Replacement Module (RRM) option. See page 148
Additional designs on page 139

Connection

S115	Connector 8-Pin M12
S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Micropulse Transducers BTL 7
Rod-style with Rapid Replacement Module

The Rapid Replacement Module (RRM) option allows quick field replacement without removing the pressure tube from the hydraulic cylinder, making field-level maintenance fast and easy.

With the RRM option, the transducer electronics and sensing element can be replaced as a single unit, while the hydraulic seal remains intact.

- No hydraulic oil spillage, and no need for environmental containment
- No danger of hot oil spillage
- No need to bleed air from the hydraulic system after replacement
- No danger of hydraulic system contamination
- 100% exchange of sensor package eliminates troubleshooting guesswork
- Dimensionally identical to standard Balluff rod-style transducers
- Replacement cartridges can be installed into existing standard pressure tubes (consult Balluff Technical Support for guidance)
- Available for all BTL7 output types
- Available for all BTL7 connector types

RRM *Rapid Replacement Module*

Micropulse Transducers BTL 7
Rod-style with Rapid Replacement Module

Ordering Information

Complete Transducer		Replacement Electronics/Sensing Element (no pressure tube)
Part Number	Characteristics	
BTL7-xxxx-Mxxxx-**ZM**-xxxx *Example:* BTL7-A510-M0305-ZM-S115	3/4"-16 UNF threads, raised-face flange, 10.2 mm Ø pressure tube, 50.8 mm null point	BTL7-xxxx-Mxxxx-**ZR**-xxxx
BTL7-xxxx-Mxxxx-**ZN**-xxxx *Example:* BTL7-E500-M1829-ZN-S32	3/4"-16 UNF threads, flat-face flange, 10.2 mm Ø pressure tube, 50.8 mm null point	
BTL7-xxxx-Mxxxx-**BM**-xxxx *Example:* BTL7-S510-M1016-BM-KA05	M18 x 1.5 threads, raised-face flange, 10.2 mm Ø pressure tube, 30 mm null point	BTL7-xxxx-Mxxxx-**BR**-xxxx
BTL7-xxxx-Mxxxx-**BN**-xxxx *Example:* BTL7-S501B-M0305-BN-S115	M18 x 1.5 threads, flat-face flange, 10.2 mm Ø pressure tube, 30 mm null point	

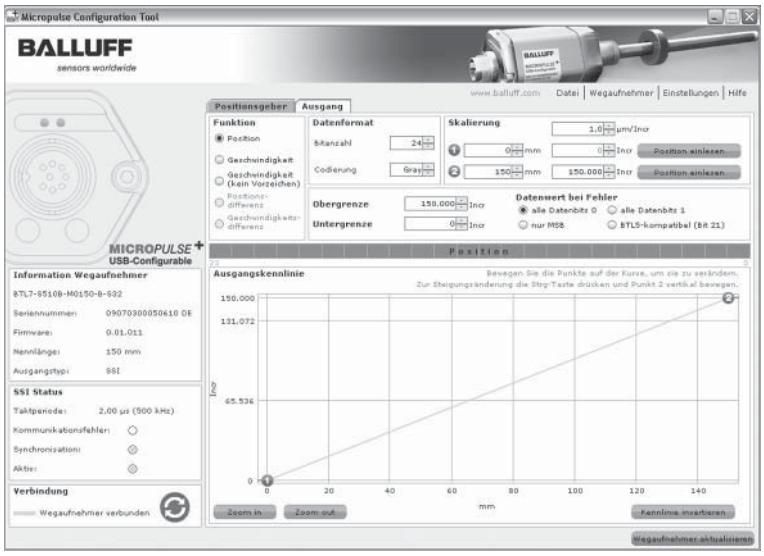
Micropulse Plus BTL7-S510_-... with USB interface
Configuration via USB
The BTL7-S510_-... transducers can be configured quickly and easily on a PC.
The most important features are:
- Online display of the current position of the magnet
- Graphical support for setting the functions and characteristics
- Display of information via the connected transducer: model, serial number, firmware version, nominal stroke, SSI output signal
- Selectable number formats and units for display
- Reset to factory settings possible
- Demo mode without having a transducer connected

System requirements
- Standard PC
- Operating system: Windows 2000/XP/Vista/7
- Screen resolution at least 1024 × 768 pixels
- 10 MB available hard disk space
- Install Java Runtime Environment (JRE) Version 1.4.2 or higher **http://java.com/getjava**
- USB port

Configuration options of the position measuring system BTL7-S510_-...
- Number of magnet 1 or 2
- Position
- Velocity
- Differential position
- Speed difference

Interface configuration
- Start/end point
- Rising/falling signal
- Error value
- Data format
- Code
- Resolution

The PC software and the corresponding manual are available on the Internet at **www.balluff.com/downloads-btl7**

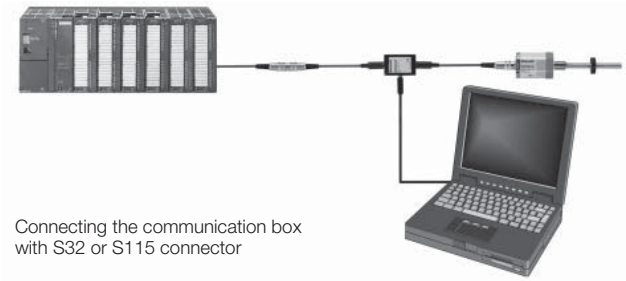


Connecting the USB communication box
With the BTL7-S510-M... transducers, the communication box can be connected between the transducer and controller. The communication box is connected to the PC using a USB cable.

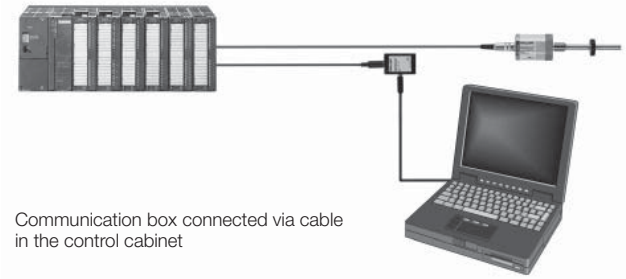
USB communication box
BTL7-A-CB01-USB-S32,
for BTL7-S/510_ ... with S32 connector

BTL7-A-CB01-USB-S115,
for BTL7-S/510_ ... with S115 connector

BTL7-A-CB01-USB-KA,
for BTL7-S/510_ ... with cable connection



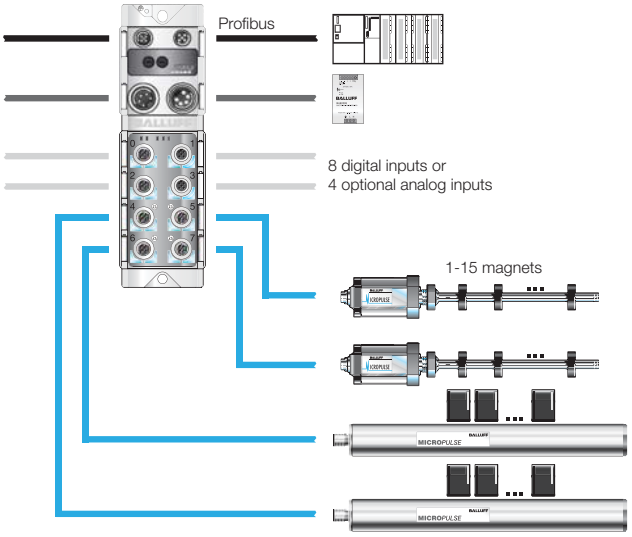
Connecting the communication box with S32 or S115 connector



Communication box connected via cable in the control cabinet

Profibus BNI modules are an elegant, cost-effective solution from Balluff.
The modules have a robust metal housing that was designed for use in harsh industrial environments and is capable of withstanding powerful mechanical loads. The modules have four independent ports for Micropulse Transducers BTL with P511. A maximum of 16 magnets can be used per BTL port. The maximum nominal stroke here is 7500 mm. Depending on the version, four additional ports with digital or analog sensors can be assigned. You can achieve maximum functionality and cost efficiency for fieldbus integration by combining Micropulse Transducers BTL with Profibus modules P111.

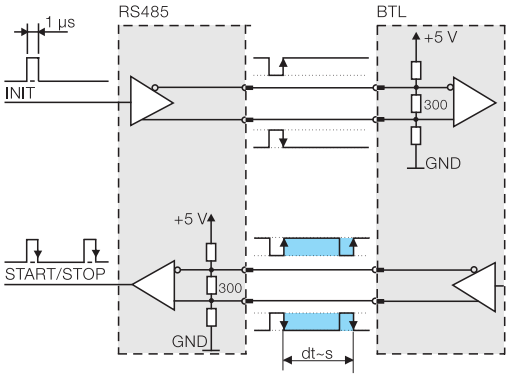
For more information, see page 247



The maximum number of magnets per BTL is 16; however altogether, it is 60 per module.

P511 interface – Cost savings using DPI/IP for start-up and installation
DPI/IP is a protocol for direct data interchange between a controller and transducer. The signal lines are used to send additional information such as manufacturer, measuring length and waveguide speed. This allows start-up or replacement of a transducer without having to make manual changes to the controller parameters.

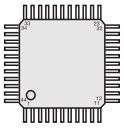
Features
- Bidirectional communication
- Position measuring system controller using Init and start/stop signals
- Integrated diagnostic functions
- Plug and Play
- Automatic configuration reduces downtimes.
- Transmission of sensor type, measuring length, specific parameters
- Measuring length up to 3250 mm



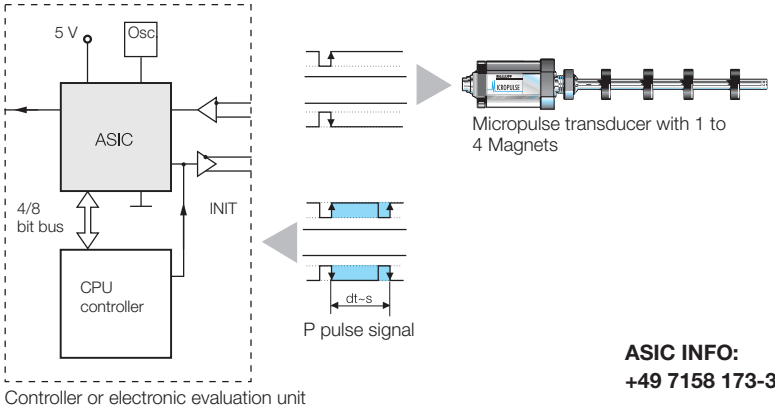
Block diagram of P interface

Highly accurate digitalizations of the P511 pulse signal
Companies developing their own electronic control and evaluation unit can create a highly accurate P interface cost-effectively and with minimum effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for Micropulse Transducers with P interface.

Advantages:
- High resolution: the actual 1 µm of the BTL position measuring system is supported by the 133 ps resolution of the chip (at low clock frequency 2 or 20 MHz)
- Position data from 4 magnets can be processed simultaneously
- 4/8-bit processor interface



Digitizing chip 44QFP



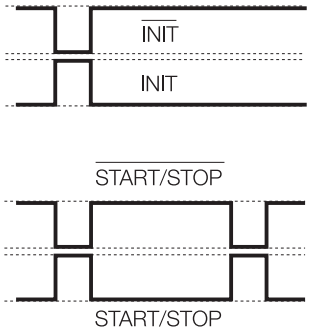
Controller or electronic evaluation unit

ASIC INFO:
+49 7158 173-370

Rod BTL7
Digital pulse interface

Series	**Rod BTL7**
Transducer interface	Pulse **P511**
Customer device interface	Pulse **P511**
Part number	BTL7-**P**511-M_ _ _ _-_-_ _ _ _
System resolution	processing-dependent
Repeat accuracy	typ. ± 2.5 µm
Hysteresis	≤ ±7 µm
Linearity deviation	±50 µm up to 500 mm nominal stroke typ. ±0.01% 501...5500 mm nominal stroke typ. ±0.02 % 5500...7620 mm nominal stroke
Ultrasonic speed (standardized)	2850 m/s
Gradient (standardized)	8.9122807 µs/inch
Supply voltage	10...30 V
Current consumption at 24 V	120 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

The rising and falling edges can be evaluated.



Please enter code for nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connector, page 236

Ordering example:

BTL7-P511-M_ _ _ _-_-_ _ _ _

Standard nominal stroke [mm]

0025...7620 mm
in 1 mm increments

Design

Z = Standard, 3/4"-16 UNF mounting threads
ZM = Standard, Rapid Replacement Module (RRM) option. See page 148
B = Metric, M18x1.5 mounting threads
BM = Metric, Rapid Replacement Module (RRM) option. See page 148
Additional designs on page 139

Connection

S115	Connector 8-Pin M12
S32	Connector 8-Pin M16 (DIN)
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m

Rod BTL5
General data

Pressure-resistant to 600 bar, high repeatability, contactless, robust

The BTL Micropulse Transducer is a robust position feedback system for measuring ranges between 25 and 5500 mm as well as for use under extreme ambient conditions.

The actual measurement section is protected inside a high-pressure resistant stainless steel tube.

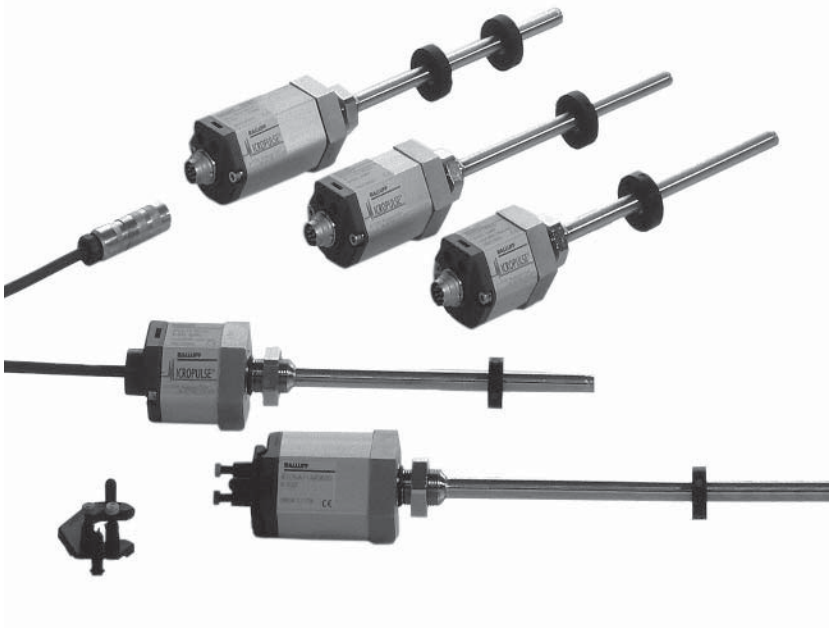
The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

Series	**Rod BTL5**
Shock load	100 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protected	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached)
Housing material	Anodized aluminum/1.4571 stainless steel outer tube, 1.3952 stainless steel cast flange
Housing attachment	Style B thread M18×1.5, style Z 3/4"-16UNF
Pressure rating	
at 10.2 mm, protective tube	600 bar with installation in hydraulic cylinder
at 8 mm, protective tube	250 bar when installed in hydraulic cylinder
Connection	Connectors/cables
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	IEC 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3
Standard nominal strokes [mm] with an 8 mm outer tube, the max. nominal stroke is 1016 mm	0025...5500 mm in 1 mm increments, depending on the interface

Scope of delivery

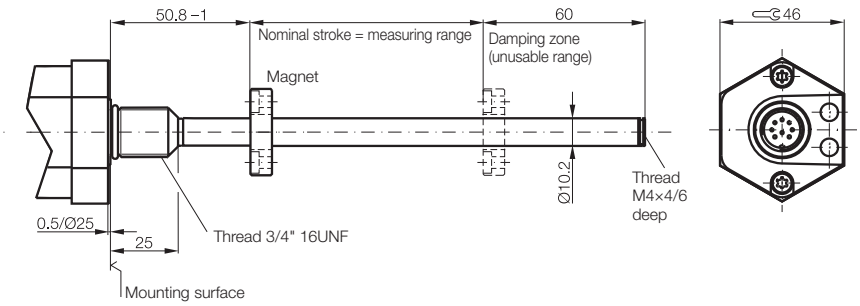
- Transducer (select your interface from page 156)
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connectors, page 236



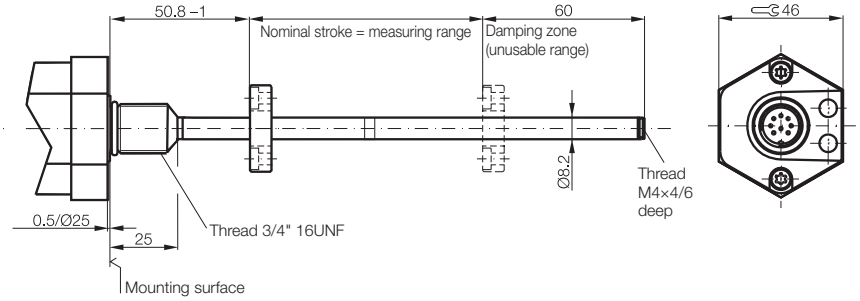
Style Z
BTL5_ _ _ _-Z-_ _ _ _

3/4" UNF mounting thread



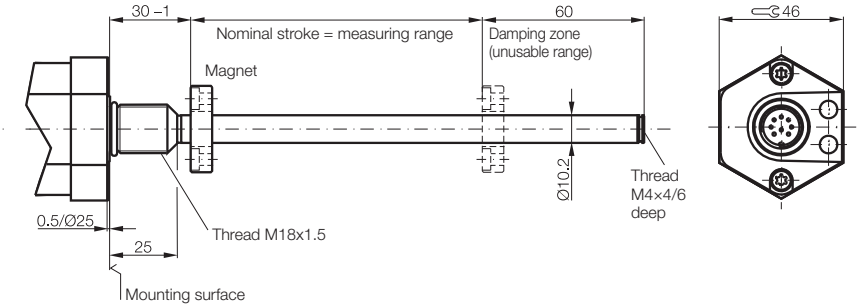
Style Z8
BTL5_ _ _ _-Z8-_ _ _ _

3/4"-UNF mounting thread
8 mm protective tube
Max. 1016 mm nominal stroke



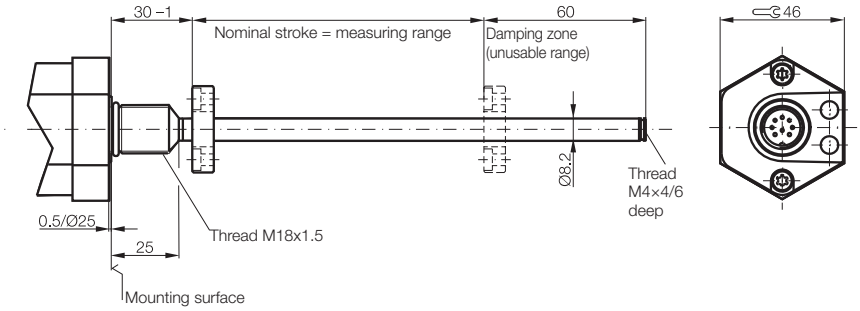
Style B
(standard design)
BTL5_ _ _ _-B-_ _ _ _

Metric
mounting thread M18×1.5



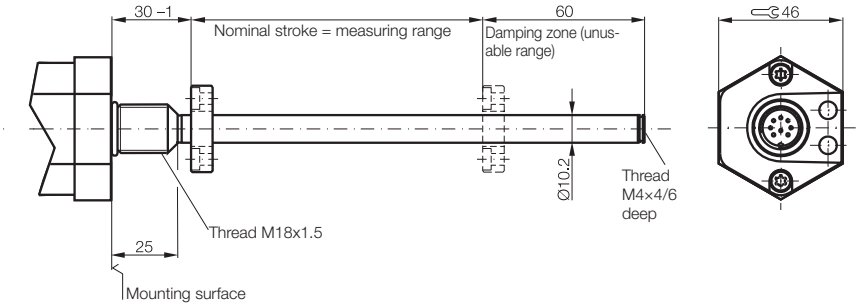
Style B8
BTL5_ _ _ _-B8-_ _ _ _

Metric mounting thread
M18×1.5
8 mm protective tube
Max. 1016 mm nominal stroke



Style A
BTL5-_ _ _ _-A-_ _ _ _

Metric mounting thread
M18×1.5
Flange without
0.5/Ø 25 mm mounting surface



CANopen interface
Based on CAN (ISO/IEC 7498 and DIN ISO 11898), CANopen provides a Layer-7 implementation for industrial CAN networks. The serial data protocol of the CAN specification is defined according to the producer-consumer principle as opposed to most other fieldbus protocols. This eliminates target addressing of the process data. Each bus node decides for itself how the received data is processed.
The CANopen interface of the Micropulse Transducer is compatible with CANopen conforming with CiA Standard DS301 Rev. 3.0, and with CAL and Layer 2 CAN networks.

EDS
CANopen offers a high level of flexibility in configuring functionality and data exchange. Using a standard data sheet in the form of an EDS file, it is easy to link the Micropulse Transducers to any CANopen system.

Process Data Object (PDO)
Micropulse Transducers send their measured values optionally in one, two or four PDOs with 8 bytes of data each. The contents of the PDOs are freely configurable. The following information can be sent:
- The current magnet with a resolution in 5 µm increments
- the current speed of the magnet, with resolution selectable in 0.1mm/s increments
- the current status of four freely programmable cams per Magnet

Synchronization Object (SYNC)
Serves as a network-wide trigger for synchronizing all network nodes. When the SYNC object is received, all Micropulse Transducers connected to the CANopen bus store their current position and speed information, and then send it sequentially to the controller. This assures time-synchronous detection of the measured values.

LED
Display of the CANopen status to DS303-3

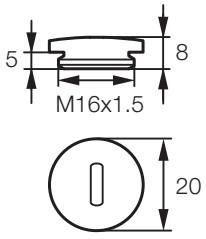
FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
So if only two magnets are positioned in the measuring range, a valid value is output for the first two positions, and a defined error value in positions 3 and 4.

Emergency Object
This object is sent with the highest priority and is used, for example, for high-priority transmission of error messages when the cam states change.

Service Data Object (SDO)
Service data objects transmit the parameters for the configuration to the transducer. The transducer may be configured on the bus by the controller or offline with a bus analyzer/CAN open tool. The configuration is stored in the non-volatile memory of the transducer.

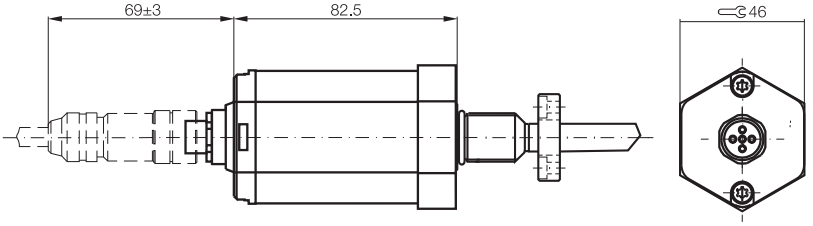
CiA 199911-301v30/11-009

Use of multiple Magnets
The minimum distance between the magnets must be 65 mm.

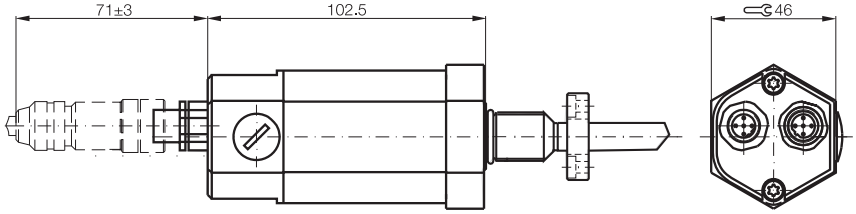


Transparent cover **BKS 16-CS-00**
Ordering code: **BAM0116**

BTL5-H1_ _-M_ _ _ -B-S92

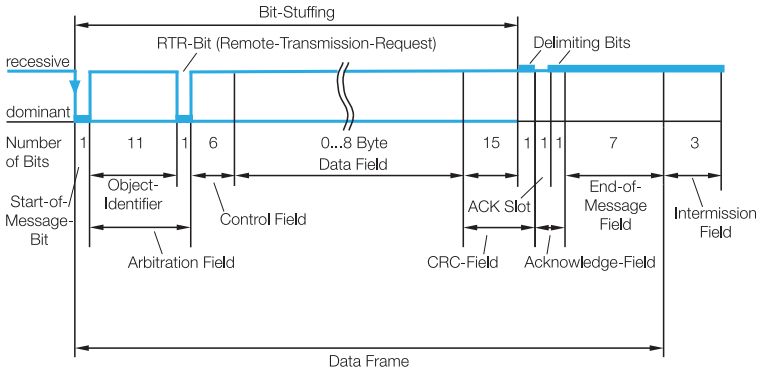


BTL5-H1_ _-M_ _ _ -B-S94



Node ID can be set by DIP switch.

Series		**BTL5 rod**						
Output signal		CANopen						
Transducer interface		**H**						
Customer device interface		CANopen						
Part number		BTL5-**H**1_ _-M_ _ _ _-_-S92						
Part number		BTL5-**H**1_ _-M_ _ _ _-_-S94						
Repeat accuracy		±1 digit						
System resolution	Position	5 µm increments						
Configurable	Velocity	0.1 mm/s increments						
Hysteresis		≤ 1 digit						
Sampling rate		$f_{STANDARD}$ = 1 kHz						
Max. linearity deviation		±30 µm at 5 µm resolution						
Temperature coefficient of overall system		(6 µm + 5 ppm × L)/°C						
Supply voltage		20...28 V DC						
Current consumption		≤ 100 mA						
Operating temperature		–40...+85 °C						
Storage temperature		–40...+100 °C						
Cable length [m] per CiA DS301		< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500
Baud rate [kbaud] per CiA DS301		1000	800	500	250	125	100	50	20/10



Please enter code for software configuration, baud rate and nominal stroke in the part number. Cable on request.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connectors, page 236

Using the CANopen interface and a cable up to 2500 m in length, the signal is sent at a length-dependent baud rate to the controller. The high interference immunity of the connection is achieved using differential drivers and by the data monitoring scheme.

Ordering example:

BTL5-H1_ _-M_ _ _ _-_-S92
BTL5-H1_ _-M_ _ _ _-_-S94

Software configuration

1	1 × position and 1 × velocity
2	2 × speed and 2 × velocity
3	4 × position

Baud rate

0	1	Mbaud
1	800	kbaud
2	500	kbaud
3	250	kbaud
4	125	kbaud
5	100	kbaud
6	50	kbaud
7	20	kbaud
8	10	kbaud

Standard nominal stroke [mm]

0025...4000 mm in 1 mm increments

Design

Z = Standard 3/4"-16 UNF, for additional designs, see page 155

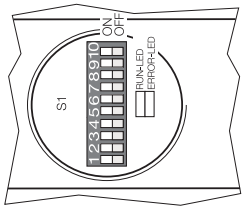
Connecting analog sensors
BTL5-H1A/C/E _ -M _ _ _ _ -A/B/Y/Z(8)-C001 allows the use of analog pressure or temperature sensors in parallel with the transducer. In this manner, the measured values of the analog sensors are transferred very easily in the CAN protocol.
Analog inputs are detected in series, not simultaneously. The second channel is converted while the first channel is being read and vice versa.

The analog process signal from the BTL is converted into digital form because the analog values from the BTL are only processed in digital form. The overall conversion time consists of the time the converter takes to perform the conversion plus additional processing time in the microcontroller (µC).
The analog values are displayed in the form of a fixed-point number in the 2's complement. The prefix of the analog value is always in bit 15.
- "0" for +
- "1" for -

CiA 199911-301v30/11-009

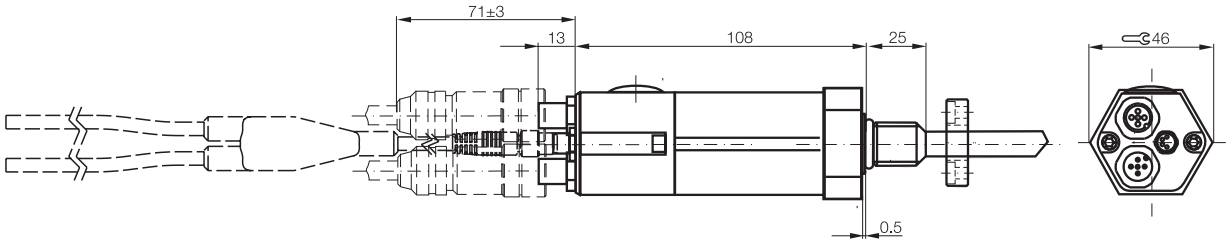
Use of one to four Magnets
The number of magnets can be preset to 1-4 via CANopen. The transducer is preset to operate with an magnet on delivery. The minimum distance between the magnets must be 65 mm.

Setting the node ID
For the node ID, values between 0 to 63 can be preset using DIP switches S1.1...S1.6.

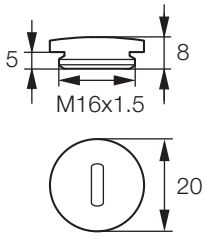


Top view of DIP switch S1

BTL5-H1_ _-M_ _ _ _-_-C001



The Node ID can be set by DIP switch.



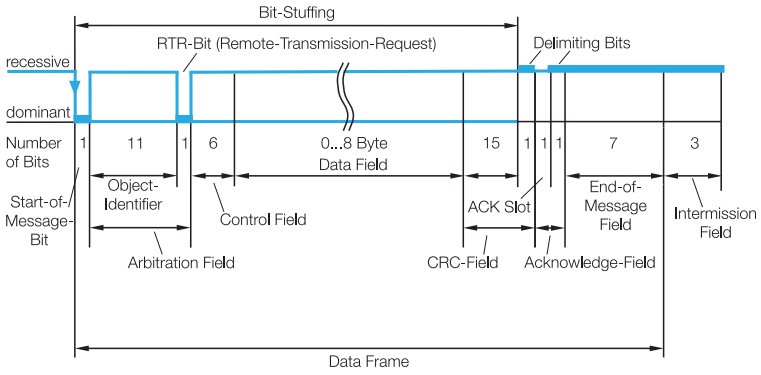
Transparent cover **BKS 16-CS-00**
Ordering code: **BAM0116**

Series	**Rod BTL5**							
Output signal	CANopen							
Transducer interface	**H**							
Customer device interface	CANopen							
Part number	BTL5-**H**1_ _-M_ _ _ _-_-_ _ _ _							
CANopen version	Potential-free							
Repeat accuracy	±1 digit							
System resolution Position	5 µm increments							
Configurable Velocity	0.1 mm/s increments							
Hysteresis	≤ 1 digit							
Sampling rate	$f_{STANDARD}$ = 1 kHz							
Max. linearity deviation	±30 µm at 5 µm resolution							
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C							
Supply voltage	20...28 V DC							
Current consumption	≤ 100 mA							
Operating temperature	–40...+85 °C							
Storage temperature	–40...+100 °C							
Cable length [m] per CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500
Baud rate [kbaud] per CiA DS301	1000	800	500	250	125	100	50	20/10

Please enter code for input configuration, baud rate and nominal stroke in the part number. Cable on request.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting thread nut, page 167
Connector, page 236



Using the CANopen interface and a cable up to 2500 m in length, the signal is sent at a length-dependent baud rate to the controller. The high interference immunity of the connection is achieved using differential drivers and by the data monitoring implemented in the data protocol.

Ordering example:

BTL5-H1_ _-M_ _ _ _-_-C001

Input configuration

A	3-wire voltage, 0...+10 V, 12-bit, Max. 2 inputs
C	3-wire current, 0...20 mA, 12-bit, Max. 2 inputs
E	2 wire current, 4...20 mA, 12-bit, Max. 2 inputs

Baud rate

0	1	Mbaud
1	800	kbaud
2	500	kbaud
3	250	kbaud
4	125	kbaud
5	100	kbaud
6	50	kbaud
7	20	kbaud
8	10	kbaud

Standard nominal stroke [mm]

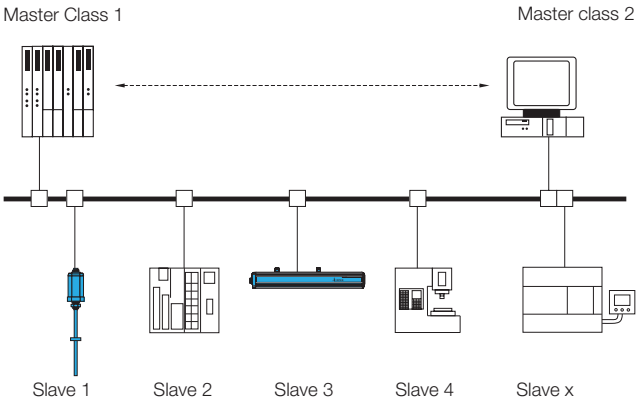
0025...4000 mm in 1 mm increments

Design

Z = Standard 3/4"-16 UHF
additional designs, page 155

As the market leading standard for serial data transmission for process automation, Profibus DP is the ideal choice for implementing automation tasks with cycle times of > 5 ms.

Data transmission
A Profibus telegram can contain up to 244 bytes of user data per telegram and node. The BTL5-T uses max. 32 bytes (max. 4 position values and max. 4 speed values) for process data transmission. Up to 126 active stations (Addresses 0 to 125) can be connected on Profibus DP. User data cannot be sent with node address 126. This address is used as the default address for bus nodes that have to be configured by a Class 2 master (for setting the device address if there are no mechanical switches available).
Each Profibus station has the same priority. Prioritizing individual nodes is not intended, but can be done by the master since the bus transmission only makes up a fraction of the process cycle anyway. At a transfer rate of 12 Mbaud, the transmission time for an average data telegram is in the 100 µs range.



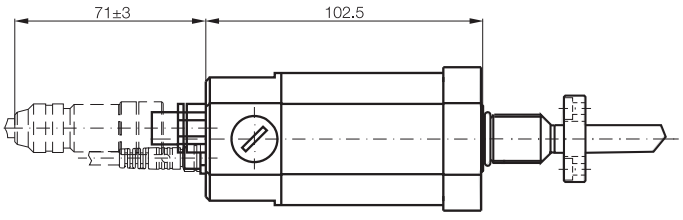
GSD (device master data)
The length of the data exchangeable with a slave is defined in the Device Master Data file (GSD) and is checked by the slave with the configuration telegram and confirmed for correctness. In modular systems, various configurations are defined in the GSD file. Depending on the desired functionality, one of these configurations can be selected by the user. The BTL5-T is a modular device with the option of selecting the number of magnets (position values).

Process data
Under Profibus DP, the default is for process data to be sent from the master to slaves acyclically and for the slave data to then be queried. To ensure synchronization of multiple devices, the master may use the SYNC and FREEZE services.

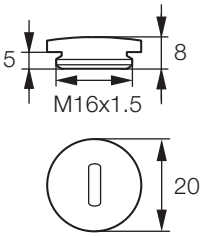
DP/V1 and DP/V2 isochronous mode
Isochronous mode enables quick and deterministic data exchange by means of clock synchronicity on the bus system. A cyclical, equidistant clock signal is sent by the master to all bus nodes. This signal allows master and slaves to be synchronized irrespective of application – with an accuracy < 1 µs.

FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
This means that if only two magnets are positioned in the measuring range, a valid value is output for the first two positions, and an error value is defined in positions 3 and 4.

The device address can be set by the DIP switch



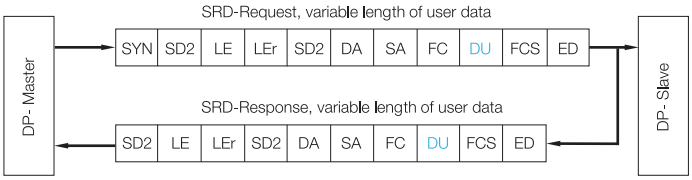
The address can be set by the DIP switch.



Transparent cover **BKS 16-CS-00**
Ordering code: **BAM0116**

Rod BTL5
Profibus DP interface

Series		**Rod BTL5**				
Output signal		Profibus DP				
Transducer interface		**T**				
Customer device interface		Profibus DP				
Part number plug version S103		BTL5-**T**1_ 0-M_ _ _ _-_-S103				
Profibus version		EN 50170, encoder profile				
Profibus interface		Potential-free				
Repeat accuracy		±1 digit				
System resolution	Position	Configurable in increments of 5 µm				
Configurable	Velocity	0.1 mm/s increments configurable				
Hysteresis		≤ 1 digit				
Sampling rate		$f_{STANDARD}$ = 1 kHz				
Max. linearity deviation		±30 µm at 5 µm resolution				
Temperature coefficient of overall system		(6 µm + 5 ppm × L)/°C				
Magnet travel speed		any				
Supply voltage		20...28 V DC				
Current consumption		≤ 120 mA				
Operating temperature		–40...+85 °C				
Storage temperature		–40...+100 °C				
GSD file		BTL504B2.GSD				
Address assignment		Mechanical switches and Master Class 2				
Cable length [m]		< 100	< 200	< 400	<1000	< 1200
Baud rate [Kbps]		12000	1500	900	187.5	93.7/19.2/9.6



Please enter code for software configuration, nominal stroke and design in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connector, page 236

Ordering example:

BTL5-T1_ 0-M_ _ _ _-_-S103

Software configuration	**Standard nominal stroke [mm]**	**Design**
1 1 × position 1 × velocity 2 2 × position 2 × velocity	0025...4000 mm in 1 mm increments	Z = Standard 3/4"-16 UNF additional designs, page 155

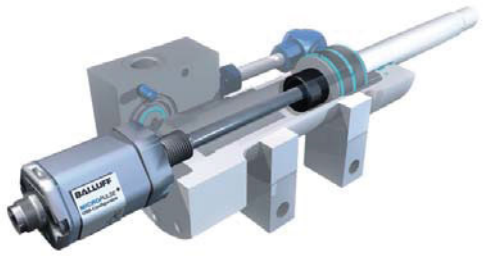
Rod BTL6
Cost-effective EtherCAT® industrial Ethernet interface

Cost-effective EtherCAT solutions for hydraulic cylinder feedback
Micropulse linear position transducers in a rod style housing are designed for use in hydraulic cylinders. Optimal control quality of the hydraulic axes is achieved through dynamic, highly-repeatable position measurement.

Integrated EtherCAT interface
The BTL6 single-connector system allows direct connection to existing EtherCAT installations. The rod style BTL6 is ideal for position monitoring applications that do not require closed-loop control.

Features:
- Non-contact measurement principle
- Pressure resistant to 600 bar (8700 psi)
- IP67
- Absolute output signal
- Stroke lengths to 4012 mm (158")
- Direct connection to Beckhoff EtherCAT masters
- Single connector solution lowers system cost
- Connector adapter allows connection of SIGNAL and POWER

Additional Information
For more information on EtherCAT, go to http://www.ethercat.org



Series	**Rod BTL6**
Output signal	EtherCAT®
Transducer interface	**V11E**
Customer device interface	EtherCAT®
Part number	BTL-**V**11E-M_ _ _ _-B-S115
System resolution	≤ 10 µm
Repeat accuracy	≤ 30 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz (< 850 mm)
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke ±0.04% 500...1500 mm nominal stroke
Supply voltage	20...28 V DC
Current consumption	≤ 100 mA
Polarity reversal protected	yes
Operating temperature	0...+70 °C
Storage temperature	–40...+100 °C

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connector, page 236

Ordering example:

BTL6-V11E - M_ _ _ _ - Z – S115

Interface
V11E EtherCAT

Standard nominal stroke [mm]
0025...4012 mm in 1 mm increments

Design
Z = Standard, 3/4"-16 UNF mounting threads
B = Metric, M18x1.5 mounting threads

Connection
S115 Connector, 8-pole, M12

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0610	24	2134	84
0102	4	0762	30	2438	96
0152	6	0914	36	2743	108
0203	8	1067	42	3048	120
0254	10	1220	48	3353	132
0305	12	1372	54	3658	144
0407	16	1524	60	3962	156
0508	20	1829	72		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

Splitter accessory for power connection (see page 245)

Rod BTL6
Cost-effective VARAN Industrial Ethernet Interface

Cost-effective VARAN solutions for hydraulic cylinder feedback
Micropulse linear position transducers in a rod style housing are designed for use in hydraulic cylinders. Optimal control quality of the hydraulic axes is achieved through dynamic, highly-repeatable position measurement.

Integrated VARAN interface
The BTL6 single-connector system allows direct connection to existing VARAN installations. The rod style BTL6 is ideal for position monitoring applications that do not require closed-loop control

Features:
- Non-contact measurement principle
- Pressure resistant to 600 bar (8700 psi)
- IP67
- Absolute output signal
- Stroke lengths to 4012 mm (158")
- Direct connection to Sigmatek VARAN masters
- Single connector solution lowers system cost
- Connector adapter allows connection of SIGNAL and POWER

Additional Information
For more information on VARAN, go to http://www.varan-bus.net

Series	**Rod BTL6**
Output signal	VARAN
Transducer interface	**V11V**
Customer device interface	VARAN
Part number	BTL6-V11**V**-M _ _ _ _ -B-S115
System resolution	≤ 15 µm
Repeat accuracy	≤ 20 µm
Sampling rate	$f_{STANDARD}$ = 1 kHz (< 850 mm)
Linearity deviation	≤ ±200 µm up to 500 mm nominal stroke ±0.04% 500...1500 mm nominal stroke
Supply voltage	20...28 V DC
Current consumption	≤ 75 mA
Polarity reversal protected	yes
Operating temperature	0...+70 °C
Storage temperature	–40...+100 °C

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connector, page 236

Ordering example:

BTL6-V11V - M_ _ _ _ - Z – S115

Interface
V11V VARAN

Standard nominal stroke [mm]
0025...4012 mm in 1 mm increments

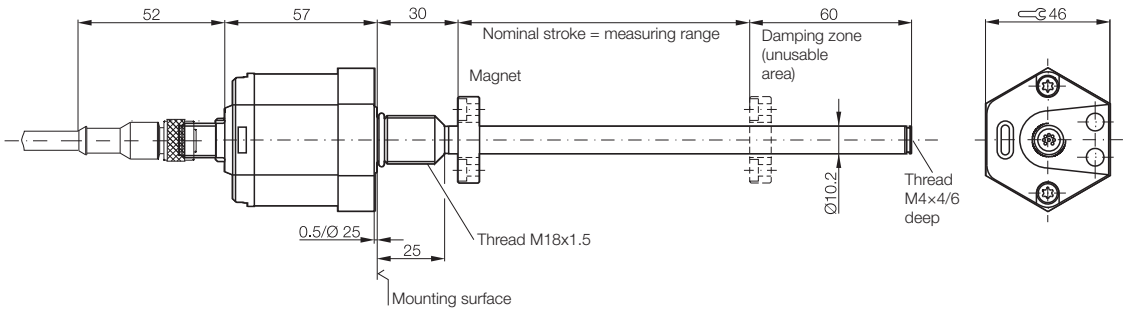
Design
Z = Standard, 3/4"-16 UNF mounting threads
B = Metric, M18x1.5 mounting threads

Connection
S115 Connector, 8-pole, M12

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0610	24	2134	84
0102	4	0762	30	2438	96
0152	6	0914	36	2743	108
0203	8	1067	42	3048	120
0254	10	1220	48	3353	132
0305	12	1372	54	3658	144
0407	16	1524	60	3962	156
0508	20	1829	72		

Additional stroke lengths available
Inch to millimeter conversion: Inches x 25.4 = millimeters

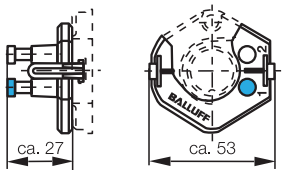


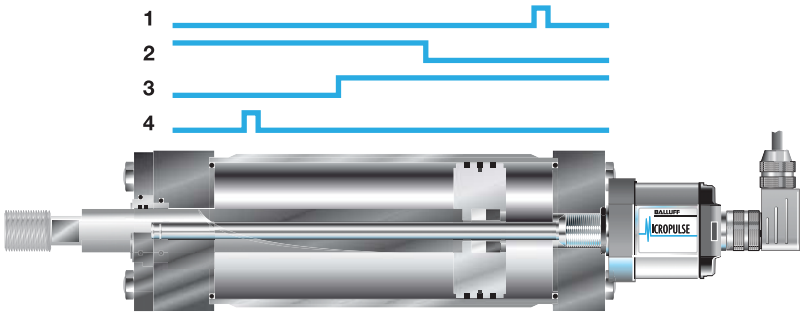
Single position measurement between the piston limits on a standard cylinder series

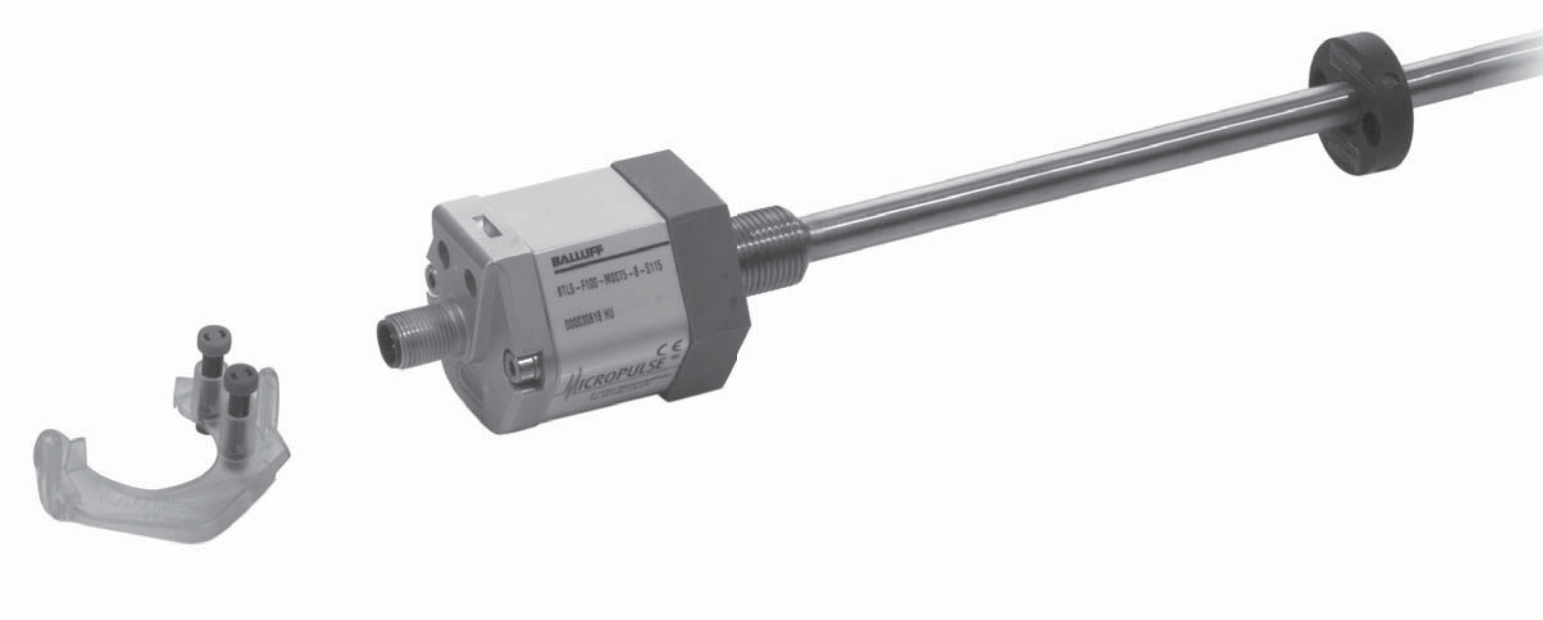
Benefits

- No special design of piston or piston rod necessary
- No permanent magnet required between the piston seals
- Easy to program
- No time-consuming adjustment
- high resolution and reproducibility
- Switching points freely programmable using calibration device or programming inputs

BTL5-A-EH01 calibration device for programming the outputs

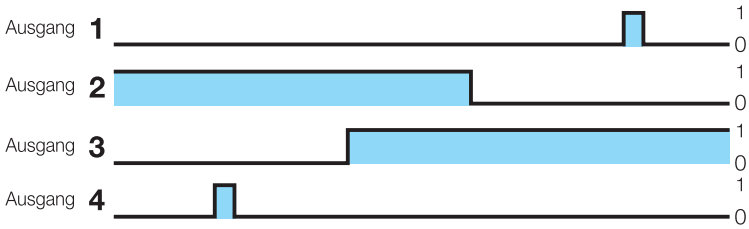






Rod BTL5
4 programmable switching points

Series	**Rod BTL5**
Transducer interface	**F**
Customer device interface	digital
Part number	BTL5-**F**1_ 0-M_ _ _ _-_-S115
Output signals	4 switching outputs
Max. current load per output	100 mA
Max. current load for 4 outputs	200 mA
Repeat accuracy	±0.1 mm
Sampling rate	$f_{STANDARD}$ = 1 kHz = ≤ 1400 mm
Supply voltage	24 V DC ±20%
Current consumption without load	≤ 100 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C
Shock load	100 g/6 ms as per IEC 60068-2-27
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached)
Housing material	Anodized aluminum/1.4571 stainless steel outer tube, 1.3952 stainless steel cast flange
Fasteners	Thread M18×1.5, 3/4"-16UNF on request
Pressure rating	600 bar with installation in hydraulic cylinder
Connection	Connector



ProSet 4

Please enter code for output signal, nominal stroke and design in the part number.

Scope of delivery
- Transducer
- Quick start instructions
- Calibration device

Please order separately:
Magnets/floats, page 166
Mounting nuts, page 167
Connectors, page 236

Ordering example:

BTL5-F1_0-M_ _ _ _-_-S115

Output

0 Output NPN switching
1 Output PNP switching

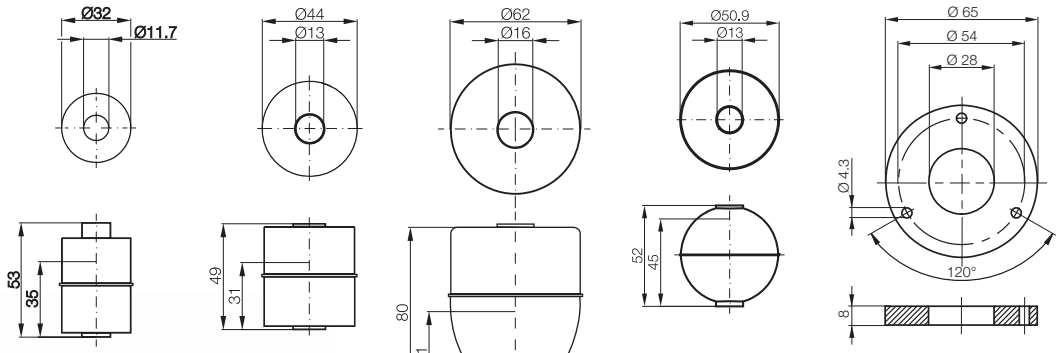
Standard nominal stroke [mm]

0025...4000 mm in 1 mm increments

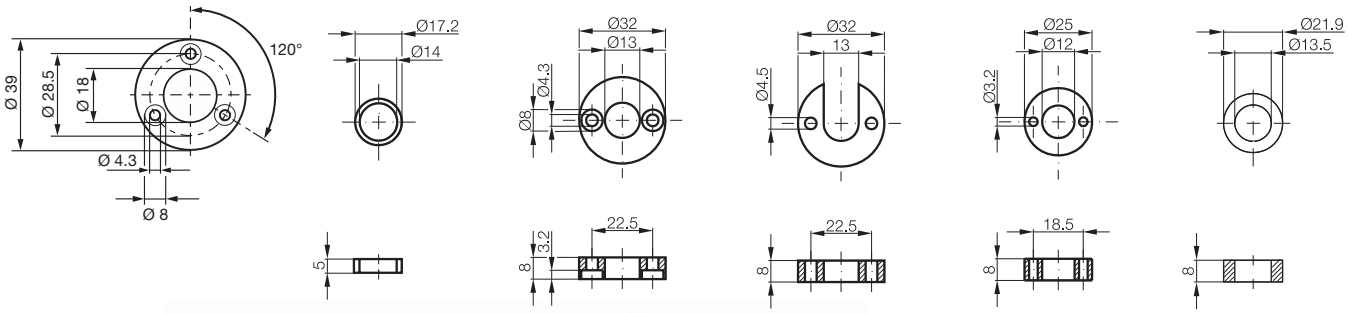
Design

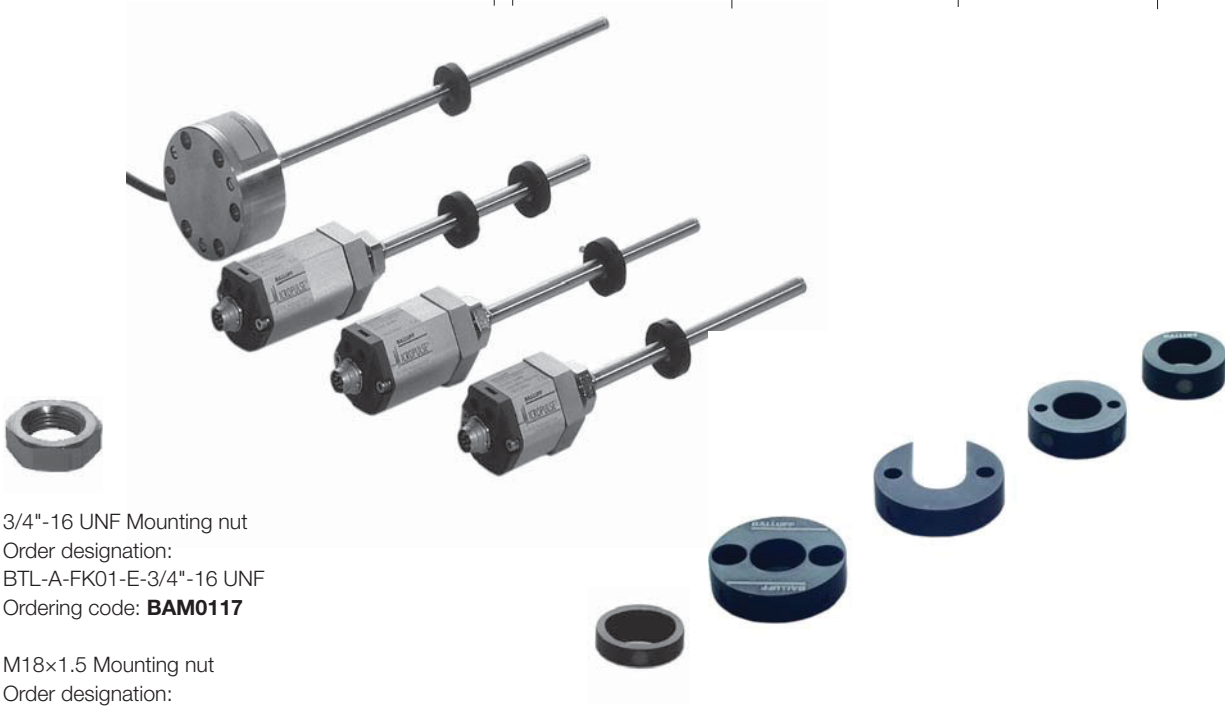
Z = Standard 34"-16 UNF
additional designs, page 155

Description	**Float**	**Float**	**Float**	**Float**	**Magnet**	
for Series	Rod BTL	BTL rod	BTL rod	BTL rod	BTL rod	
Ordering code	**BTL1KFR**	**BAM0146**	**BAM014C**	**BAM0149**	**BAM01CE**	
Part number	BTL2-S-3212-4Z	BTL2-S-4414-4Z	BTL2-S-6216-8P	BTL2-S-5113-4K	BTL-P-1018-3R	
Material	Stainless steel 1.4404	Stainless steel 1.4404	Stainless steel 1.4404	Stainless steel 1.4404	Al	
Weight	approx. 20 g	approx. 34 g	approx. 69 g	approx. 35 g		
Magnet travel speed					any	
Operating temperature/ Storage temperature	–20...+120 °C	–20...+120 °C	–20 to +120 °C	–20...+120 °C	–40...+100 °C	
Immersion depth in water	approx. 35 mm	approx. 31 mm	approx. 41 mm	approx. 26 mm		
Pressure resistance (static)	24 bar	20 bar	15 bar	40 bar		
Ordering code						
Part number PA 60 glass fiber reinforced						
Material						
Weight						
Magnet travel speed						
Operating temperature/ Storage temperature						



	Magnet	Magnet	Magnet	Magnet	Magnet	Magnet
	BTL rod	BTL rod	BTL rod	BTL rod	BTL rod	BTL rod
	BAM013Y	**BAM013H**	**BAM013L**	**BAM013P**	**BAM013J**	**BAM013R**
	BTL-P-1028-15R	BTL-P-0814-GR-PAF	BTL-P-1013-4R	BTL-P-1013-4S	BTL-P-1012-4R	BTL-P-1014-2R
	Al	Ferrite bound in PA	Aluminum	Aluminum	Aluminum	Aluminum
	approx. 68 g	approx. 1.5 g	approx. 12 g	approx. 12 g	approx. 12 g	approx. 10 g
	any	any	any	any	any	any
	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C
			BAM013M		**BAM013K**	
			BTL-P-1013-4R-PA		BTL-P-1012-4R-PA	
			PA 60 glass fiber reinforced		PA 60 glass fiber reinforced	
			approx. 10 g		approx. 10 g	
			any		any	
			–40...+100 °C		–40...+100 °C	



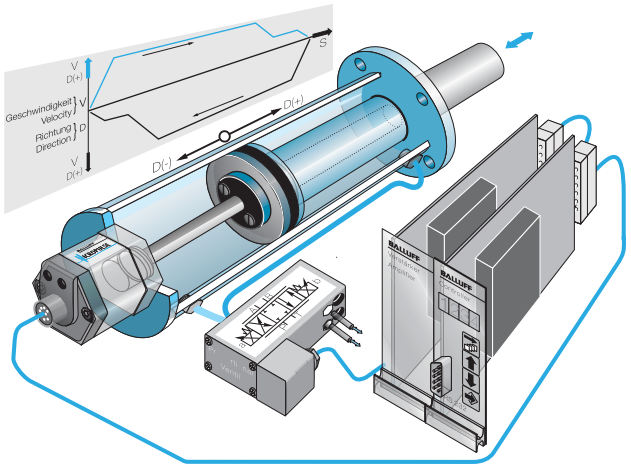


3/4"-16 UNF Mounting nut
Order designation:
BTL-A-FK01-E-3/4"-16 UNF
Ordering code: **BAM0117**

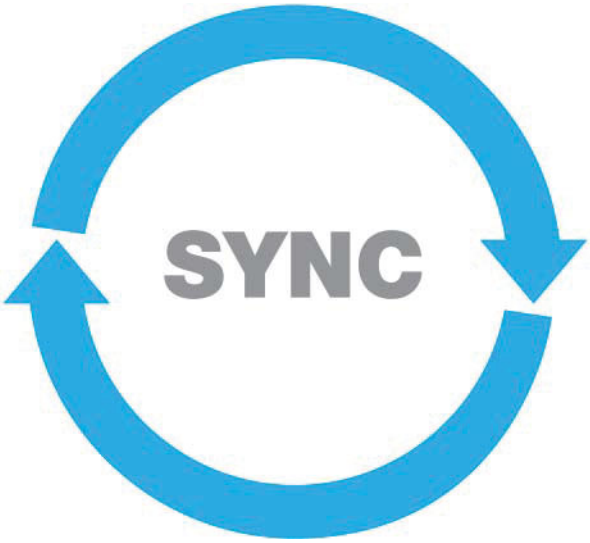
M18×1.5 Mounting nut
Order designation:
BTL-A-FK01-E-M18×1.5
Ordering code: **BAM0118**

Installation notices

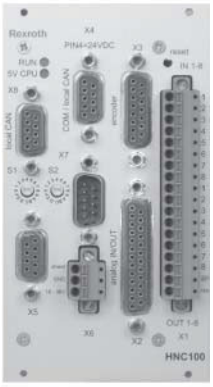
SSI-SYNC – better control behavior and higher dynamics
The absolute positioning information from the Micropulse Transducer is transmitted synchronously to the axis control card. This synchronous data acquisition permits a precise calculation of the speed and acceleration.
The feedback of these status sizes (speed and acceleration) allows the damping and natural frequency of a hydraulic system to be increased. These measures permit greater loop gain and with it, better control behavior and higher dynamics.



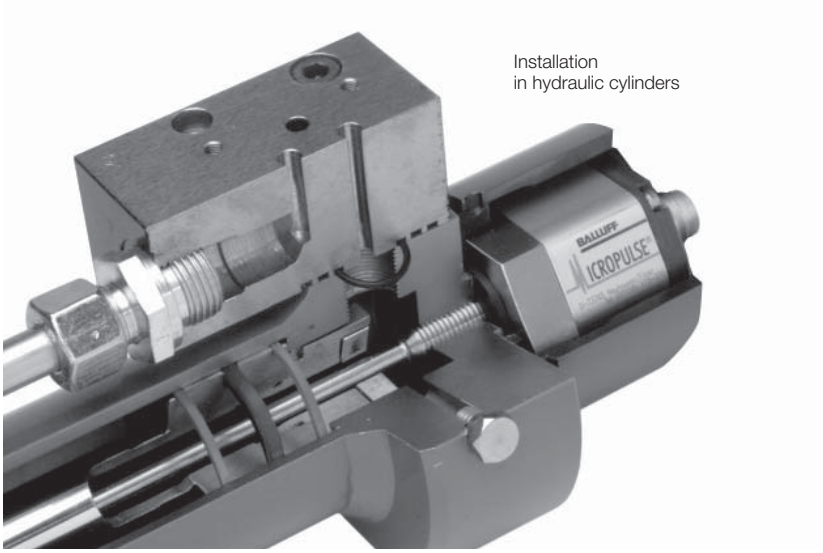
Application with hydraulic cylinder in a control circuit



BTL7 Micropulse Transducer S1_ _

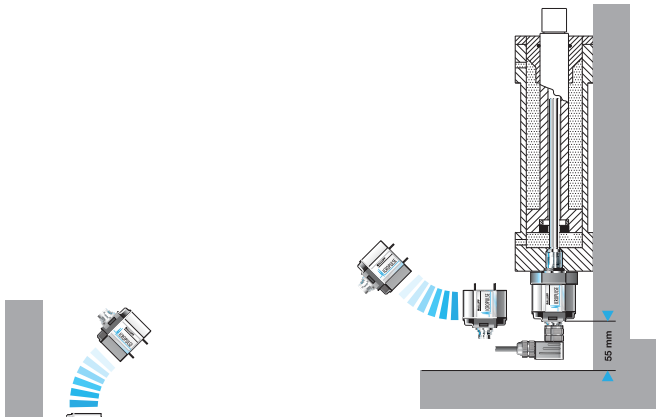


Control card with SSI interface for connecting Micropulse Transducers



Installation in hydraulic cylinders

Service without great assembly effort
Transducers are often installed in hydraulic cylinders at locations that are difficult to access. In the event of service, a complete replacement of the electronics with wave guide is often a difficult and expensive proposition.
Should a problem occur in the electronics of the Micropulse Transducer, the electronics head can be easily and quickly exchanged for a new one. The fluid circuit is also not disturbed in the event of service, as no drainage is necessary.

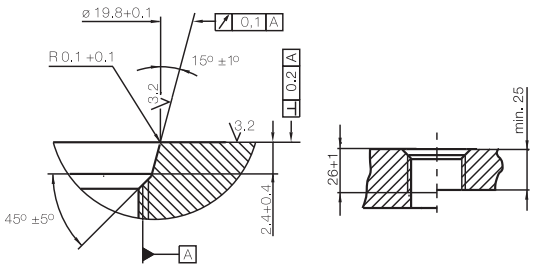


Servicing a vertical installation location

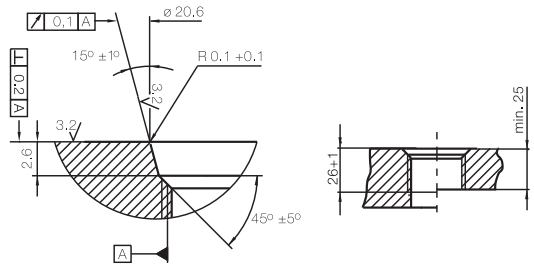
Servicing a horizontal installation location

Installation
The Micropulse Transducer BTL has a M18×1.5 or 3/4"-16 UNF mounting thread. We recommend that the mounting be made of non-magnetizable material. If magnetizable materials are used, then the measures shown below have to be taken. Sealing is done at the flange mounting surface, for example, in the B design, with a M18×1.5 thread with an included 15.4×2.1 O-ring.

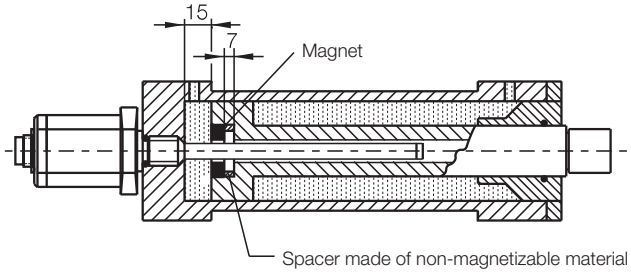
Insertion hole
The transducer comes with an M18×1.5 (according to ISO) or a 3/4"-16UNF (according to SAE) thread to secure it. Depending on the version, the threaded hole must be made before installation.

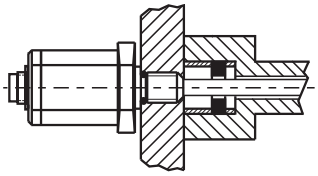


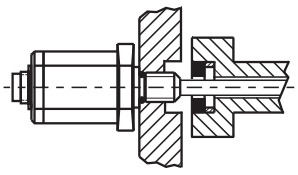
Insertion hole M18×1.5, as per ISO 6149, O-ring 15.4×2.1



Insertion hole 3/4"-16UNF according to SAE J475, 15.3×2.4 O-ring



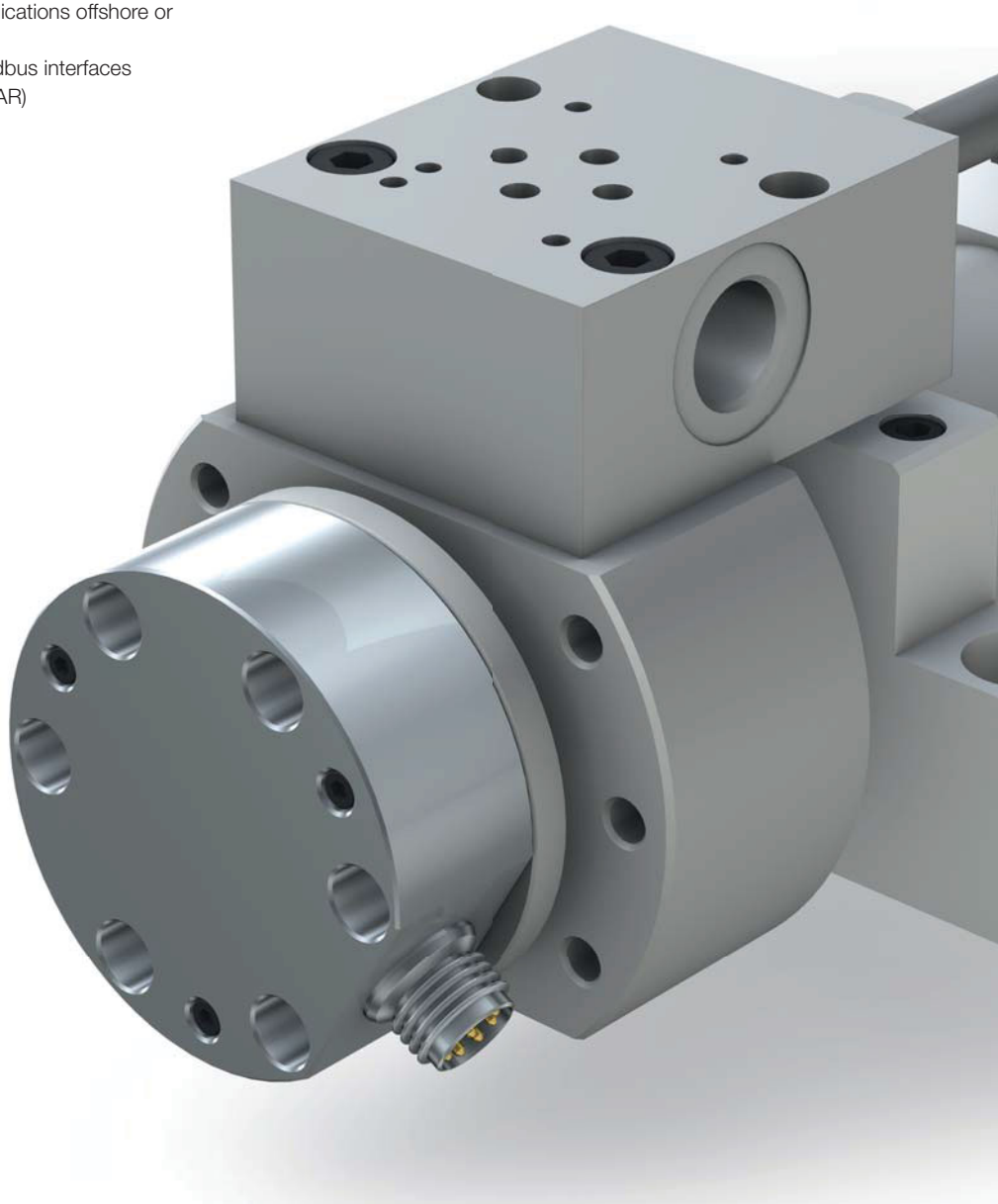




Micropulse Transducers

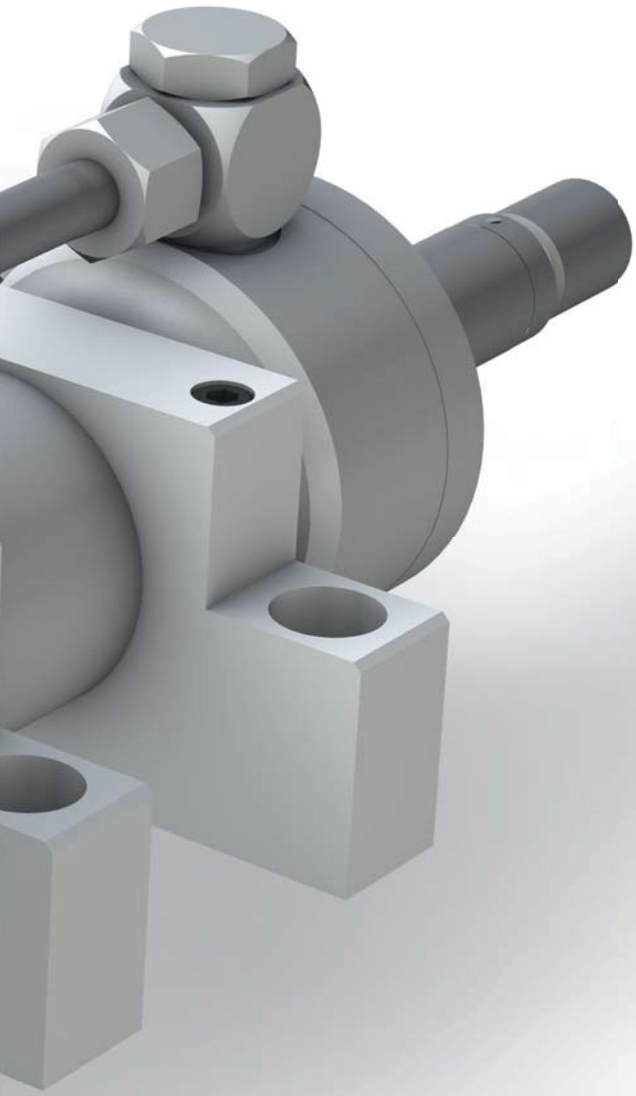
Compact Rod and AR Rod

- Compact housing saves valuable space in and around the cylinder
- Rugged stainless steel housing
- Shock and vibration-secure with IP 67/68 degree of protection
- Pressure-resistant housing, for extreme applications offshore or under water
- Available with analog signals, digital and fieldbus interfaces
- Complete integration in hydraulic cylinders (AR)



Compact Rod and AR Rod
Contents

MICROPULSE®



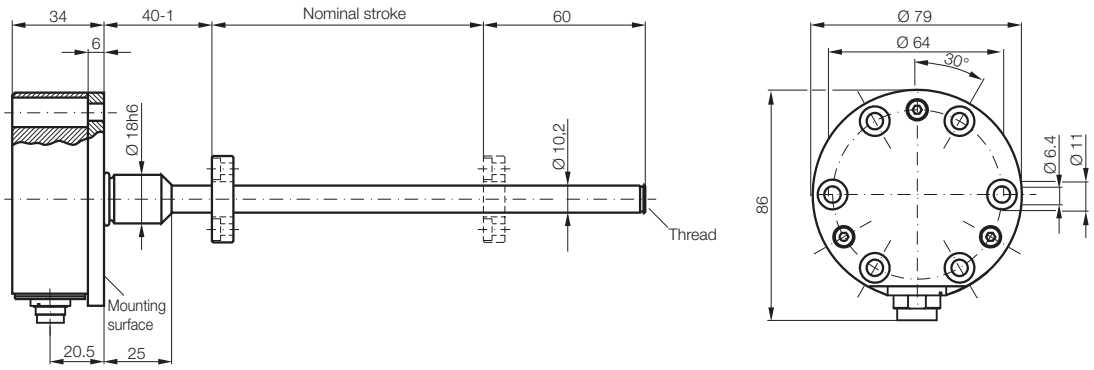
Pressure rated to 600 bar (8700 psi), high repeatability, non-contact, robust

The BTL Micropulse Transducer is a robust position feedback system for measuring ranges between 25 and 7620 mm under extreme ambient conditions.
The actual measurement section is protected inside a high-pressure resistant stainless steel tube.
The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

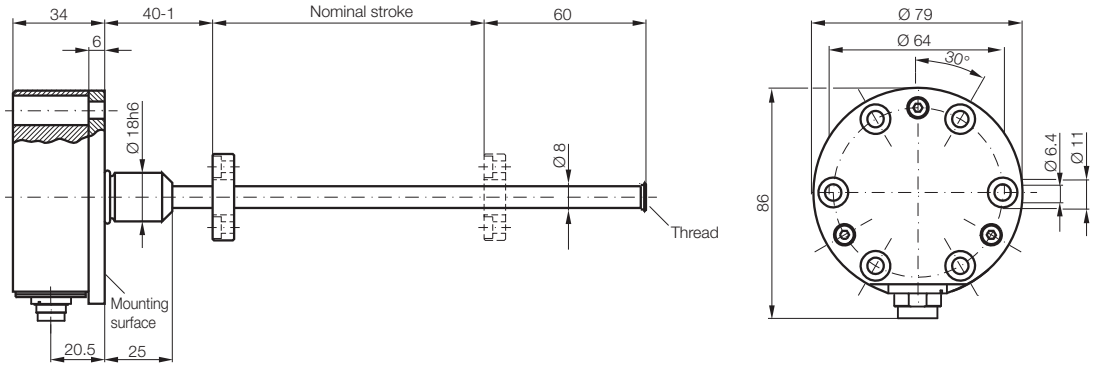
Series	**K BTL7 compact rod**
Shock load	150 g/6 ms as per EN 60068-2-27
Vibration	20 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	to 36 V
Overvoltage protection	to 36 V
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC 60529	IP 68 with cable outlet, IP 67 with screwed-on connector BKS-S...
Housing material	1.4571 stainless steel outer tube, 1.3952 stainless steel cast flange
Fasteners	Design K, 18h6 with 6 cylinder head screws
Pressure rating	
at 10.2 mm, protective tube	600 bar with installation in hydraulic cylinder
at 8 mm, protective tube	250 bar when installed in hydraulic cylinder
Connection	Connector or cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	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
Standard nominal strokes [mm] with an 8 mm outer tube, the max. nominal stroke is 1016 mm	0025...7620 mm in 1 mm increments

– Bolt-in design
– Stainless steel

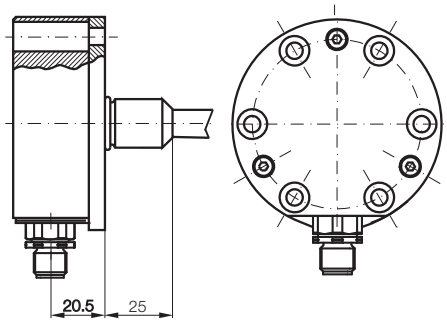
Design K,
BTL7-...-K-SR32



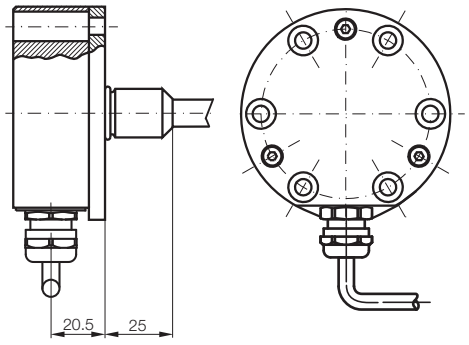
Design K8,
BTL7-...-K8-SR32



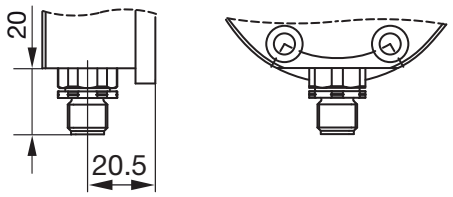
Design K,
BTL7-...-K-SR115



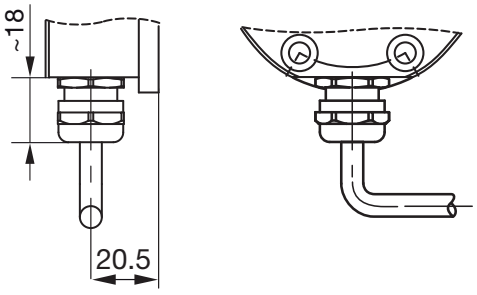
Design K, BTL7-...-K-K _ _, radial cable outlet



BTL7-...-K-SR115



BTL7...-K-K _ _



Stroke lengths up to 7620 mm

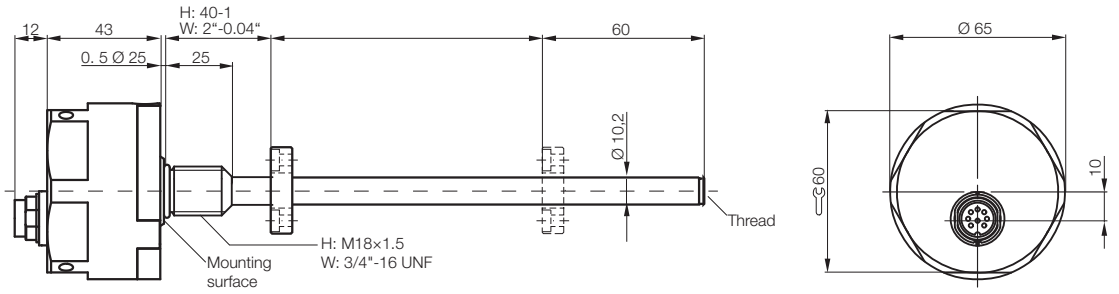
Pressure rated to 600 bar (8700 psi) bar, high repeatability, non-contact, robust

The BTL Micropulse Transducer is a robust position measuring system for measuring ranges between 25 and 7620 mm under extreme ambient conditions. The actual measurement section is protected inside a high-pressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

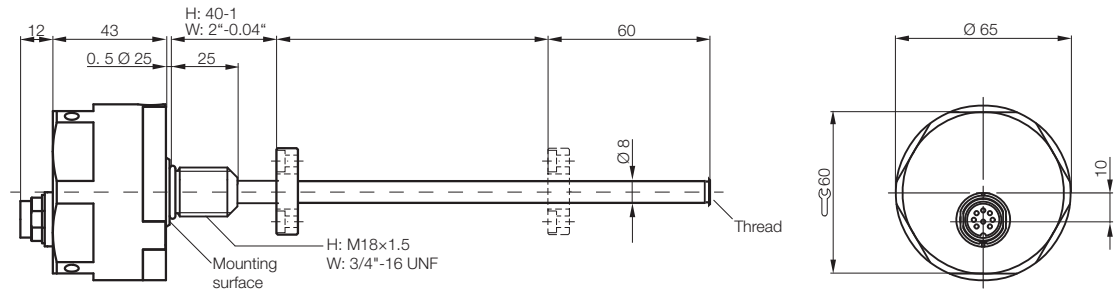
Series	**BTL7 compact H/W rod**
Shock load	150 g/6 ms as per EN 60068-2-27
Vibration	20 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	to 36 V
Overvoltage protection	to 36 V
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC 60529	IP 68 with cable outlet, IP 67 with screwed-on connector BKS-S...
Housing material	Anodized aluminum/1.4571 stainless steel outer tube, 1.3952 stainless steel cast flange
Fasteners	Design H M18×1.5 thread Design W 3/4"-16UNF
Pressure rating	
at 10.2 mm, protective tube	600 bar with installation in hydraulic cylinder
at 8 mm, protective tube	250 bar when installed in hydraulic cylinder
Connection	Connector or cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	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
Standard nominal strokes [mm] with an 8 mm outer tube, the max. nominal stroke is 1016 mm	0025...7620 mm in 1 mm increments

– Thread-in design
– Stainless steel

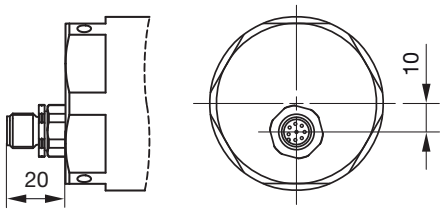
Design H/W,
BTL7-...-H/W-S32



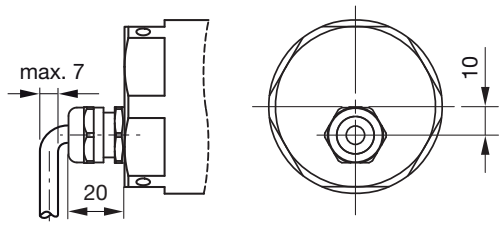
Design H/W,
BTL7-...-H8/W8-S32



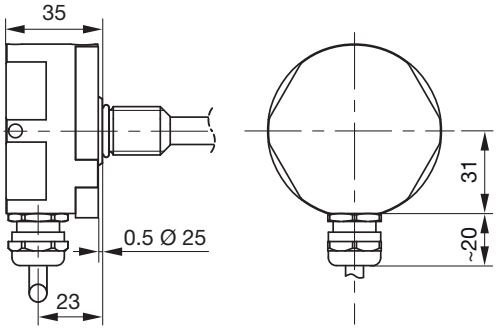
Design H/W,
BTL7-...-H/W-S115



Design H/W,
BTL7-...-H/W-KA



Design H/W,
BTL7-...-H/W-K



Measurement rate to 4 kHz

Features of Micropulse BTL7-A/C/E/G...H, K, W
- Non-contact detection of piston position
- Insensitive to contamination to IP 68
- Shock and vibration resistant 150 g/20 g
- Absolute output signal
- Measurement lengths 25 to 7620 mm in 1 mm increments
- Flexibly adjustable measuring range through button programming
- High measurement rate up to 4 kHz
- Temperature range -40 to +85°C

Micropulse Transducer BTL7 Compact with BTL-A-CB02 Calibration Box

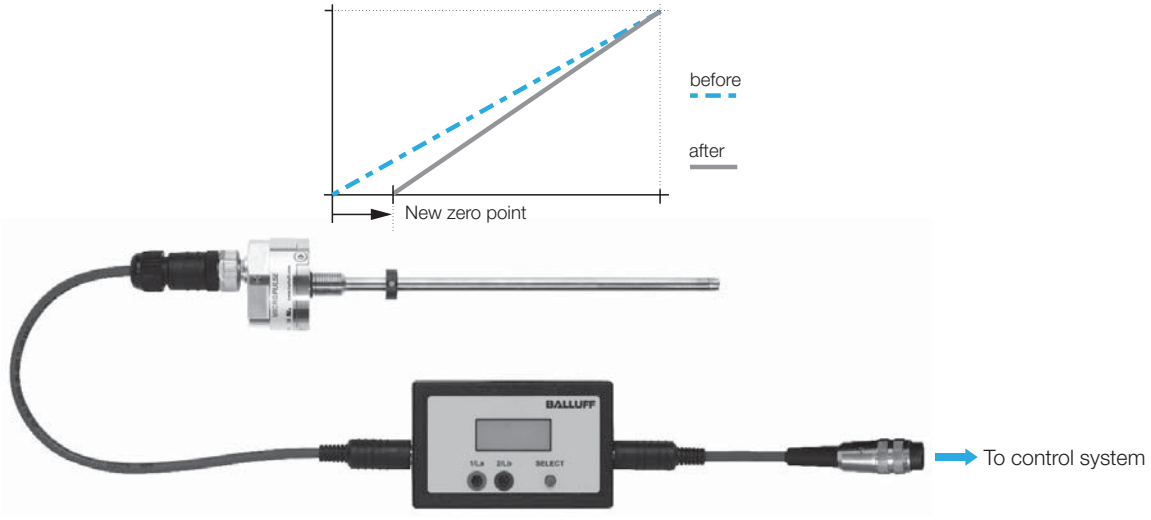
With the BTL-A-CB02 Calibration Box, the slope (rising or falling) of the position measuring system can be easily and quickly adapted to the requirements of the hydraulic cylinder and the application. With simple plug & play, without PC, laptop or extensive software downloading, the measuring range as well as the slope of the output characteristic are set. The setting option saves storage and setup costs, since a Micropulse BTL7 Compact can fulfill different requirements where, in the past, several systems were required.

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Load resistance	
System resolution	
Repeat accuracy	
Measurement rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption at 24 V DC	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	

Please enter code for output signal, nominal stroke, design and connection in the part number.

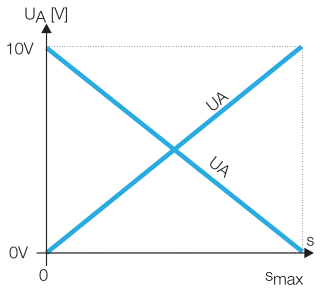
Scope of delivery
- Transducer
- Quick start instructions
- Stainless steel fastening screws “600 bar”

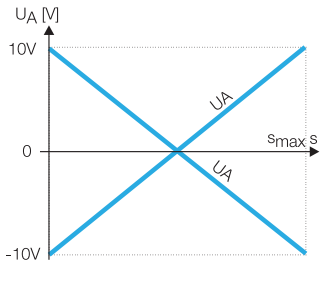
Please order separately:
Calibration box, page 178
Magnets/Floats, page 166
Mating cables/Connectors, page 236 and 244

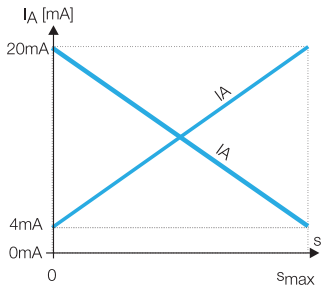


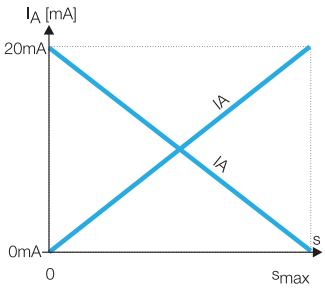
Set the output characteristic with the calibration box.
Zero and end points, measuring range, rising and falling characteristic

Rod Compact BTL7	Rod Compact BTL7	Rod Compact BTL7	Rod Compact BTL7
analog	analog	analog	analog
A	**G**	**E**	**C**
analog	analog	analog	analog
BTL7-**A**510-M_ _ _ _-_-_ _ _ _	BTL7-**G**510-M_ _ _ _-_-_ _ _ _	BTL5-**E**5_0-M_ _ _ _-_-_ _ _ _	BTL7-**C**5_0-M_ _ _ _-_-_ _ _ _
0...10 V and 10...0 V	–10...10 V and 10...–10 V		
		4...20 mA or 20...4 mA	0...20 mA or 20...0 mA
Max. 5 mA	Max. 5 mA		
		≤ 500 ohms	≤ 500 ohms
≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA
System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
Max. 4 kHz	Max. 4 kHz	Max. 4 kHz	Max. 4 kHz
±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke	±50 µm to ≤ 500 mm nominal stroke
±0.01% FS > 5500 mm nominal stroke	±0.01% FS > 5500 mm nominal stroke	±0.01% FS > 5500 mm nominal stroke	±0.01% FS > 5500 mm nominal stroke
±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke	±0.02% FS > 5500 mm nominal stroke
≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K	≤ 30 ppm/K
10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC
≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
to 36 V	to 36 V	to 36 V	to 36 V
to 36 V	to 36 V	to 36 V	to 36 V
500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)
–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C









Ordering example:

BTL7-_5_0-M_ _ _ _-_ _-_ _ _ _

Output signal

A	0...10 V and 10...0 V
G	–10...10 V and 10...–10 V
E	4...20 mA or 20...4 mA
C	0...20 mA or 20...0 mA

Characteristic

1	rising and falling (output types A and G)
0	Rising (output types C and E)
7	Falling (output types C and E)

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	2743	108
0102	4	3048	120
0152	6	3353	132
0203	8	3658	144
0254	10	3962	156
0305	12	4267	168
0407	16	4572	180
0508	20	4877	192
0610	24	5182	204
0762	30	5486	216
0914	36	5791	228
1067	42	6096	240
1220	48	6401	252
1372	54	6706	264
1524	60	7010	276
1829	72	7315	288
2134	84	7620	300
2438	96		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

K bolt-in design
10.2 mm Ø pressure tube
40 mm null point

K8 bolt-in design
8 mm Ø pressure tube
40 mm null point
(max. stroke length = 1016 mm)

W 3/4"-16 UNF thread-in design
10.2 mm Ø pressure tube
50.8 mm (2") null point

W8 3/4"-16 UNF thread-in design
8 mm Ø diameter pressure tube
50.8 mm (2") null point
(max. stroke length = 1016 mm)

H M18 x 1.5 thread-in design
10.2 mm Ø pressure tube
30 mm null point

H8 M18 x 1.5 thread-in design
8 mm Ø diameter pressure tube
30 mm null point
(max. stroke length = 1016 mm)

Connection

K-radial design
K02 PUR cable 2 m
K05 PUR cable 5 m
K10 PUR cable 10 m
K15 PUR cable 15 m
SR32 Connector, 8-pole, M16
SR115 Connector, 8-pole, M12

H/W radial design
K02 PUR cable 2 m
K05 PUR cable 5 m
K10 PUR cable 10 m
K15 PUR cable 15 m

H/W design, axial
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m
S32 Connector, 8-pole, M16
S115 Connector, 8-pole, M12

Calibration box

Calibration boxes with cable sets	
Part number	**Cable set**
BTL7-A-CB02	Cable connection
BTL7-A-CB02-S115	Connector S115
BTL7-A-CB02-S32	Connector S32

Micropulse Transducer BTL7 Rod Compact with "Calibration box" BTL-A-CB02

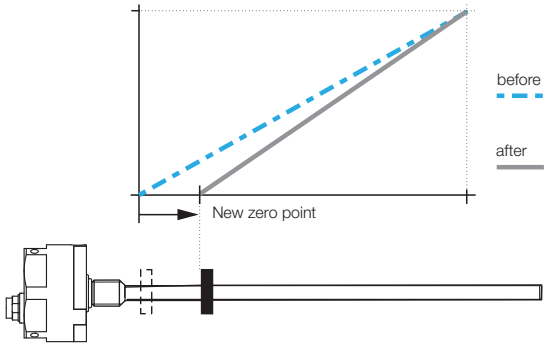
Set the output characteristic with the calibration box.
Zero and end point, measuring range, rising or falling characteristic.

Teach-in
The factory-set zero and end points are replaced by new zero and end points. The zero and end points can be set independently of each other, and the characteristic slope changes.

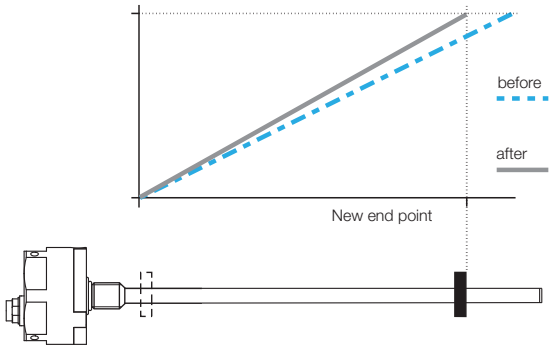
Inverting (only with BTL7-C/E)
The slope of the current output can be inverted by activating the programming inputs. For example, the rising characteristic of the output becomes a falling characteristic.
The voltage outputs are not inverted.

Adjusting
Setting and adjusting the characteristic with stopped magnet. The factory-set zero and end points can be replaced by a new start and end points, and the associated output values can be adjusted. The start and end values can be adjusted as desired to the limits.
Adjustment is possible from serial number 120615000xxxxx xx.

Reset
Restoring the transducer to its factory default settings.



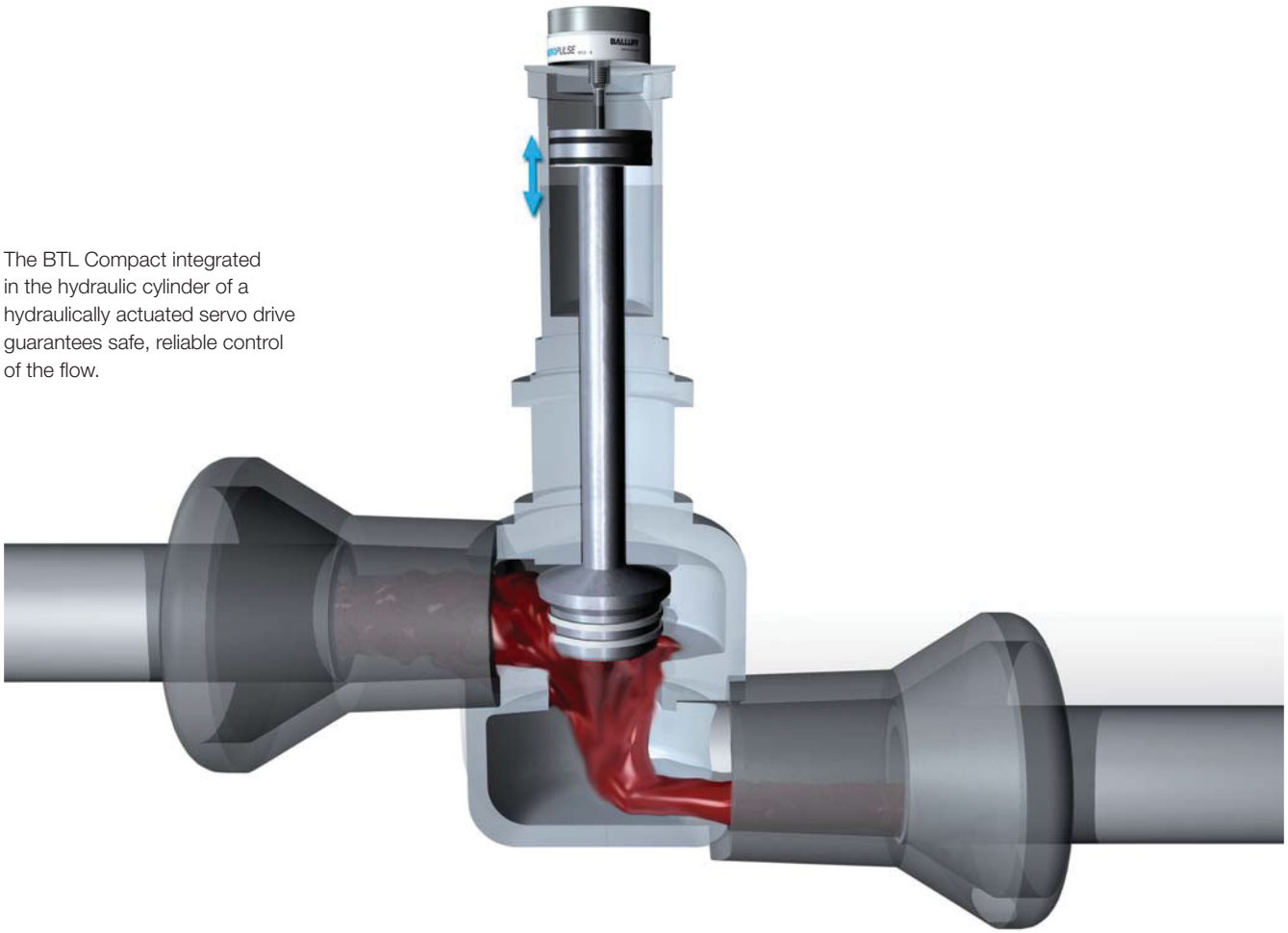
Read in new zero point



Read in new end point

BTL Compact – the standard in power plant and process engineering

Balluff, as the first manufacturer of magnetostrictive position measuring systems, presented the BTL Compact, with a length of only 34 mm, as an innovation as early as the 1995 Hanover trade fair. The target applications were hydraulically actuated valve drives in power plant and process engineering. In the meantime, thousands of BTL Compacts all over the world reliably measure the current position of valves and guarantee safe, dependable and perfect control.
Balluff is once again achieving new benchmarks with the new generation, the Micropulse BTL7 Compact. The position measuring system, which is 100% backward-compatible with the existing BTL5 generation, impresses with its improvement in many types of performance data and a large number of extensions in application and function.



The BTL Compact integrated in the hydraulic cylinder of a hydraulically actuated servo drive guarantees safe, reliable control of the flow.

Pressure rated to 600 bar, high repeatability, non-contact, robust

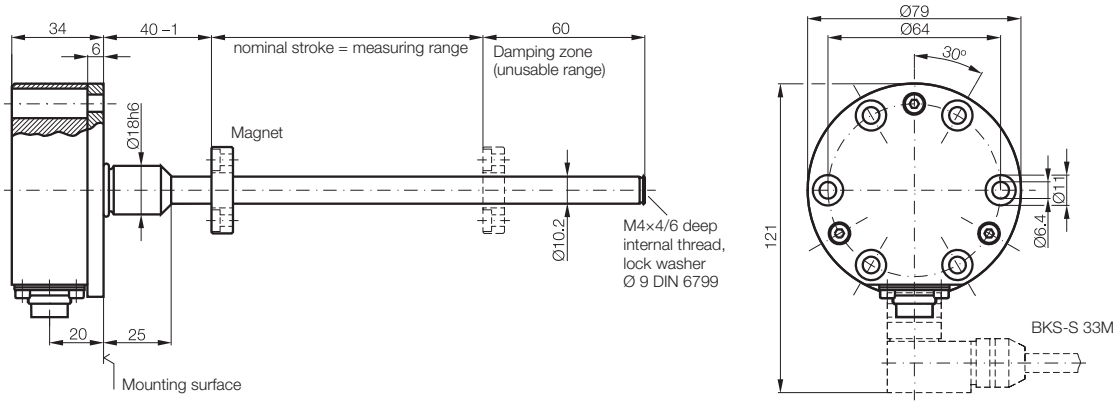
The BTL Micropulse Transducer is a robust position measuring system for measuring ranges between 25 and 5500 mm as well as for use under extreme ambient conditions. The actual measurement section is protected in a high-pressure resistant stainless steel tube. The system is ideally suited for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

Series	**Rod Compact K BTL5**
Shock load	100 g/6 ms according to EN 60068-2-27 and 100 g/2 ms according to EN 60068-2-29
Vibration	12 g, 10...2000 Hz according to EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached); IP 68 (5 bar with cable)
Housing material	Stainless steel 1.4305
Flange and tube material	Tube stainless steel 1.4571, flange 1.4571 or 1.4429 or 1.4404
Housing attachment	Design K, 18h6 with 6 cylinder head screws
Connection	Connector or cable connection
Connector suggestion, see page 232/233	BKS-S 32M/BKS-S 32M-C/BKS-S 33M
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3
Standard nominal strokes [mm]	0025...5500 mm in 1 mm increments, depending on the interface

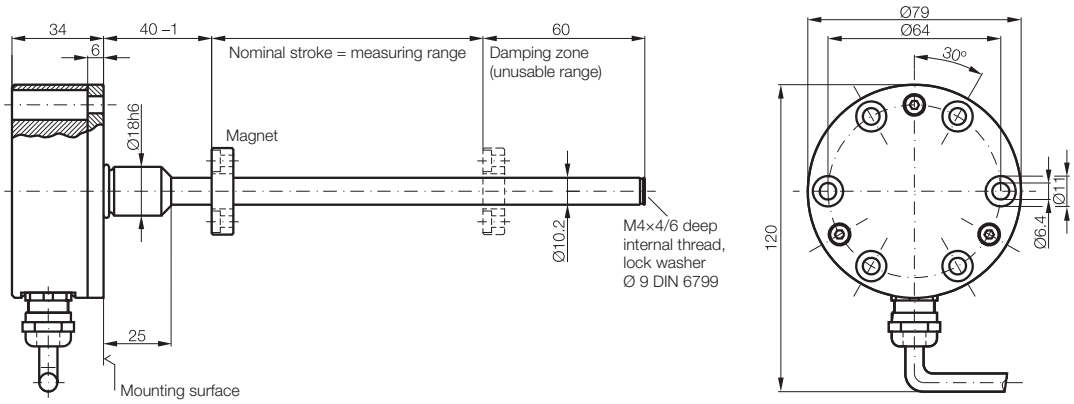
Note:
The information on pages 180 through 189 covers the Compact K housing and H/W housing transducer with digital, SSI and fieldbus outputs only.

For analog output versions see the BTL7 compact rod, starting on page 172.

Design K, BTL5-...-M_ _ _ _-K-SR32



Design K, BTL5-...-M_ _ _ _-K-K_ _



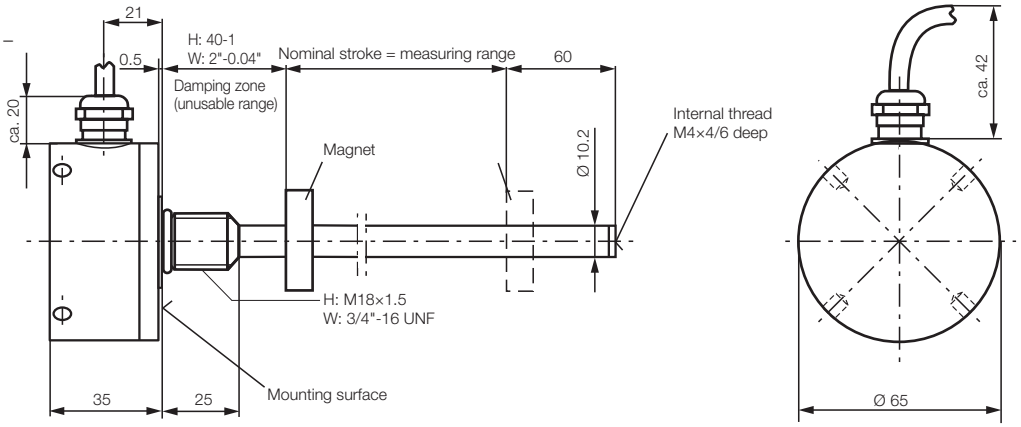
Pressure-resistant to 600 bar, high repeatability, non-contact, robust

The BTL Micropulse Transducer is a robust position measuring system for measuring ranges between 25 and 5500 mm as well as for use under extreme ambient conditions. The actual measurement section is protected in a high-pressure resistant stainless steel tube. The system is ideal for use in hydraulic cylinders for position feedback or as a level monitor with aggressive media in the food and chemical industries.

Series	**BTL5 Rod Compact H**
Shock load	100 g/6 ms in accordance with EN 60068-2-27 and 100 g/2 ms in accordance with EN 60068-2-29
Vibration	12 g, 10...2000 Hz in accordance with EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67 (with IP-67 connector BKS-S... attached); IP 68 (5 bar with cable)
Design material	Stainless steel 1.4305
Flange and tube material	Tube stainless steel 1.4571, flange 1.4571 or 1.4429 or 1.4404
Housing attachment	Design H thread M18×1.5, design W 3/4"-16UNF
Connection	Connector or cable connection
Connector suggestion see page 232/233	BKS-S 32M/BKS-S 32M-C/BKS-S 33M
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3
Standard nominal strokes [mm]	0025...5500 mm in 1 mm increments

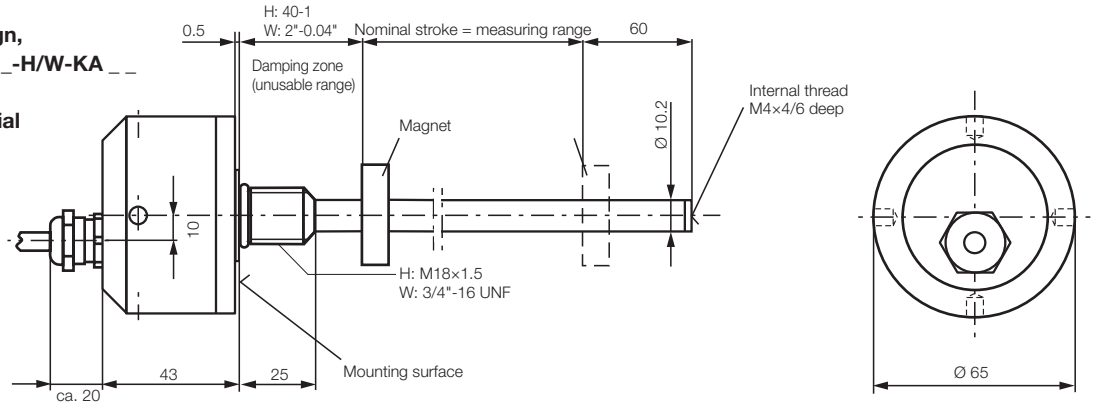
Hardware design,
BTL5-...-M_ _ _ _-H/W-K_ _

Radial cable outlet



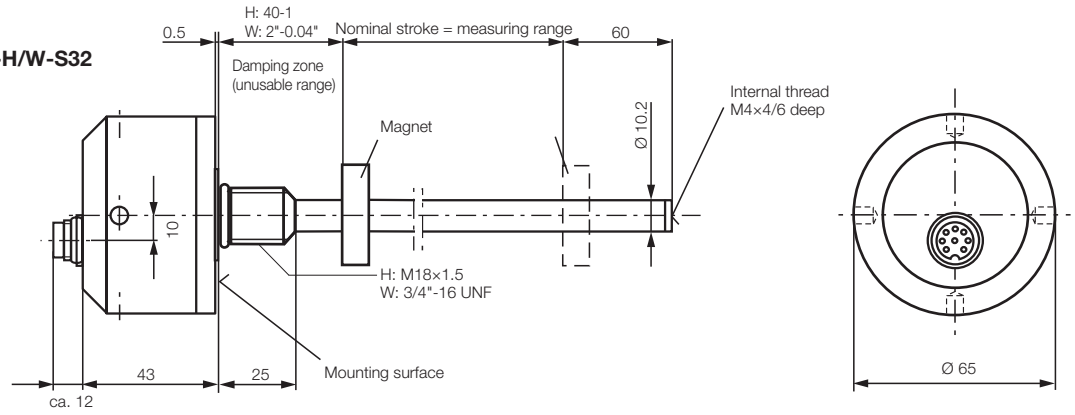
Hardware design,
BTL5-...-M_ _ _ _-H/W-KA _ _

Cable outlet axial



H/W housing,
BTL5-...-M_ _ _ _-H/W-S32

Connector axial



compact and cost-effective

P Interface

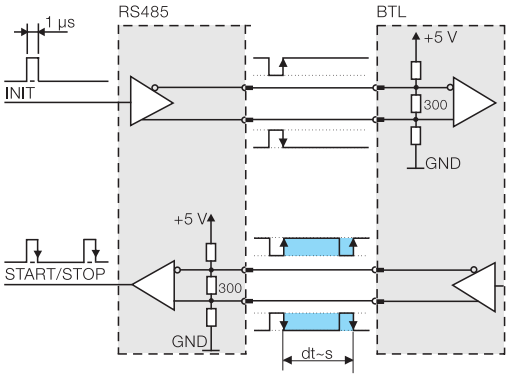
The P interface is compatible with BTA evaluation units as well as with controllers and modules from various manufacturers including Siemens, B & R, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO and others.
Reliable signal transmission, even with cable lengths of up to 500 m between the BTA evaluation unit and the BTL transducer. This is guaranteed by the especially interference-proof RS485 differential drivers and receivers. Interference signals are effectively suppressed.

Highly precise digitizing of the P pulse signal

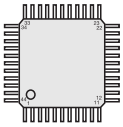
Companies developing their own electronic control and evaluation unit can create a highly accurate P interface cost effectively and with minimum effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for Micropulse Transducers with P interface.

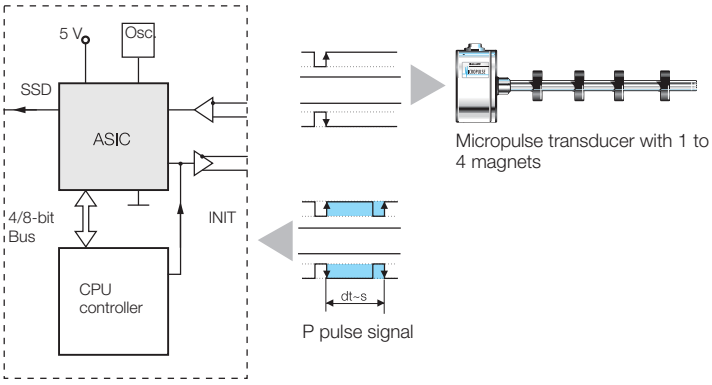
Benefits

- Position resolution 1 µm!
- The 1 µm resolution of the Micropulse position measuring system is achieved by the high resolution of the digitizing chip (133 pS) (clock frequency 2 or 20 MHz).
- Position data from 4 magnets can be processed simultaneously
- 4/8-bit processor interface



Block diagram of P interface


Digitizing chip 44QFP



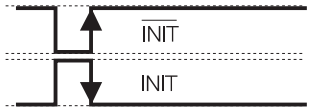
Micropulse transducer with 1 to 4 magnets

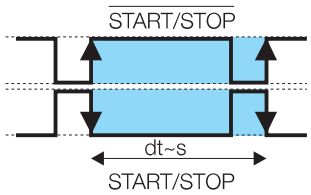
P pulse signal

Controller or electronic evaluation unit

Compact Rod
Digital pulse interface

Series	**BTL5 Compact rod**
Transducer interface	Pulse **P**
Customer device interface	Pulse **P**
Part number	BTL5-**P**1-M_ _ _ _-_-_ _ _ _
System resolution	processing-dependent
Repeat accuracy	2 µm or ±1 digit depending on electronic evaluation unit
Resolution	≤ 2 µm
Hysteresis	≤ 4 µm
Measurement rate	$f_{STANDARD}$ = 1 kHz = ≤ 1400 mm
Max. linearity deviation	±100 µm up to 500 mm nominal stroke ±0.02% 500...5500 mm nominal stroke
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C
Supply voltage	20...28 V DC
Current consumption	≤ 100 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C





Please enter code for nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, page 166
Mounting nut, page 167 (for Rod Compact H)
Connector, page 236

Ordering example:

BTL5-P1-M_ _ _ _-_-_ _ _ _

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	1524	60
0102	4	1829	72
0152	6	2134	84
0203	8	2438	96
0254	10	2743	108
0305	12	3048	120
0407	16	3353	132
0508	20	3658	144
0610	24	3962	156
0762	30	4267	168
0914	36	4572	180
1067	42	4877	192
1220	48	5182	204
1372	54	5486	216

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

K bolt-in design
10.2 mm Ø pressure tube
40 mm null point

K8 bolt-in design
8 mm Ø pressure tube
40 mm null point
(max. stroke length = 1016 mm)

W 3/4"-16 UNF thread-in design
10.2 mm Ø pressure tube
50.8 mm (2") null point

W8 3/4"-16 UNF thread-in design
8 mm Ø diameter pressure tube
50.8 mm (2") null point
(max. stroke length = 1016 mm)

H M18 x 1.5 thread-in design
10.2 mm Ø pressure tube
30 mm null point

H8 M18 x 1.5 thread-in design
8 mm Ø diameter pressure tube
30 mm null point
(max. stroke length = 1016 mm)

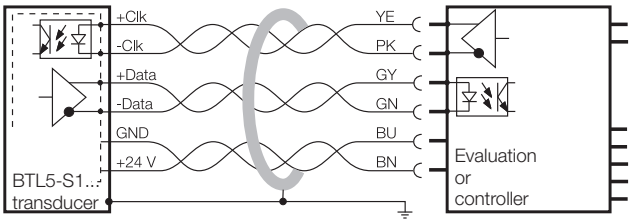
Connection

Radial output
K02 PUR cable 2 m
K05 PUR cable 5 m
K10 PUR cable 10 m
K15 PUR cable 15 m
SR32 Connector

Radial output
K02 PUR cable 2 m
K05 PUR cable 5 m
K10 PUR cable 10 m
K15 PUR cable 15 m

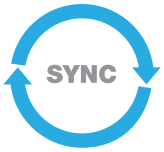
Axial output
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m
S32 Connector

Standard SSI interface
The synchronous serial data transmission uses controllers from various manufacturers, such as Siemens, Bosch Rexroth, WAGO, B & R, Parker, Esitron, PEP and others and the Balluff BDD-AM 10-1-SSD and BDD-CC 08-1-SSD display and control units.
Reliable signal transmission, even with cable lengths of up to 400 m between controller and BTL transducer. This is guaranteed by the especially interference-free RS485/422 differential drivers and receivers. Any interference signals are effectively suppressed.



BTL5-S1... with evaluation/controller, connection example

Synchronized BTL5-S1_ _B-M_ _ _ _-_ -_ _ _ _ SSI interface
Micropulse Transducers with synchronized SSI interface are well suited for dynamic control applications. Data acquisition in the transducer is synchronized using the controller's external clock, allowing an optimum speed calculation to be performed in the controller.
A prerequisite for this synchronous method of transducer operation is time stability of the clock signal.
The **maximum scan rate f_A**, at which a new current value is generated for each scan, can be derived from the table:



Nominal stroke area			Scan rate
< Nominal stroke	≤	100 mm	1500 Hz
100 mm < Nominal stroke	≤	1000 mm	1000 Hz
1000 mm < Nominal stroke	≤	1400 mm	666 Hz
1400 mm < Nominal stroke	≤	2600 mm	500 Hz
2600 mm < Nominal stroke	≤	4000 mm	333 Hz

The clock frequency depends on the cable length.

Cable length	Clock frequency
< 25 m	1000 kHz
< 50 m	500 kHz
< 100 m	400 kHz
< 200 m	200 kHz
< 400 m	100 kHz

Ordering example:

BTL5-S1_ _-M_ _ _ _-_-_ _ _ _-C for asynchronous operation
BTL5-S1_ _B-M_ _ _ _-_-_ _ _ _-C for synchronous operation

Coding

0	Binary code rising (24-bit)
1	Gray code rising (24-bit)
6	Binary code rising (25-bit)
7	Gray code rising (25-bit)

System resolution

1	1 µm
2	5 µm
3	10 µm
4	20 µm
5	40 µm
6	100 µm
7	2 µm

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	1220	48
0102	4	1372	54
0152	6	1524	60
0203	8	1829	72
0254	10	2134	84
0305	12	2438	96
0407	16	2743	108
0508	20	3048	120
0610	24	3353	132
0762	30	3658	144
0914	36	3962	156
1067	42		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

WB ProCompact rod
3/4"-16 UNF thread-in design
50.8 mm (2") null point

H8 ProCompact rod
M18 x 1.5 thread-in design
30 mm null point

Connection

Radial output
F05 5 m PTFE jacketed cable

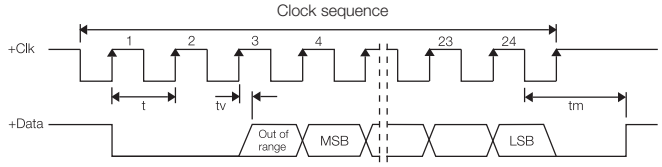
Axial output
FA05 5 m PTFE jacketed cable

Compact and synchronous

Rod Compact
SSI interface

Series	**Rod Compact BTL5**
Output signal	Synchronous-serial
Transducer interface	S
Customer device interface	Synchronous-serial
Part number	BTL5-S1_ _-M_ _ _ _-_-_ _ _ _
Part number synchronization	BTL5-S1_ _B-M_ _ _ _-_-_ _ _ _
System resolution depending on model (LSB)	1, 2, 5, 10, 20, 40 or 100 µm
Repeat accuracy	±1 digit
Hysteresis	≤ 1 digit
Measurement rate	$f_{STANDARD}$ = 2 kHz
Max. linearity deviation	±30 µm at ≤ 10 µm resolution or ≤ ±2 LSB
Temperature coefficient of overall system	(6 µm +5 ppm × L)/°C
Supply voltage	20...28 V DC
Current consumption	≤ 80 mA
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

Clock sequence



Please enter code for coding, system resolution, nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, page 166
Mounting nut, page 167
Connector, page 236

Ordering example:

BTL5-S1_ _-M_ _ _ _-_-_ _ _ _ for asynchronous operation
BTL5-S1_ _B-M_ _ _ _-_-_ _ _ _ for synchronous operation

Coding

0	Binary code rising (24-bit)
1	Gray code rising (24-bit)
6	Binary code rising (25-bit)
7	Gray code rising (25-bit)

System resolution

1	1 µm
2	5 µm
3	10 µm
4	20 µm
5	40 µm
6	100 µm
7	2 µm

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	1220	48
0102	4	1372	54
0152	6	1524	60
0203	8	1829	72
0254	10	2134	84
0305	12	2438	96
0407	16	2743	108
0508	20	3048	120
0610	24	3353	132
0762	30	3658	144
0914	36	3962	156
1067	42		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

K bolt-in design
10.2 mm Ø pressure tube
40 mm null point

K8 bolt-in design
8 mm Ø pressure tube
40 mm null point
(max. stroke length = 1016 mm)

W 3/4"-16 UNF thread-in design
10.2 mm Ø pressure tube
50.8 mm (2") null point

W8 3/4"-16 UNF thread-in design
8 mm Ø diameter pressure tube
50.8 mm (2") null point
(max. stroke length = 1016 mm)

H M18 x 1.5 thread-in design
10.2 mm Ø pressure tube
30 mm null point

H8 M18 x 1.5 thread-in design
8 mm Ø diameter pressure tube
30 mm null point
(max. stroke length = 1016 mm)

Connection

Radial output

K02	PUR cable 2 m
K05	PUR cable 5 m
K10	PUR cable 10 m
K15	PUR cable 15 m
SR32	Connector

Radial output

K02	PUR cable 2 m
K05	PUR cable 5 m
K10	PUR cable 10 m
K15	PUR cable 15 m

Axial output

KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m
S32	Connector

CANopen interface
Based on CAN (ISO/IEC 7498 and DIN ISO 11898), CANopen provides a Layer-7 implementation for industrial CAN networks. The serial data protocol of the CAN specification is defined, in contrast to most other field bus protocols, according to the producer-consumer principle. This eliminates target addressing of the process data. Each bus node decides for itself how the received data is processed.
The CANopen interface of the Micropulse Transducer is compatible with CANopen according to CiA Standard DS301 Rev. 3.0 as well as with CAL and Layer 2 CAN networks.

EDS
CANopen offers a high level of flexibility in configuring functionality and data exchange. Using a standard data sheet in the form of an EDS file, it is easy to link the Micropulse Transducers to any CANopen system.

Process Data Object (PDO)
Micropulse Transducers send their measured values optionally in one, two or four PDOs with 8 bytes of data each. The contents of the PDOs are freely configurable. The following information can be sent:
- The current position of the magnet, with a resolution in 5 µm increments
- the current speed of the magnet, with resolution selectable in 0.1mm/s increments
- the current status of four freely programmable cams per magnet

Synchronization Object (SYNC)
SYNC serves as a network-wide trigger for synchronizing all network nodes. When the SYNC object is received, all Micropulse Transducers connected to the CANopen bus store their current position and speed information, and then send it sequentially to the controller. This assures time-synchronous detection of the measured values.

FMM
The sensor can be operated as a 4-magnet type, whereby the sensor itself recognizes how many magnets are currently active.
So if only two magnets are positioned in the measuring range, a valid value is output for the first two positions and a defined error value for positions 3 and 4.

Emergency Object
The emergency object is sent with the highest priority. It is used, for example, to report errors or can be used for high-priority transfer of changes in the status of the cam.

Service Data Object (SDO)
Service data objects transmit the parameters for the configuration to the transducer. The transducer may be configured on the bus by the controller or offline with a bus analyzer/CANopen tool.
The configuration is stored in the transducer's non-volatile memory.

CiA 199911-301v30/11-009

Use of multiple magnets
The minimum distance between the magnets must be 65 mm.

Ordering example:

BTL5-H1_ _-M_ _ _ _-_ _-_ _ _ _-C

Software configuration

1	1 × position and 1 × speed
2	2 × position and 2 × speed
3	4 × position

Baud rate

0	1 Mbaud
1	800 kbaud
2	500 kbaud
3	250 kbaud
4	125 kbaud
5	100 kbaud
6	50 kbaud
7	20 kbaud
8	10 kbaud

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	1220	48
0102	4	1372	54
0152	6	1524	60
0203	8	1829	72
0254	10	2134	84
0305	12	2438	96
0407	16	2743	108
0508	20	3048	120
0610	24	3353	132
0762	30	3658	144
0914	36	3962	156
1067	42		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

WB ProCompact rod
3/4"-16 UNF thread-in design
50.8 mm (2") null point

H8 ProCompact rod
M18 x 1.5 thread-in design
30 mm null point

Connection

Radial output
K05 PUR cable 5 m

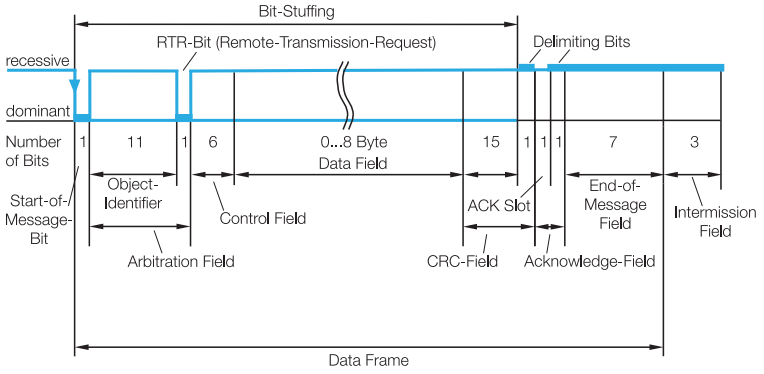
Axial output
KA05 PUR cable 5 m

Series	**Rod Compact BTL5**							
Output signal	CANopen							
Transducer interface	H							
Customer device interface	CANopen							
Part number	BTL5-**H**1_ _-M_ _ _ _-_ _-_ _ _ _							
CANopen Version	Potential-free							
Repeat accuracy	±1 digit							
System resolution, Position	5 µm increments							
configurable Speed	0.1 mm/s increments							
Hysteresis	≤ 1 digit							
Measurement rate	$f_{STANDARD}$ = 1 kHz							
Max. linearity deviation	±30 µm at 5 µm resolution							
Temperature coefficient of overall system	(6 µm + 5 ppm × L)/°C							
Supply voltage	20...28 V DC							
Current consumption	≤ 100 mA							
Operating temperature	–40...+85 °C							
Storage temperature	–40...+100 °C							
Cable length [m] per CiA DS301	< 25	< 50	< 100	< 250	< 500	< 1000	< 1250	< 2500
Baud rate [kbaud] per CiA DS301	1000	800	500	250	125	100	50	20/10

Please enter code for software configuration, baud rate, nominal stroke and design in the part number. Cable on request.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, page 166
Mounting nut, page 167
Connector, page 236



Using the CANopen interface and a cable up to 2500 m in length, the signal is sent at a length-dependent baud rate to the controller. The high interference immunity of the connection is achieved using differential drivers and by the data monitoring implemented in the data protocol.

Ordering example:

BTL5-H1_ _-M_ _ _ _-_ _-_ _ _ _

Software configuration

1	1 × position and 1 × speed
2	2 × position and 2 × speed
3	4 × position

Baud rate

0	1 Mbaud
1	800 kbaud
2	500 kbaud
3	250 kbaud
4	125 kbaud
5	100 kbaud
6	50 kbaud
7	20 kbaud
8	10 kbaud

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	1220	48
0102	4	1372	54
0152	6	1524	60
0203	8	1829	72
0254	10	2134	84
0305	12	2438	96
0407	16	2743	108
0508	20	3048	120
0610	24	3353	132
0762	30	3658	144
0914	36	3962	156
1067	42		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

K bolt-in design
10.2 mm Ø pressure tube
40 mm null point

K8 bolt-in design
8 mm Ø pressure tube
40 mm null point
(max. stroke length = 1016 mm)

W 3/4"-16 UNF thread-in design
10.2 mm Ø pressure tube
50.8 mm (2") null point

W8 3/4"-16 UNF thread-in design
8 mm Ø diameter pressure tube
50.8 mm (2") null point
(max. stroke length = 1016 mm)

H M18 x 1.5 thread-in design
10.2 mm Ø pressure tube
30 mm null point

H8 M18 x 1.5 thread-in design
8 mm Ø diameter pressure tube
30 mm null point
(max. stroke length = 1016 mm)

Connection

Radial output
K02 PUR cable 2 m
K05 PUR cable 5 m
SR92 Connector

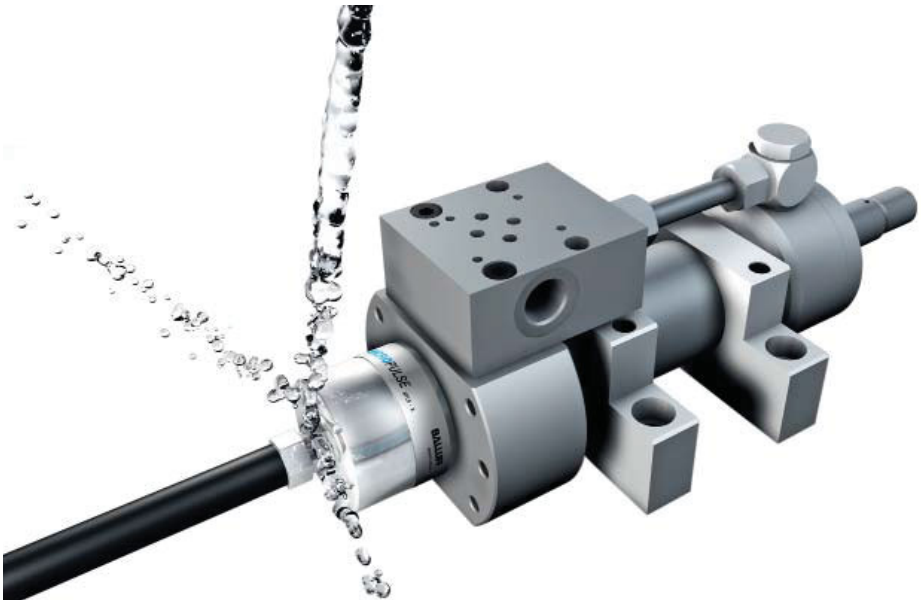
Radial output
K02 PUR cable 2 m
K05 PUR cable 5 m

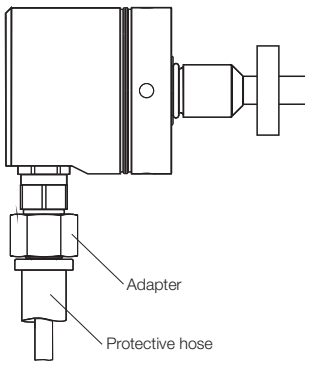
Axial output
KA02 PUR cable 2 m
KA05 PUR cable 5 m
S92 Connector

The outdoor system IP 69K, 40 bar

Micropulse ProCompact with cable protection system
Extreme ambient conditions, in which high reliability and accuracy are required, are typical application areas for Micropulse ProCompact transducers. The non-contact working principle of the systems ensures a complete absence of wear and nearly endless service life. The high-precision output signal is available as an absolute signal for the controller in a wide range of different interfaces.

Application areas:
- Locks and floodgates
- Water power plants
- Large, hydraulically powered valves
- Positioning the reflection channels for thermosolar power plants
- Dredger
- Railway track
- Logging machines
- Hydroelectric power stations
- Construction machinery
- Combine harvesters





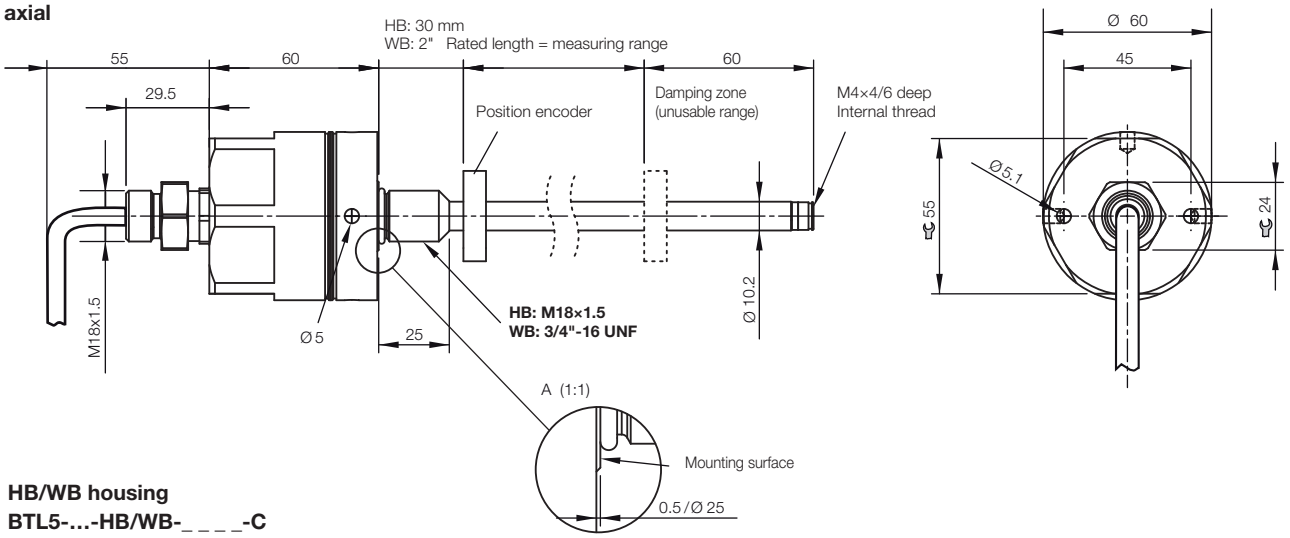
Accessories for the cable protection system

Series	**Adapter**
Ordering code	**BAM01JW**
Part number	BAM AD-XA-007-M18×1.5/D12-2
Housing material	Brass (not seawater-resistant)
Ordering code	**BAM01JY**
Part number	BAM AD-XA-007-M18×1.5/D12-4
Housing material	Stainless steel V2A (conditionally seawater-resistant)
Series	**Protective hose**
Part number	BAM PT-XA-001-095-0-_ _ _
Tube length	02, 05, 10, 15, 20, 30, 50 and 100 m
Degree of protection	IP 68 (40 bar) IP 67K (in installed and screwed-on state)
Housing material	PUR (resistant to seawater, weld spatter and UV radiation)
Outer diameter	16 mm
Inside diameter	9.5 mm
Temperature range	–40...+95 °C
Bending radius min. (static)	51 mm

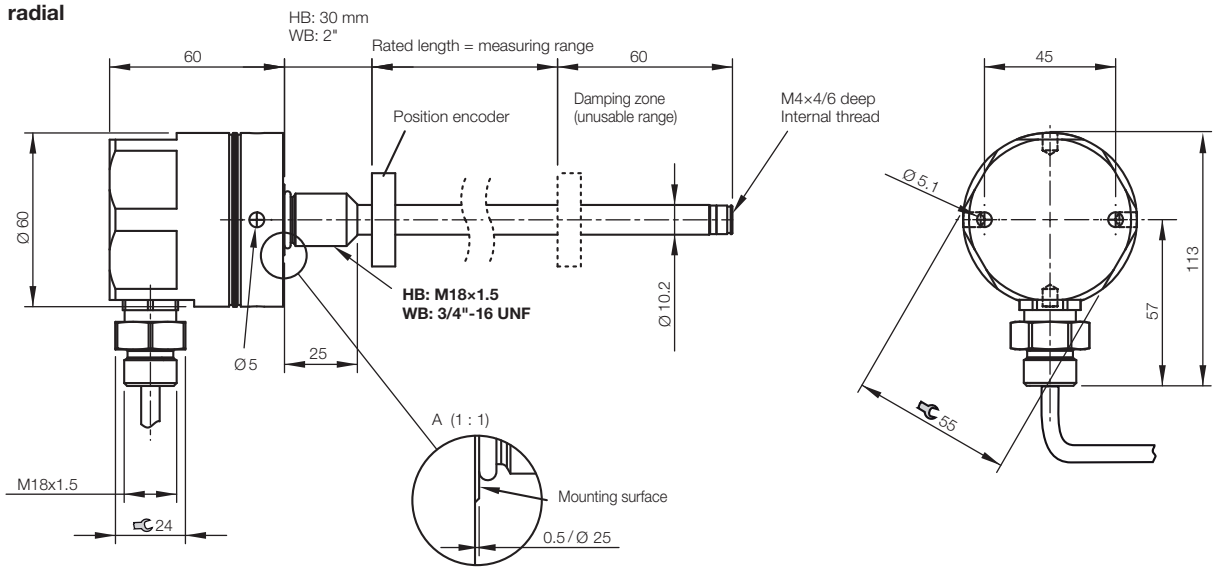
General data

Series	**Rod ProCompact HB/WB BTL5**
Shock load	100 g/6 ms per EN 60068-2-27 and 100 g/2 ms per EN 60068-2-29
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Overvoltage protection	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 68 (5 bar with cable); IP 69K, 40 bar (with cable protection system)
Housing material	Stainless steel 1.4404
Flange and tube material	Stainless steel tube 1.4571, flange 1.4404
Housing attachment	Flange with thread
Connection	Cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Rapid, transient electrical pulses (burst)	EN 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3
Standard nominal strokes [mm]	0025...5500 mm in 1 mm increments

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



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



The outdoor system IP 69K, 40 bar

Micropulse ProCompact with cable protection system
Extreme ambient conditions, in which high reliability and accuracy are required, are typical application areas for Micropulse ProCompact transducers. The non-contact working principle of the systems ensures a complete absence of wear and nearly endless service life. The high-precision output signal serves as an absolute signal for the controller in a wide range of different interfaces.

Application areas:
- Locks and floodgates
- Water power plants
- Large, hydraulically powered valves
- Positioning the reflection channels for thermosolar power plants
- Dredger
- Railway track
- Logging machines
- Hydroelectric power stations
- Construction machinery
- Combine harvesters

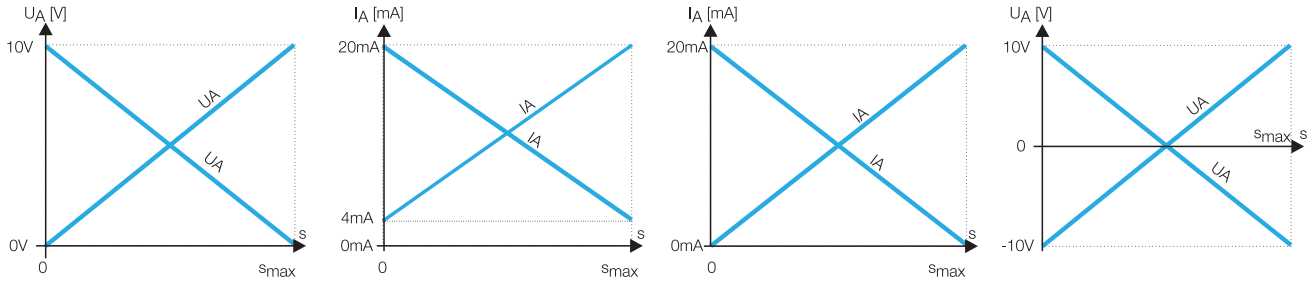
Series		
Output signal		
Transducer interface		
Customer device interface		
Part number		
Output voltage		
Output current		
Load current		
Max. residual ripple		
Load resistance		
System resolution		
Hysteresis		
Repeat accuracy		
Measurement rate		
Max. linearity deviation		
Temperature coefficient	Voltage output	
	Current output	
Supply voltage		
Current consumption		
Polarity reversal protected		
Overvoltage protection		
Dielectric strength		
Operating temperature		
Storage temperature		

Please enter code for output signal, nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, on page 166
Mounting nut, on page 167

	BTL5 Compact rod	**BTL5 Compact rod**	**BTL5 Compact rod**	**BTL5 Compact rod**
	analog	analog	analog	analog
	A	**E**	**C**	**G**
	analog	analog	analog	analog
	BTL5-**A11**-M_ _ _ _-HB/WB-_ _ _ _	BTL5-**E1**-M_ _ _ _-HB/WB-_ _ _ _	BTL5-**C1**-M_ _ _ _-HB/WB-_ _ _ _	BTL5-**G11**-M_ _ _ _-HB/WB-_ _ _ _
	0...10 V and 10...0 V			–10...10 V and 10...–10 V
		4...20 mA or 20...4 mA	0...20 mA or 20...0 mA	
	Max. 5 mA			Max. 5 mA
	≤ 5 mV			≤ 5 mV
		≤ 500 ohms	≤ 500 ohms	
	≤ 0.1 mV	≤ 0.2 µA	≤ 0.2 µA	≤ 0.1 mV
	≤ 4 µm	≤ 4 µm	≤ 4 µm	≤ 4 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz
	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke	±100 µm up to 500 mm nominal stroke
	±0.02% 500...max. nominal stroke	±0.02% 500...max. nominal stroke	±0.02% 500...max. nominal stroke	±0.02% 500...max. nominal stroke
	[150 µV/°C + (5 ppm/°C x P xU/L)] x ΔT			[150 µV/°C + (5 ppm/°C x P xU/L)] x ΔT
		[0.6 µA/°C + (10 ppm/°C x P xI/L)] x ΔT	[0.6 µA/°C + (10 ppm/°C x P xI/L)] x ΔT	
	20...28 V DC	20...28 V DC	20...28 V DC	20...28 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
	yes	yes	yes	yes
	TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes	TransZorb protection diodes
	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)
	–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C
	–40...+100 °C	–40...+100 °C	–40...+100 °C	–40...+100 °C



Ordering example:

BTL5-E1_-M_ _ _ _-_ _-_ _ _ _-C

Characteristic

1 rising and falling (output types A and G)

0 Rising

7 Falling (output types C and E)

Commonly specified stroke lengths:

mm	inches	mm	inches	mm	inches
0051	2	0762	30	2743	108
0102	4	0914	36	3048	120
0152	6	1067	42	3353	132
0203	8	1220	48	3658	144
0254	10	1372	54	3962	156
0305	12	1524	60	4267	168
0407	16	1829	72	4572	180
0508	20	2134	84	4877	192
0610	24	2438	96	5080	200

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

WB ProCompact rod
3/4"-16 UNF thread-in design
50.8 mm (2") null point

H8 ProCompact rod
M18 x 1.5 thread-in design
30 mm null point

Connection

Radial output
F05 5 m PTFE jacketed cable

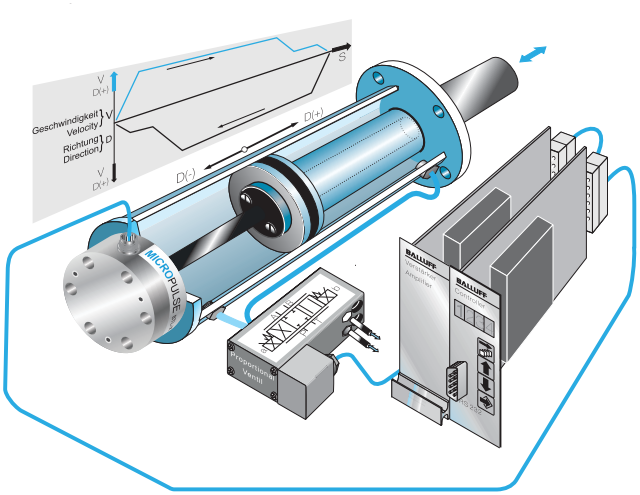
Axial output
KA05 5 m PTFE jacketed cable

Installation notices

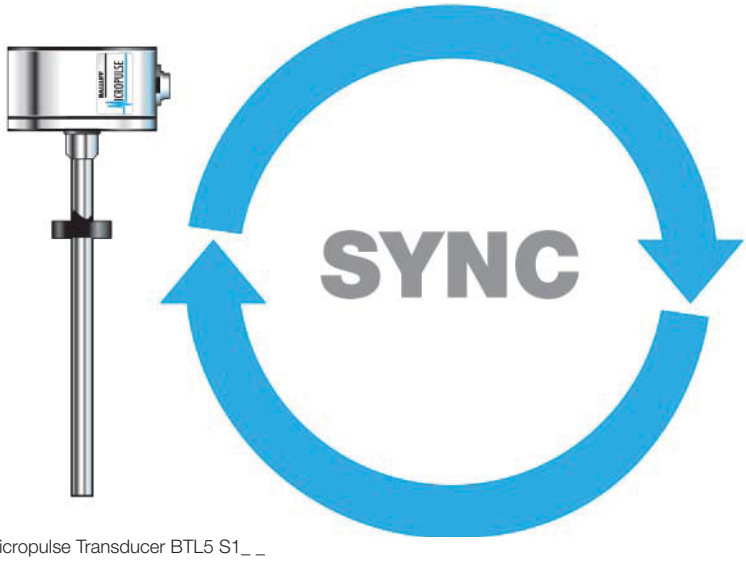
SSI-SYNC – better control behavior and higher dynamics

The absolute position information from the Micropulse Transducer is transmitted synchronously to the axis control card. This synchronous data acquisition permits a precise calculation of the speed and acceleration.

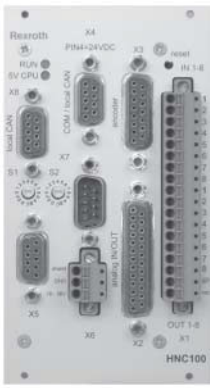
The feedback of these status sizes (speed and acceleration) allows the damping and natural frequency of a hydraulic system to be increased. These measures permit greater control and, with it, better control behavior and higher dynamics.



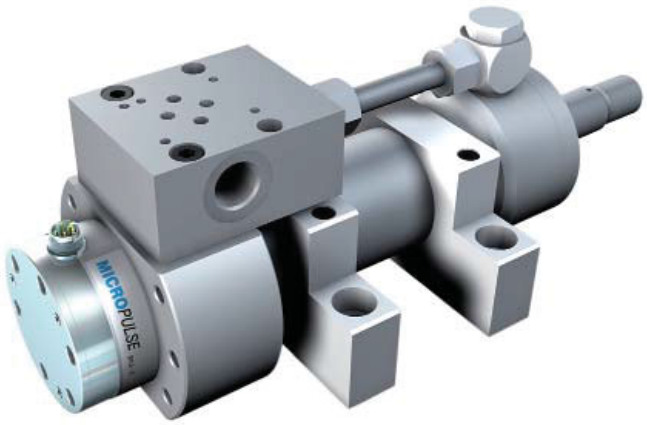
Application with hydraulic cylinder in a control circuit



Micropulse Transducer BTL5 S1_ _

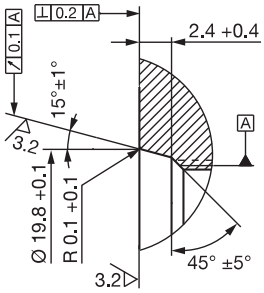


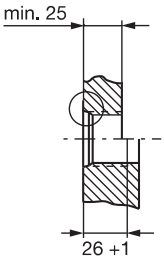
Control card with SSI interface for connecting Micropulse Transducers



Installation of BTL Rod Compact H

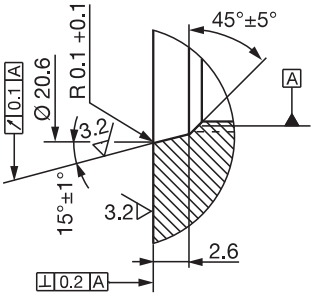
The Micropulse Transducer BTL has an M18×1.5 mounting thread. We recommend that the mounting is made of non-magnetizable material.
If magnetizable materials are used, then the measures shown below have to be taken. Sealing is done at the flange mounting surface using the supplied 15.4×2.1 O-ring with M18×1.5 thread.



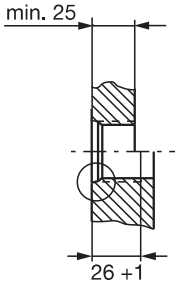


Installation of BTL5 Rod Compact W

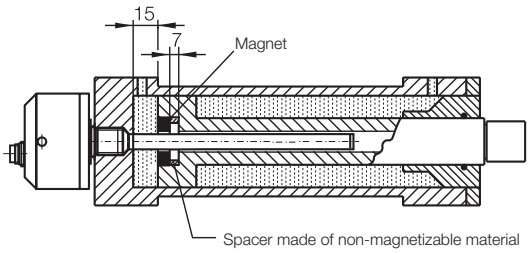
The Micropulse Transducer BTL has a M18×1.5 mounting thread. We recommend that the mounting is made of non-magnetizable material.
If magnetizable materials are used, then the measures shown below have to be taken. Sealing is at the flange mounting surface using the supplied 15.4×2.1 O-ring with M18×1.5 thread.

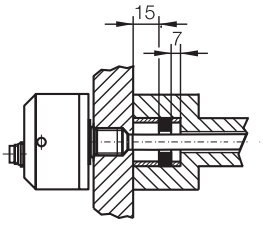


Countersink for O-ring,



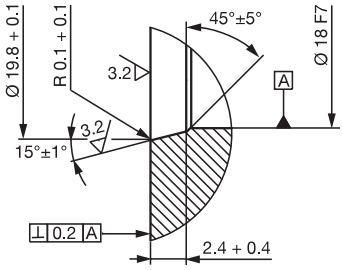
Tapped hole
3/4" 16 UNF thread

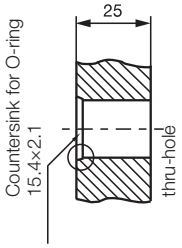


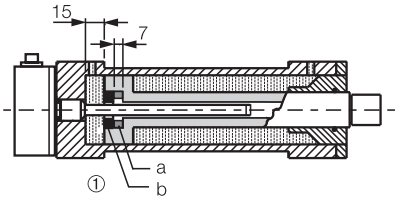


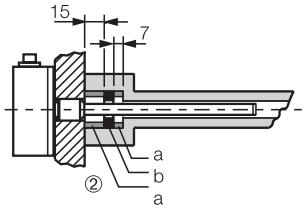
Installation BTL5 Rod Compact K

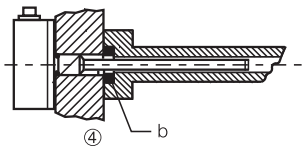
The Micropulse Transducer has 6 mounting holes for cylinder head screws (ISO 4762 M6×18 A2-70).
We recommend that the holder is made of non-magnetizable material. If magnetizable materials are used, the measures described above have to be taken. Sealing is at the flange mounting surface using the supplied 15.4×2.1 mm O-ring.











①-② with magnetizable material
④ with non-magnetizable material
A Spacer made of non-magnetizable material
B Magnet

Position detection in mobile hydraulics

Sensors are being used more and more to extend the lifetime and increase safety in mobile working machines.

The new Micropulse AR Transducer senses the piston position in mobile hydraulic cylinders.

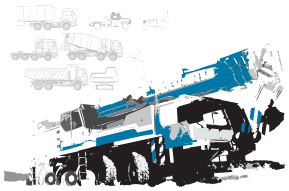
The sensor operates according to the proven Balluff magnetostrictive measuring principle. The compact size of the sensor makes it ideal for use in slender joint bearings and spherical eye end cylinders or large bore cylinders. The electronic evaluation unit integrated in the sensor has been designed to meet the strict EMC Directives for industrial lift trucks, agricultural and forestry equipment and earthmoving machinery.

Compatibility testing according to EMC Directives

ISO 14982 Agricultural and Forestry Machinery
ISO 13766 Earthmoving Machinery
ISO 7637-1/2/3 Road Vehicles
EN 12895 Industrial Trucks
EN 50121-3-2 Railway Applications
ISO 11452-5 Electromagnetic HF field, 200 V/m

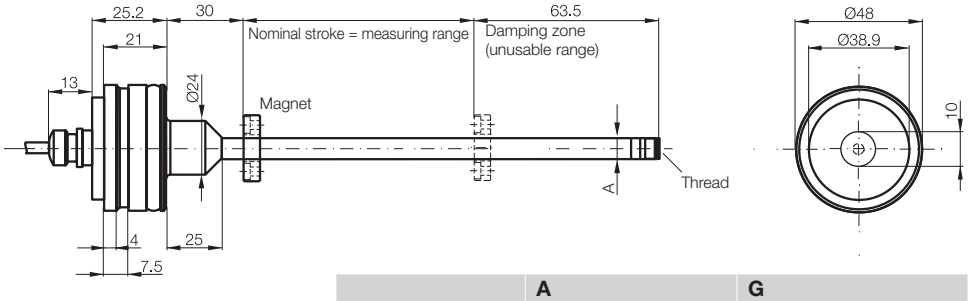
Series	**Rod AR BTL6**
Shock load	100 g/6 ms as per EN 60068-2-27
Continuous shock	50 g/2 ms
Vibration	12 g, 10...2000 Hz per EN 60068-2-6
Polarity reversal protected	yes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67
Housing material	Stainless steel outer tube 1.4571, stainless steel flange 1.4404
Pressure rating	
at 10.2 mm, with protective tube E2	350 bar installed in hydraulic cylinder
at 8 mm, with protective tube E28	250 bar when installed in hydraulic cylinder
Connection	Cable connection or stranded wire
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Surge voltage	EN 61000-4-5 Severity level 2
Line-induced disturbances	EN 61000-4-6 Severity level 3
Magnetic fields	EN 61000-4-8 Severity level 4
Standard nominal strokes [mm] with 8 mm outer tube (style E28), the max. nominal stroke is 1016 mm	0050...1524 mm in 1 mm increments

CE



Design E2/E28
BTL6-...-E2/E28-_ _ _ _-KA

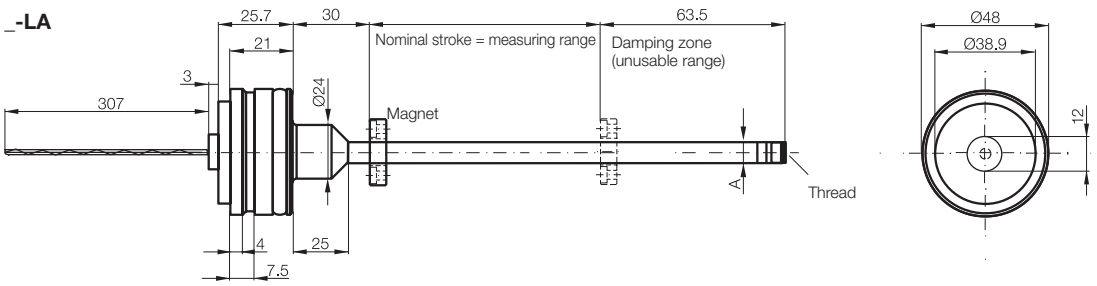
Cable outlet
axial centric



	A	G
E2	10.2	Thread M4×4/6 deep
E28	8	without thread

Design E2/E28
BTL6-...-E2/E28-_ _ _ _-LA

Cable outlet
axial with
stranded wire

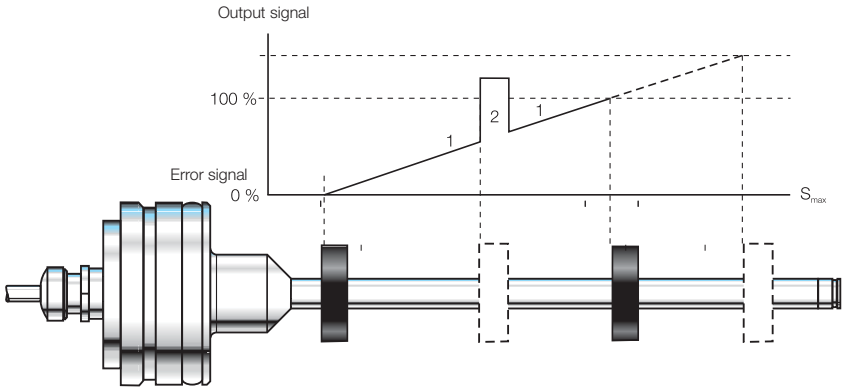


	A	G
E2	10.2	Thread M4×4/6 deep
E28	8	without thread

Rod AR BTL6
Analog interface

The position encoder's position is determined from the runtime of an ultrasonic wave, triggered by magnetostriction.
It is output as an analog value and has a rising characteristic. This is done with high precision and reproducibility within the measuring range designated as the rated length. If there is no position encoder within the measuring range, an error signal is output. There is a damping zone at the rod end. This zone may be traversed, but is not useful for metrology purposes. The electrical connection between the transducer, the controller and the power supply is established using a cable or stranded wire.

Position encoder position
- Within the measuring range (1)
- Position encoder not available (2)



Output signal with rising characteristic

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Max. residual ripple	
Load resistance	
System resolution	
Hysteresis	
Repeat accuracy	
Measurement rate	
Max. linearity deviation	
Temperature coefficient	Output voltage Current output
Supply voltage	
Current consumption	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	
Storage temperature	

Ordering example:

BTL6-_500-M_ _ _ _ _-_ _ _-_ _ _ _ _

Output signal

A	0...10 V
B	0...5 V
E	4...20 mA

Standard nominal strokes [mm]

0050...2000 mm
in 1-mm increments

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	0610	24
0102	4	0762	30
0152	6	0914	36
0203	8	1067	42
0254	10	1220	48
0305	12	1372	54
0407	16	1524	60
0508	20		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Design

E2	Protective tube Ø 10.2 mm
E28	Protective tube Ø 8 mm, max. rated length 1016 mm

Connection

Axial output

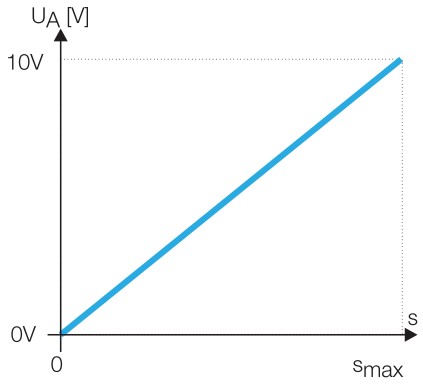
KA02	PUR cable 2 m
KA05	PUR cable 5 m
KA10	PUR cable 10 m
KA15	PUR cable 15 m
KA20	PUR cable 20 m

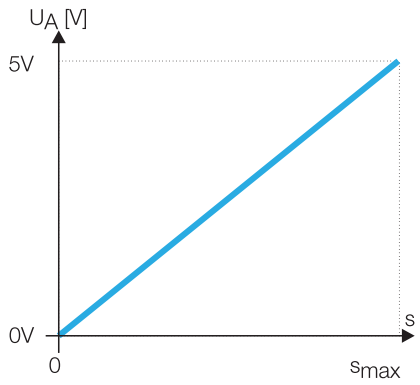
Axial output

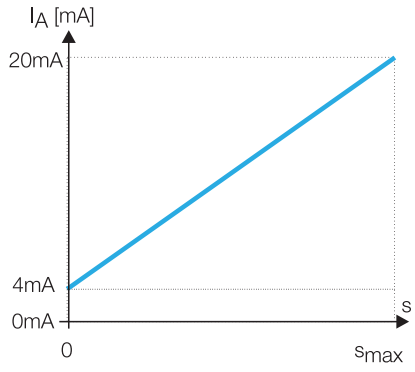
LA00,3	PUR stranded wire, 0.3 m

"Pigtail" connector systems "ZA"
See page 249.

	Rod AR BTL6	**Rod AR BTL6**	**Rod AR BTL6**
	analog	analog	analog
	A	**B**	**E**
	analog	analog	analog
	BTL6-**A**500-M_ _ _ _-_ _ _-_ _ _ _	BTL6-**B**500-M_ _ _ _-_ _ _-_ _ _ _	BTL6-**E**500-M_ _ _ _-_ _ _-_ _ _ _
	0...10 V	0...5 V	
			4...20 mA
	Max. 2 mA	Max. 2 mA	
	≤ 5 mV	≤ 2 mV	
			≤ 500 ohms
	± 1.5 mV	± 1.5 mV	± 7 µA
	≤ 5 µm	≤ 4 µm	
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz	$f_{STANDARD}$ = 1 kHz
	±200 µm to 500 mm nominal stroke	±200 µm to 500 mm nominal stroke	±200 µm to 500 mm nominal stroke
	typ. ±0.02% ≥ 500 nominal stroke	typ. ±0.02% ≥ 500 nominal stroke	typ. ±0.02% ≥ 500 nominal stroke
	[150 µV/°C + (5 ppm/°C × P × U/L)] × ΔT	[150 µV/°C + (5 ppm/°C × P × U/L)] × ΔT	[150 µV/°C + (5 ppm/°C × P × U/L)] × ΔT
	[0.6 µA/°C + (10 ppm/°C × P × I/L)] × ΔT	[0.6 µA/°C + (10 ppm/°C × P × I/L)] × ΔT	[0.6 µA/°C + (10 ppm/°C × P × I/L)] × ΔT
	10...30 V DC	10...30 V DC	10...30 V DC
	typ. ≤ 60 mA	typ. ≤ 60 mA	typ. ≤ 60 mA
	yes	yes	yes
	yes	yes	yes
	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)
	–40...+85 °C	–40...+85 °C	–40...+85 °C
	–40...+100 °C	–40...+100 °C	–40...+100 °C





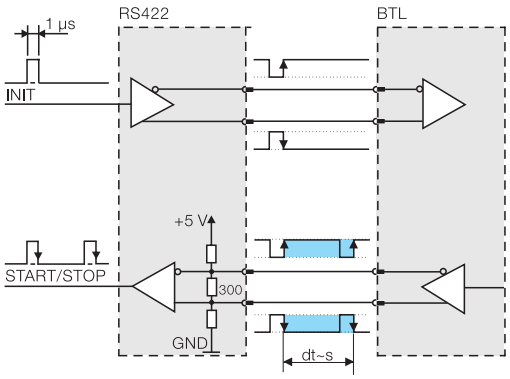


Please enter code for output signal, nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, page 166

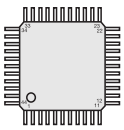
P510 interface
The 510 interface is compatible with BTA evaluation units as well as with controllers and modules from various manufacturers including Siemens, B & R, Bosch, Phoenix Contact, Mitsubishi, Sigmatek, Parker, Esitron, WAGO and others.
Reliable signal transmission, even with cable lengths of up to 500 m between the BTA evaluation unit and the transducer. This is guaranteed by the especially interference-proof RS485/differential drivers and receivers. Interference signals are effectively suppressed.



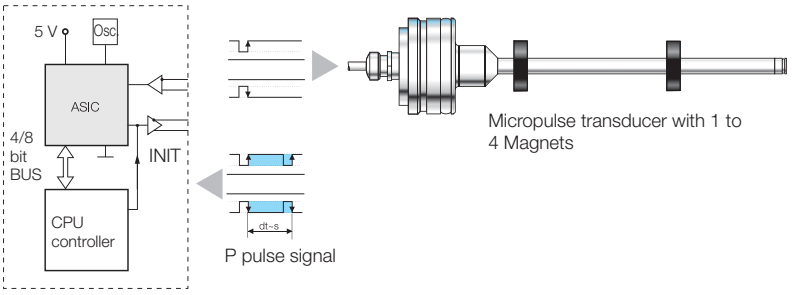
Block diagram of P interface

Universal P510 for rising and falling edge evaluation
As a consequence of different control philosophies, digital pulse interfaces are available in two different types depending on the controller.
The difference lies in how the edges are processed. The falling edges are processed in the P interface and the rising edges in the M interface. To reduce the number of different models to a minimum, the P510 interface was created as a universal pulse interface which combines both functions. The reference point for the propagation time measurement is the "start pulse".

Extremely precise digitizing chip for P510 pulse interface
Companies developing their own electronic control and evaluation unit can create a highly accurate P interface cost effectively and with minimum effort using the Balluff digitizing chip. The digitizing chip was developed as a high-resolution, configurable ASIC for Micropulse Transducers with P interface.


Digitizing Chip 44QFP

Benefits
- High resolution: the actual 1 µm of the BTL position measuring system is supported completely by the 133 ps resolution of the chip (at low clock frequency 2 or 20 MHz).
- Position data from 4 magnets can be processed simultaneously
- 4/8-bit processor interface

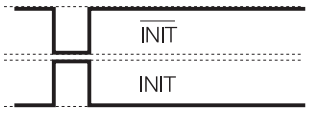


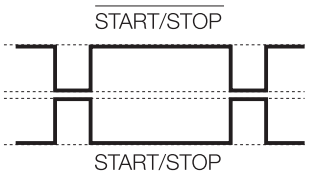
Micropulse transducer with 1 to 4 Magnets
P pulse signal
Controller or electronic evaluation unit

Rod AR BTL6
Digital pulse interface

Series	**Rod AR BTL6**
Transducer interface	Pulse **P510**
Customer device interface	Pulse **P510**
Part number	BTL6-**P**510-M_ _ _ _-_ _ _-_ _ _ _ _
System resolution	processing-dependent
Repeat accuracy	≤ 10 µm
Repeatability	≤ 20 µm
Resolution	≤ 10 µm
Linearity deviation	±200 µm up to 500 mm nominal stroke typ. ±0.02%, max. ±0.04% 500...1500 mm nominal stroke
Supply voltage	10...30 V DC
Current consumption	≤ 60 mA (at 1kHz)
Operating temperature	–40...+85 °C
Storage temperature	–40...+100 °C

The rising and falling edges can be evaluated.





Please enter code for nominal stroke, design and connection in the part number.

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Magnet/float, page 166

Ordering example:

BTL6-P510-M_ _ _ _-_ _ _-_ _ _ _ _

Standard nominal strokes [mm]

0050...1524 mm
in 1-mm increments

Design

E2 Protective tube Ø 10.2 mm
E28 Protective tube Ø 8 mm,
Max. rated length 1016 mm

Commonly specified stroke lengths:

mm	inches	mm	inches
0051	2	0610	24
0102	4	0762	30
0152	6	0914	36
0203	8	1067	42
0254	10	1220	48
0305	12	1372	54
0407	16	1524	60
0508	20		

Additional stroke lengths available
Inch to millimeter conversion:
Inches x 25.4 = millimeters

Connection

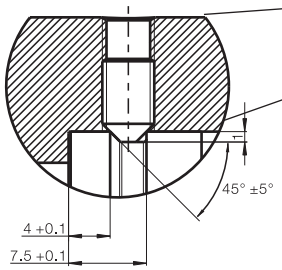
Axial output
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m
KA20 PUR cable 20 m

Axial output
LA00,3 PUR stranded wire, 0.3 m

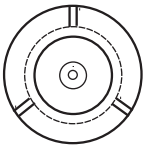
"Pigtail" connector systems "ZA"
See page 249

Installation notices

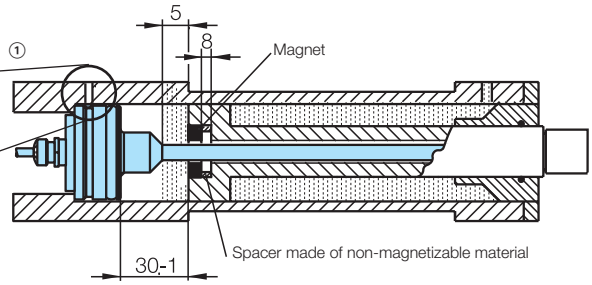
Set screw
DIN 914 M5×8

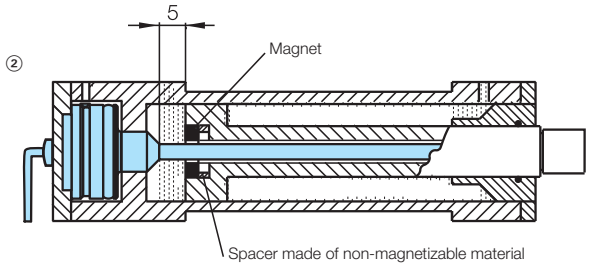


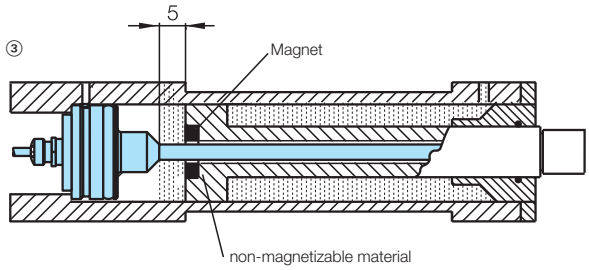
Fixing the transducer using three M5 set screws at an angle of 120 °C

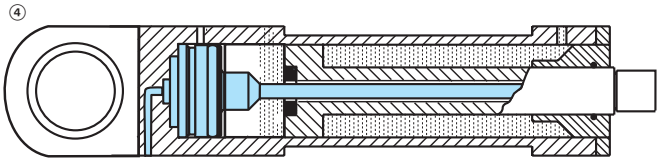


Installation examples









① Installation on the piston, in magnetic piston material
② Installation from rear, in magnetizable piston material
③ Installation on the piston
④ Installation on piston in a cylinder with articulated lug

Rod AR BTL6
Installation notices

Micropulse Transducers

Rod EX

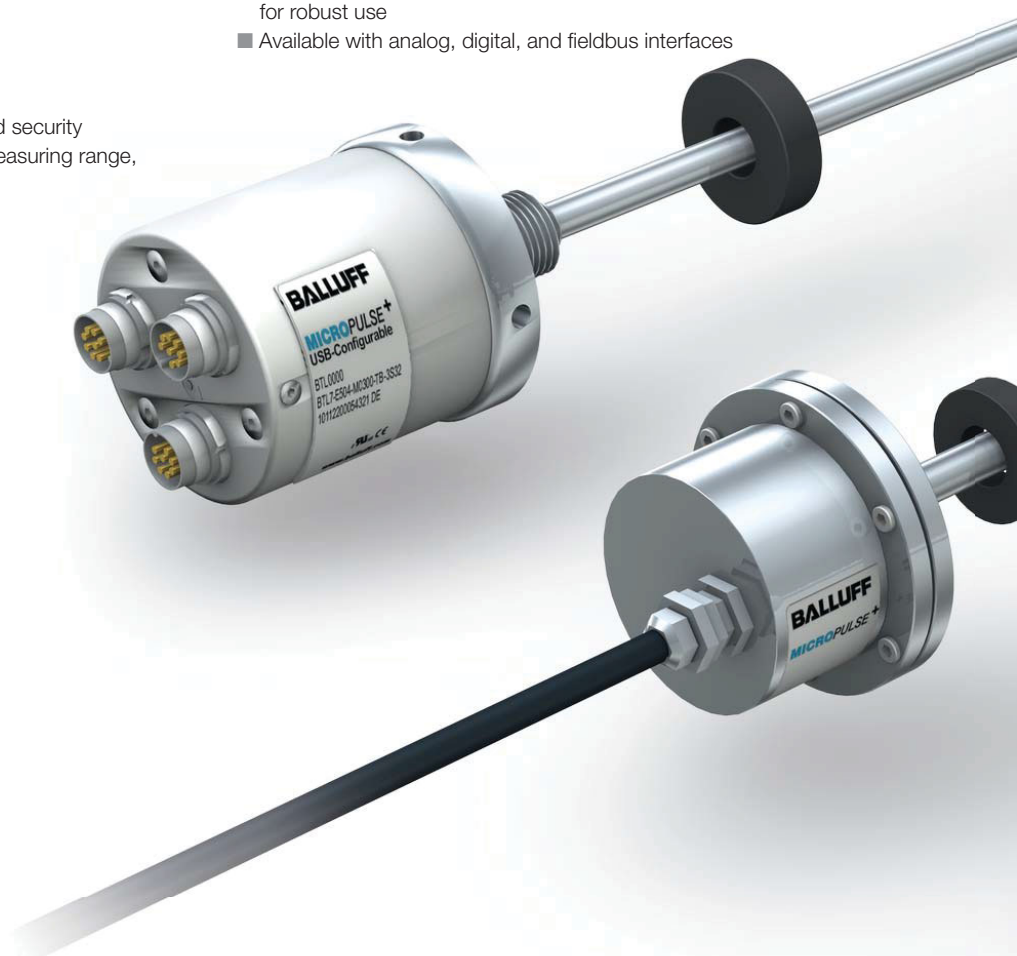
- For use in a potentially explosive environment
- Worldwide approvals:
  - ATEX
  - IECEx
  - North American NEC (TA12 version only)
- With robust stainless steel design
- Can also be used as a filling level sensor

Rod T Redundant

- 2 or 3 times redundant design for increased security
- Universally programmable via USB – set measuring range, invert signal, configure system, document and transmit configuration
- Mount with M18x1.5 or UNF 3/4" thread or via adapter with connecting flange and 6 cheese head screws

Rod CD

- Pressure-resistant up to 1000 bar – the sensor for high-pressure hydraulic units
- M22x1.5 mounting thread with 12.7 mm pressure tube
- Measuring lengths up to 2000 mm in 1 mm increments
- Shock- and vibration-resistant with high degree of protection, for robust use
- Available with analog, digital, and fieldbus interfaces



Contents

MICROPULSE®

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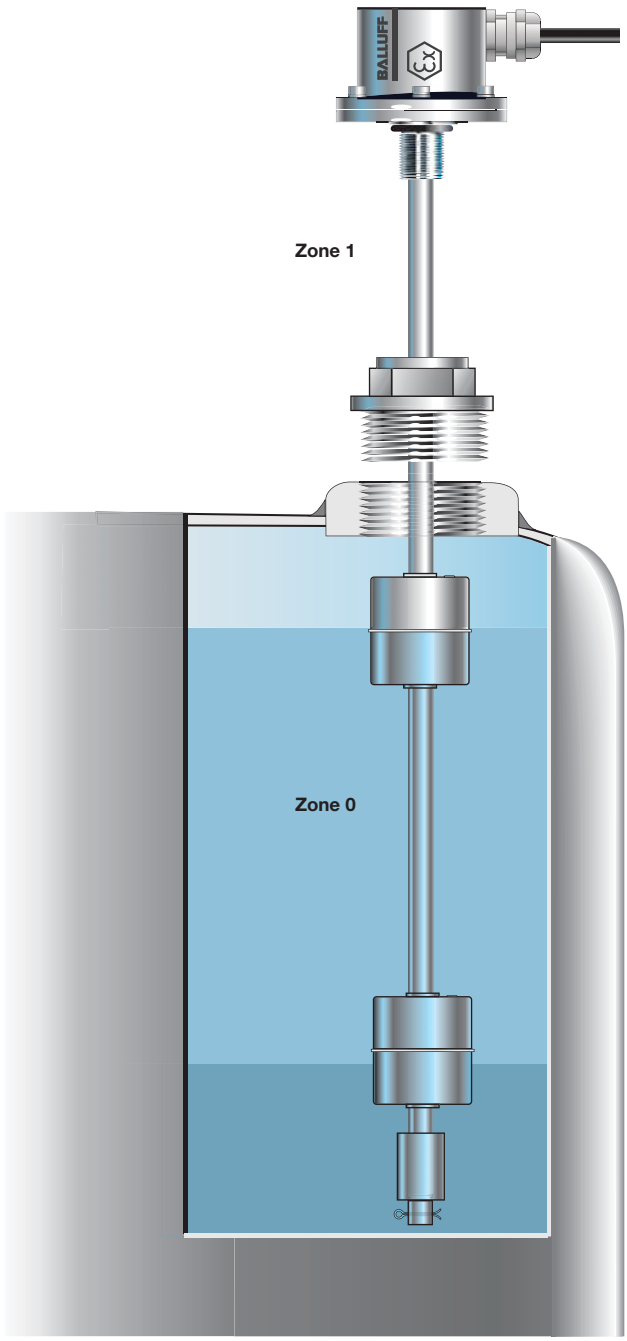
It is the responsibility of the user to ensure that the product carries the appropriate approvals for the area in which it will be used.

BTL5-_1-M....-B-DEXA-_ _ _
Rod version "DEXA" is the safe and reliable approach for filling level applications in Zone 0. A cotter pin prevents the float from getting lost. Float, see page 216.

Applications
- Filling stations
- Tank systems
- Refineries
- Chemical industry
- Pharmaceuticals



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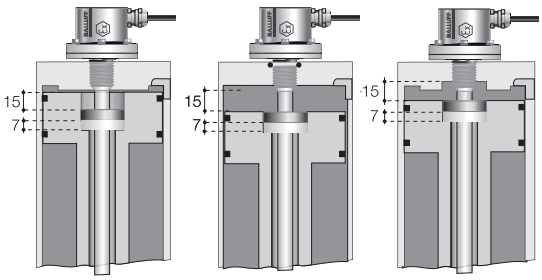
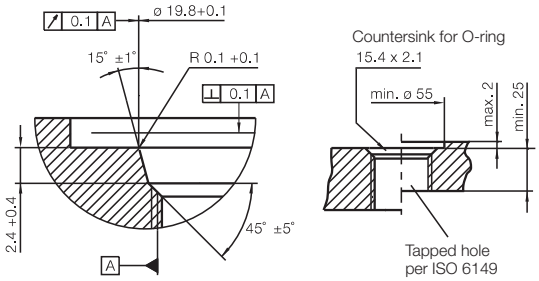
Installation examples

BTL5-_1-M....-B-DEXB-_ _
The BTL can be used to sense the position of a hydraulic piston directly without making contact, even up to pressures of 600 bar. The BTL is threaded into the head of the cylinder. The measurement section enters a hole drilled deep into the piston.

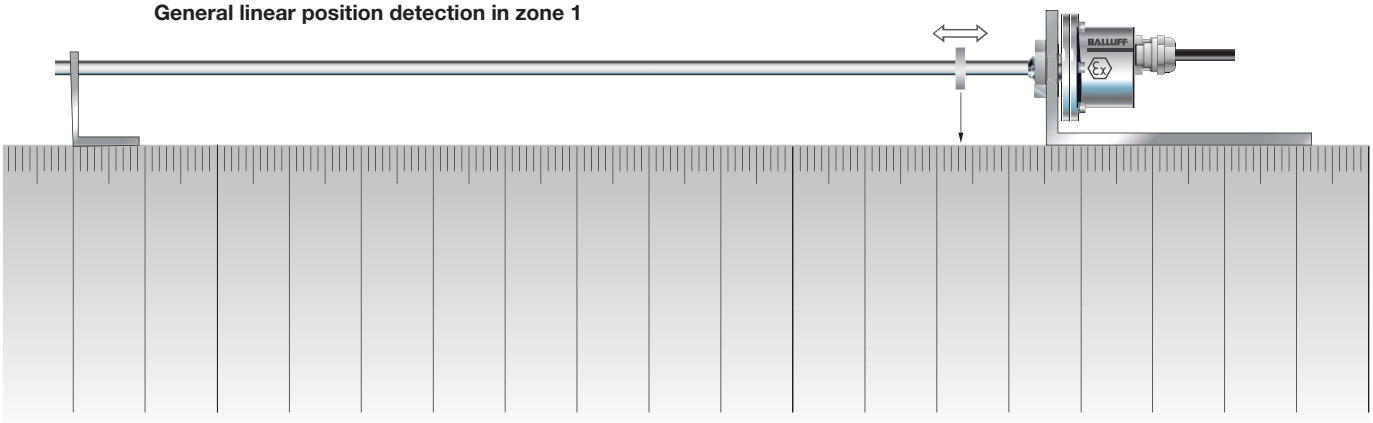


Applications
- Actual value monitoring in hydraulic cylinders
- Valve adjustment in power plants
- Filling units
- Positioning spray guns

Installation
The Micropulse transducer BTL has a M18×1.5 mounting thread. We recommend that the mounting is made of non-magnetizable material.
If magnetizable materials are used, the measures described above have to be taken. Sealing is at the flange mounting surface using the supplied O-ring 15.4×2.1 with M18×1.5 thread.



General linear position detection in zone 1

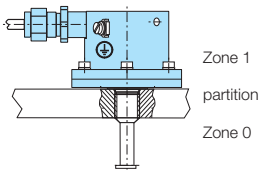


Pressure-resistant up to 600 bar, high repeatability, non-contact, robust
The Micropulse transducer BTL is a robust position feedback system for measuring ranges between 25 and 4000 mm as well as use under extreme ambient conditions.

Ex protection type “d” – flameproof encapsulation
Transducers designated **Ex d IIB + H2 T6 Ga/Gb** meet the requirements for electrical equipment in potentially explosive areas. When in use you must follow applicable safety regulations, such as:
- Explosion protection guidelines (EX-RL)
- Constructing electrical equipment in potentially explosive atmospheres (EN 60079-14)
- Protection type “d”, flameproof encapsulation (EN 60079-1)

Transducers from category II 1/2 G designated Ex d IIB+H2 T6 meet the requirements for electrical equipment in areas containing potentially explosive gases. Requirements for areas containing flammable dust are also fulfilled in accordance with category II 3D designated Ex tD IP 67 T85°C, A zone 22.

IEC *IECEx* ATEX




Physikalisch-Technische Bundesanstalt
PTB
EG-Baumusterprüfbescheinigung

Series	**Rod DEX BTL5**
Part number	BTL5-_1M_ _ _ _-_-DEX_-_ _ _ _
Shock load	100 g/6 ms as per EN 60068-2-27 and 100 g/2 ms as per EN 60068-2-29
Vibration	12 g, 10...2000 Hz as per EN 60068-2-6
Operating temperature	–40...+60°C
Polarity reversal protected	yes
Overvoltage protection	TransZorb protection diodes
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67
Housing material	Stainless steel 1.4305
Flange and tube material	Tube stainless steel 1.4571, flange 1.4571 or 1.4429 or 1.4404
Housing attachment	Model B thread M18×1.5, model Z 3/4" 16 UNF, model K fit 18h6 with 6 cheese-head screws
Connection	Cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Electrical fast transient bursts	IEC 61000-4-4 Severity level 4
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3

Please enter code for output signal, interface, coding, nominal stroke, model, rod end, and connection in the part number.

Scope of delivery
- Transducer
- User's Guide

Please order separately:
Magnet, page 216
Float, page 216

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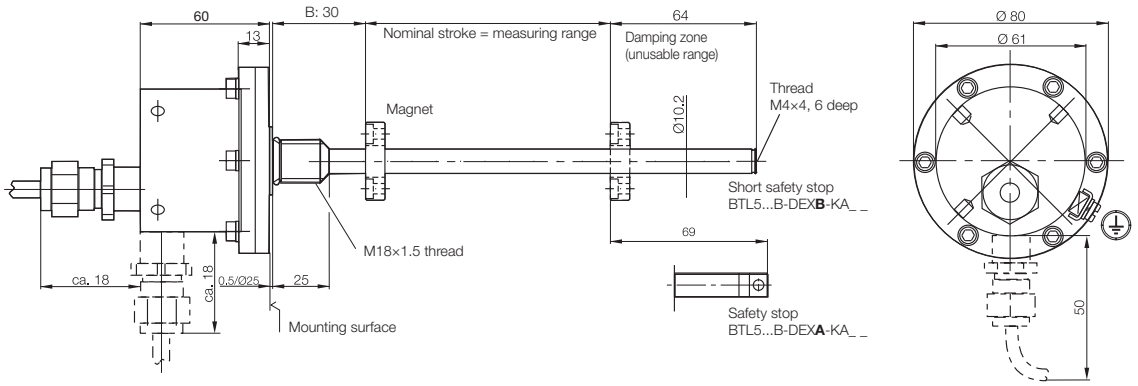
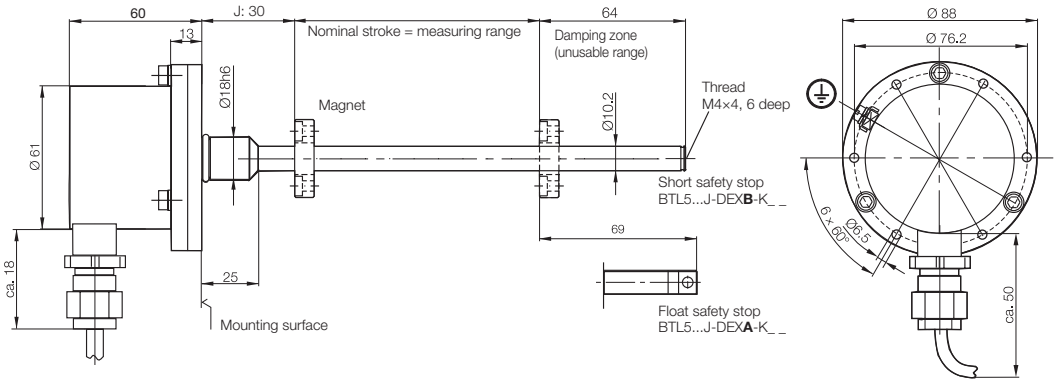
Housing B, metric mounting thread
Cable outlet axial, radial



Model J, flange Ø 18 mm, pitch circle Ø 76.2 mm,
Cable outlet radial



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Analog interface no zero- or end-point setting possible; see technical data on page 182
Ordering example:

BTL5-_ _ _-M_ _ _ _-_-DEX_-_ _ _ _

Output signal

A11 0...10 V and 10...0 V rising and falling
E10 4...20 mA, rising
E17 20...4 mA, falling
C10 0...20 mA, rising
C17 20...0 mA, falling
G11 –10...10 V and 10...–10 V rising and falling

Standard nominal stroke [mm]

0025...4000 mm in 1 mm increments

Design

B
J
Z

Rod end

A Float safety stop
B Short safety stop

Connection

Axial cable outlet
only for model B, Z
KA02 PUR cable 2 m
KA05 PUR cable 5 m
KA10 PUR cable 10 m
KA15 PUR cable 15 m

Radial output
K02 PUR cable 2 m
K05 PUR cable 5 m
K10 PUR cable 10 m
K15 PUR cable 15 m

Digital pulse interface, see technical data on page 184
Ordering example:

BTL5-_1-M_ _ _ _-_-DEX_-_ _ _ _

Interface

P Pulse interface P

Standard nominal stroke [mm]

See above analog interface DEX

Design

B
J
Z

Rod end

A Float safety stop
B Short safety stop

Connection

see above analog interface DEX

SSI interface, see technical data on page 186
Ordering example:

BTL5-S1_ _-M_ _ _ _-_-DEX _-_ _ _ _ for asynchronous operation
BTL5-S1_ _B-M_ _ _ _-_-DEX _-_ _ _ _ for synchronous operation

Coding

0 Binary code, rising (24-bit)
1 Gray code, rising (24-bit)
6 Binary code, rising (25-bit)
7 Gray code, rising (25-bit)

System resolution

1 1 µm
2 5 µm
3 10 µm
4 20 µm
5 40 µm

Standard nominal stroke [mm]

See above analog interface DEX

Design

B
J
Z

Rod end

A Float safety stop
B Short safety stop

Connection

See above, analog interface DEX

Explosion Proof Flameproof

Rod J-DEXC-TA12
General data

The Micropulse TA12 transducer has been specifically designed for use in potentially explosive areas. Field-proven Micropulse non-contact magnetostrictive technology provides precise absolute linear position feedback, while the rugged IP68-rated enclosure provides robust protection in demanding applications. The highly reliable TA12 is ideal for applications where equipment uptime is critical.

Benefits:
- Worldwide certification
- ATEX, IECEx, and North American approvals
- Rapid Replacement Module (RRM) allows for fast and easy field replacement of internal electronics, keeping downtime to a minimum
- Ex-proof design eliminates the need for intrinsically safe (IS barriers)
- Completely self-contained; no need for external processing electronics
- Rugged stainless steel housing rated to IP68 stands up to demanding environmental conditions
- Wide range of output options to interface with virtually any control system
- Provides consistent, stable accuracy over a temperature range from -40°C to +80°C (-40°F to +176°F)

Applications:
- Valve control
- Liquid level measurement
- Turbine applications
- Grain elevators
- Oil and gas industry applications

Please see page 210-211 for ordering information.

Series	**Rod J-DEXC-TA12**
Part number	BTL5-_ _-M_ _ _ _-J-DEXC-TA12 (see ordering information on next page)
Shock load	100 g/6 ms as per EN 60068-2-27
Vibration	12 g, 10...2000 Hz as per EN 60068-2-6
Operating temperature	–40...+80°C for T5
Storage temperature	–40...+100°C outside of Ex zone
Degree of protection	IP 68
Housing material	Stainless steel, 304
Protective tube	Stainless steel, 316
Pressure rating	600 bar max.
Connection	Screw terminals
Cable entry	1/2"-14 NPT conduit entry
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Electrical fast transient bursts	EN 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6 Severity level 3

Scope of delivery
- Transducer
- User's Guide

Please order separately:
Magnet, page 216
Float, page 216

RRM Rapid Replacement Module

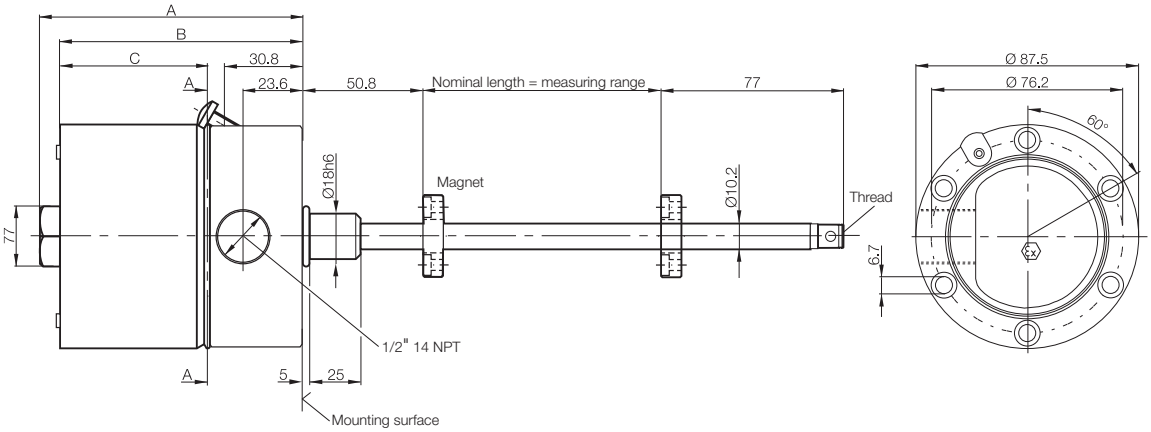
C US
CSA13.2411253X

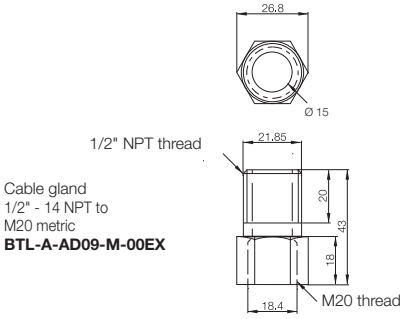
Class I Zone 1 AEx d IIC T* Ga/Gb T6 Ta -40° to 65°C, T5 Ta -40° to 80°C
Class I Zone 1 Ex d IIC T* Ga/Gb T6 Ta -40° to 65°C, T5 Ta -40° to 80°C
Class I, Division 1, Groups A,B,C,D
Class II, Division 1, Groups E,F,G;
Class III T6 Ta -40° to 65°C, T5 Ta -40° to 80°C Type 4X/6P; IP68
SIRA 11ATEX1104X
IECEx SIR 11.0048X

Ex II 1/2GD
Ex d IIC T* Ga/Gb Ta -40° to 65°C (T6) -40° to 80°C (T5)
Ex t IIIC T85/T100°C Da IP68 Ta -40° to 65°C (T85) -40° to 80°C (T100)

CE 0518 Ex

Model J-DEXC, flange Ø 18 mm, mounting hole Ø 76.2 mm





Cable gland
1/2" - 14 NPT to
M20 metric
BTL-A-AD09-M-00EX

Interface	A (mm)	B (mm)	C (mm)
Analog **A, E, C** Digital **SSI**	104.12	96.12	59.5
Profibus DP, CANopen	135.62	127.62	91

Analog interface, for technical data, see User's Guide
Ordering example:

BTL5-_ _ _-M_ _ _ _-J-M 0 1 -TA (replacement electronics module only, no pressure housing)
BTL5-_ _ _-M_ _ _ _-J-DEXC-TA12 (complete transducer)

Output signal

A51 0...10 V and 10...0 V Rising and falling
E50 4...20 mA, rising
E57 20...4 mA, falling
C50 0...20 mA, rising
C57 20...0 mA, falling
G51 -10...10 V and 10...-10 V rising and falling

Standard nominal stroke [mm]

0025...4445 mm in 1 mm increments

Connection

TA12 Internal thread 1/2" 14 NPT

Programming tool for null point and end point **BTL5-A-EH03**

SSI interface, for technical data, see User's Guide
Ordering example:

BTL5-S1_ _-M_ _ _ _-J-M 0 2 -TA (replacement electronics module only, no pressure housing)
BTL5-S1_ _-M_ _ _ _-J-DEXC-TA12 for asynchronous operation (complete transducer)
BTL5-S1_ _-B-M_ _ _ _-J-DEXC-TA12 for synchronous operation (complete transducer)

Coding	System resolution	Standard nominal stroke [mm]	Connection
0 Binary code, rising (24-bit) 1 Gray code, rising (24-bit) 6 Binary code, rising (25-bit) 7 Gray code, rising (25-bit)	1 1 µm 2 5 µm 3 10 µm 4 20 µm 5 40 µm	0025...3962 mm	TA12 Internal thread 1/2" 14 NPT

CANopen interface, see technical data on page 156-159
Ordering example:

BTL5-H1_ _-M_ _ _ _-J-M 0 1 -TA (replacement electronics module only, no pressure housing)
BTL5-H1_ _-M_ _ _ _-J-DEXC-TA12 (complete transducer)

Software configuration	Baud rate	Standard nominal stroke [mm]	Connection
1 1 × position and 1 × velocity 2 2 × position and 2 × velocity	0 1 Mbaud 1 800 kbaud 2 500 kbaud 3 250 kbaud 4 125 kbaud 5 100 kbaud 6 50 kbaud 7 20 kbaud 8 10 kbaud	Analog interface J-DEXC	TA12 Internal thread 1/2" 14 NPT

Profibus DP interface, see technical data on page 160/161
Ordering example:

BTL5-T1_ 0-M_ _ _ _-J-M 0 2 -TA (replacement electronics module only, no pressure housing)
BTL5-T1_ 0-M_ _ _ _-J-DEXC-TA12 (complete transducer)

Software configuration	Standard nominal stroke [mm]	Connection
1 1 × position and 1 × velocity 2 2 × position and 2 × velocity	Analog interface J-DEXC	TA12 Internal thread 1/2" 14 NPT

Ignition protection type "n" for zone 2

Protection type "n"
designated "EEx n"
Devices in this category are intended for use in areas where an explosive atmosphere is not expected. The probability is extremely small. Even if it were to occur, it would be only for a short time. Several methods of flameproofing are combined under the designation.

Rod series, analog interface, see page 138/139
Ordering example:

BTL7-_ _ _-M_ _ _ _-_-NEX-_ _ _ _

Output signal		Standard nominal stroke [mm]	Design		Connection	
A510	0...10 V and 10...0 V	0025...0500 mm	B	M18×1.5	S32	with connector plug
E500	4...20 mA, rising	in 1-mm increments	Z	3/4" 16 UNF	S115	with connector plug
E570	20...4 mA, falling		CD	M22×1.5 high-pressure resistant	KA05	PUR cable 5 m
C500	0...20 mA, rising					
C570	20...0 mA, falling					

Please enter code for output signal, nominal stroke, design and connection in the part number.

Please order separately:
Magnet, page 217
Float, page 216
Connector, page 236

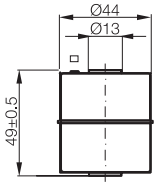
	ATEX	II 3 G Ex nA IIC T4 Gc II 2 D Ex tb IIIC T135°C Db IP 6x
	IECEx	Ex nA IIC T4 Gc Ex tb IIIC T135°C Db IP6x
C US	**U.S.**	Zone 2, AEx nA IIC Gc T4 AEx tb IIIC Db T135°C
	Canada	Class I, Zone 2, Ex nA IIC T4 Ex tb IIIC T135°C
	NI (non-incendive)	Class I, Division 2, Groups ABCD Class II, Division 2, Groups EFG; T4

Notes

Floats (Zone 0)

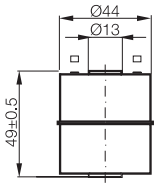
BTL2-S-4414-4Z-Ex
Ordering code: **BAM0147**
Cylindrical float, zone 0 permitted up to density $\rho \geq 0.7$ g/cm³

Orientation:
Raised dimple on upper side of float



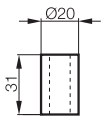
BTL2-S-4414-4Z01-Ex
Ordering code: **BAM0148**
Cylindrical float, zone 0, density of float $\rho = 0.85$ g/cm³ for separation layer measurement

Orientation:
2 raised dimples on upper side of float



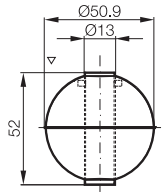
Interface
A second float can be added to measure the position of the interface between two liquids, such as oil and condensed water.
Suitable: BTL2-S-4414-4Z01-Ex.

BTL2-A-DH01-E-32-Ex
Spacer sleeve for the float:
BTL2-S-4414-4Z-Ex
BTL2-S-4414-4Z01-Ex
BTL2-S-5113-4K-Ex
The sleeve is included.

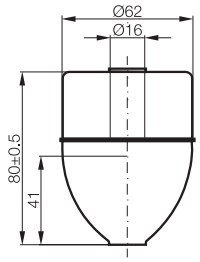


BTL2-S-5113-4K-Ex
Ordering code: **BAM014A**
Ball float, zone 0 permitted up to density ρ ≥ 0.7 g/cm³

Orientation:
Raised dimple on upper side of float



BTL2-S-6216-8P-Ex
Ordering code: **BAM014E**
Parabolic float, permitted up to ρ ≥ 0.6 g/cm³



Float model	Immersion depths given ρ = 1 g/cm³(H_2O)	Immersion depths given ρ = 0.7 g/cm³
BTL2-S-6216-8P-Ex	s_s ~ 41 mm	s_s ~ 57 mm
BTL2-S-5113-4K-Ex	s_s ~ 26 mm	s_s ~ 40 mm
BTL2-S-4414-4Z-Ex	s_s ~ 30 mm	s_s ~ 39 mm
BTL2-S-4414-4Z01-Ex	s_s ~ 45 mm	submerges

See technical data on page 207

Magnet (zone 1) for installation in hydraulic cylinder
See page 167

Evaluation units, digital displays
See page 250

Rod Redundant
General data

Series	**Rod Redundant BTL7**
Shock load	100 g/6 ms as per EN 60068-2-27
Vibration	12 g, 10...2000 Hz as per EN 60068-2-6
Polarity reversal protected	to 36 V
Overvoltage protection	to 36 V
Dielectric strength	500 V AC (GND to housing)
Degree of protection as per IEC 60529	IP 67
Housing material	Aluminum anodized/protective tube stainless 1.4571, flange stainless 1.4571
Fasteners	Model TB thread M18×1.5, Model TZ thread 3/4" 16 UNF Model TK, 18h6 with 6 cheese head screws, Model TT thread M30x1.5
Pressure rating with 10.2 mm protective tube	600 bars if installed in a hydraulic cylinder up to 2000 mm in nominal stroke 300 bar for nominal stroke > 2000 mm
Pressure rating with 21 mm protective tube	250 bars if installed in hydraulic cylinder up to 2000 mm nominal stroke
Connection	Connector or cable connection
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3 Severity level 3
Fast transient interference pulses (BURST)	EN 61000-4-4 Severity level 3
Surge voltage (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
Standard nominal strokes [mm]	25...7620 mm in 1-mm increments

Stroke Lengths up to 7620 mm

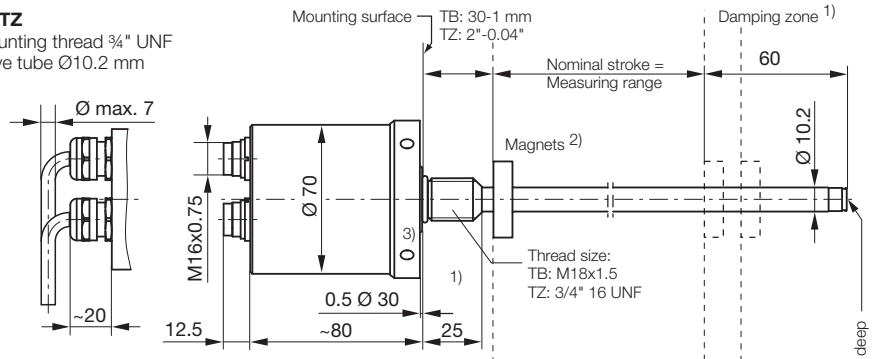
Rod Redundant
General data

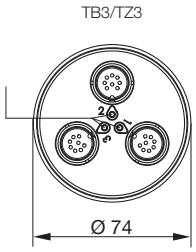
Pressure-resistant up to 600 bar, high repeatability, redundant, non-contact
BTL7 redundant Micropulse transducers: the robust position measuring system for use in safety-related valves and hydraulic cylinders for measuring ranges between 25 and 7620 mm.

Up to three independent position measuring systems in the same housing enable fail-safe linear measurement of, for example, safety valves or the combined monitoring of position and velocity.

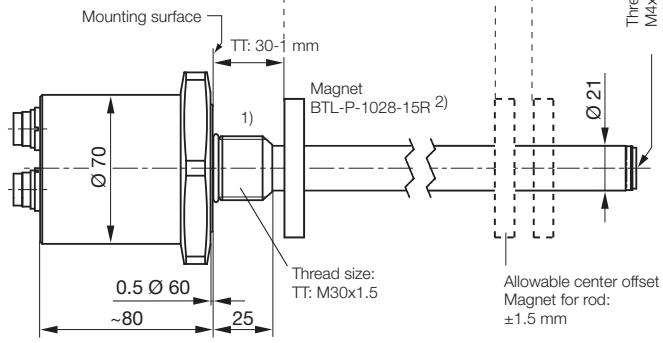
Design TB
Metric mounting thread M18×1.5
Protective tube Ø10.2 mm

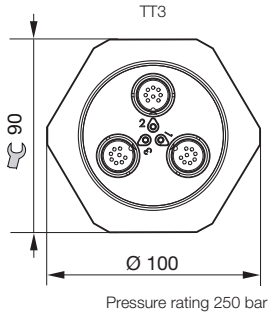
Design TZ
SAE mounting thread ¾" UNF
Protective tube Ø10.2 mm





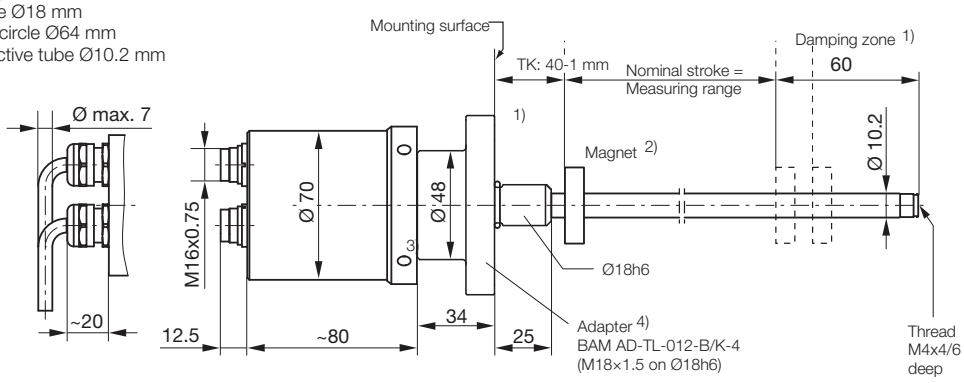
Design TT
Metric mounting thread M30×1.5
Protective tube Ø21 mm

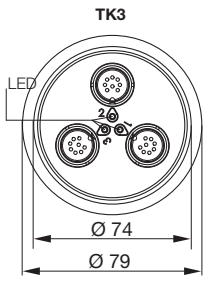




Pressure rating 250 bar

Design TK
Flange Ø18 mm
Pitch circle Ø64 mm
Protective tube Ø10.2 mm





1) Unusable range
2) Not included in the scope of delivery
3) Ø 6.1 for hook wrench Ø 74
4) Included in the scope of delivery

Properties of Micropulse BTL7-A/C/E/G to TB/TZ/TK/TT

- 2 or 3 times redundant
- Non-contact detection of piston position
- IP 67, insensitive to contamination
- Shock and vibration resistant 100 g/12 g
- Absolute output signal
- Measurement lengths 25 to 7620 mm in 1-mm increments
- Flexibly configurable measuring range via computer programming
- Status LED to indicate the operating state
- Temperature range –40 to +85°C

Flexible measuring range

The start and end point of the measuring range can be adapted to the application. The output signal for the position indicator or the movement speed can be set just as conveniently.
Once configured, settings can easily be copied redundantly to the remaining measuring channels of the BTL7.

Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Load resistance	
System resolution	
Repeat accuracy	
Sampling rate, length-dependent	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption at 24 V DC (per unit)	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	

Ordering example:

BTL7-_5_ _-M_ _ _ _-_ _ _-_ _ _

Output signal

A 0...10 V or 10...0 V
C 0...20 mA or 20...0 mA
E 4...20 V or 20...4 V
G –10...10 mA or 10...–10 mA

Nominal stroke [mm]

25...7620 mm
in 1-mm increments

Output gradient

04 1 output can be configured as rising
05 1 output can be configured as falling

Rod version, fastener

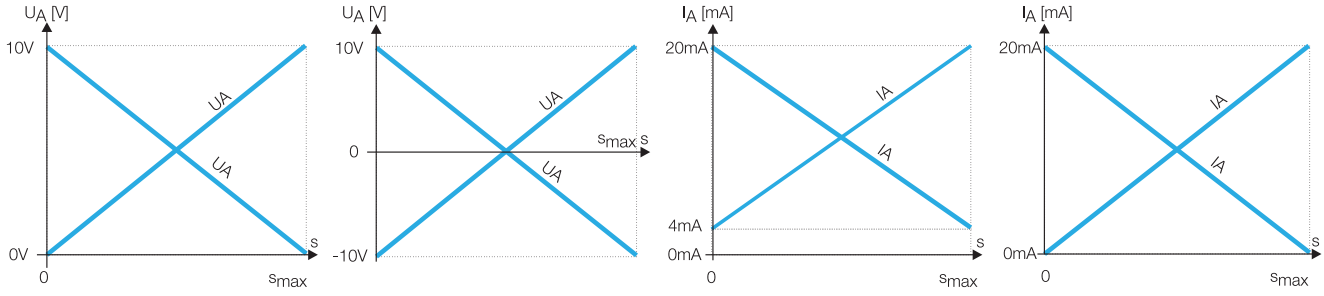
TB2 = Standard mounting thread 3/4"-16 UNF, O-ring, rod diameter 10.2 mm, 2 times redundant
TB3 = Standard mounting thread 3/4"-16 UNF, O-ring, rod diameter 10.2 mm, 3 times redundant

For additional designs, see page 219

Connection

S32 8-pin, M16 plug according to IEC 130-9
S135 6-pin, M16 plug according to IEC 130-9
KA05 5 m cable, PUR

	Rod Redundant BTL7	Rod Redundant BTL7	Rod Redundant BTL7	Rod Redundant BTL7
	analog	analog	Analog	Analog
	A	**G**	**E**	**C**
	Analog	Analog	Analog	Analog
	BTL7-**A**504-M_ _ _ _-_-_ _ _ _	BTL7-**G**504-M_ _ _ _-_-_ _ _ _	BTL5-**E**504_0-M_ _ _ _-_-_ _ _ _	BTL7-**C**504_0-M_ _ _ _-_-_ _ _ _
	0...10 V	-10...10 V		
			4...20 mA	0...20 mA
	Max. 5 mA	Max. 5 mA		
			≤ 500 ohms	≤ 500 ohms
	≤ 0.33 mV	≤ 0.33 mV	≤ 0.66 µA	≤ 0.66 µA
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	Max. 500 Hz	Max. 500 Hz	Max. 500 Hz	Max. 500 Hz
	±200 µm to ≤ 500 mm nominal stroke	±200 µm to ≤ 500 mm nominal stroke	±200 µm to ≤ 500 mm nominal stroke	±200 µm to ≤ 500 mm nominal stroke
	±0.04% FS > 500 mm nominal stroke	±0.04% FS > 500 mm nominal stroke	±0.04% FS > 500 mm nominal stroke	±0.04% FS > 500 mm nominal stroke
	≤ 40 ppm/K	≤ 40 ppm/K	≤ 20 ppm/K	≤ 20 ppm/K
	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA	≤ 150 mA
	to 36 V	to 36 V	to 36 V	to 36 V
	to 36 V	to 36 V	to 36 V	to 36 V
	500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)	500 V AC (ground to housing)
	–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C



Please enter code for output signal, nominal stroke, design, and connection in the part number.

Scope of delivery

- Transducer
- Quick start instructions
- Fastening screws, stainless steel, "600 bar" (only design TK)
- Adapter flange (only design TK)

Please order separately:
Calibration box, page 178
Magnet, page 223

System requirements
- Standard PC
- Operating system: Windows 2000/XP/Vista/7
- Screen resolution at least 1024 × 768 pixels
- 10 MB available hard disk space
- Install Java Runtime Environment (JRE) Version 1.4.2 or higher
  http://java.com/getjava
- USB port

USB configuration

Start, end value setting and configuration via USB
The Micropulse Configuration Tool software enables Balluff transducers of type BTL7-A/E50... to be quickly and easily configured on a computer.
The most important features are:
- Online display of the current position of the magnet
- Graphic support for setting the functions and characteristics
- Display of information about the connected transducer
- Selectable number formats and units for display
- Reset to factory settings possible
- Demo mode without having a transducer connected

Connecting the USB communication box
With the BTL7-A/504/505-S32 transducers, the communication box can be connected between the transducer and controller. The communication box is connected to the PC using a USB cable.

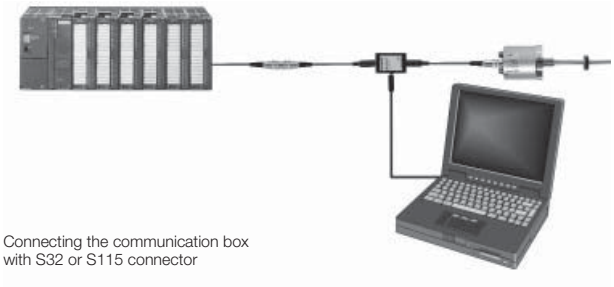
USB communication box

BTL7-A-CB01-USB-S32,
for BTL7-A/E504/505... with S32 connector

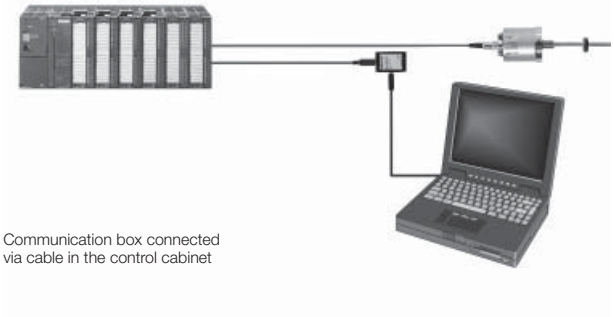
BTL7-A-CB01-USB-KA,
for BTL7-A/E504/505... with cable connection

Scope of delivery
- USB communication box
- Cable set
- Quick start instructions

Description	
for Series	
Ordering code	
Part number	
Material	
Weight	
Magnet travel speed	
Operating temperature/Storage temperature range	
Ordering code PA 60 glass fiber reinforced	
Part number PA 60 glass fiber reinforced	
Material	
Weight	
Magnet travel speed	
Operating temperature/Storage temperature range	



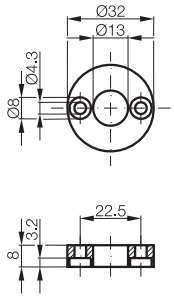
Connecting the communication box with S32 or S115 connector

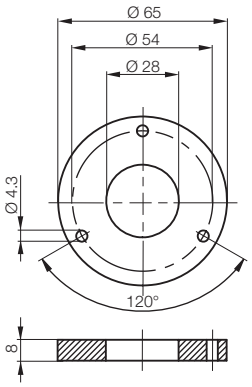


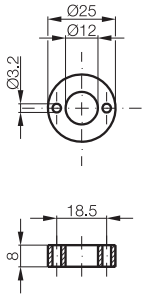
Communication box connected via cable in the control cabinet

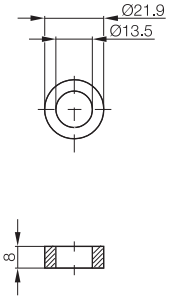
The computer software and corresponding manual are available on the Internet at **www.balluff.com/downloads-btl7**

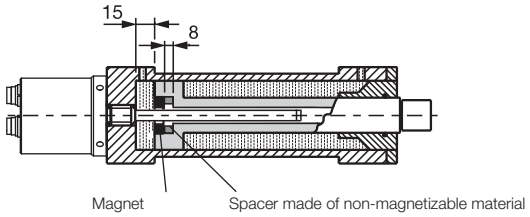
	Magnet	**Magnet**	**Magnet**	**Magnet**
	Rod BTL	Rod BTL	Rod BTL	Rod BTL
	BAM013L	**BAM013Y**	**BAM013J**	**BAM013R**
	BTL-P-1013-4R	BTL-P-1028-15R	BTL-P-1012-4R	BTL-P-1014-2R
	Aluminium	Aluminium	Aluminium	Aluminium
	approx. 12 g	approx. 68 g	approx. 12 g	approx. 10 g
	any	any	any	any
	–40...+100°C	–40...+100°C	–40...+100°C	–40...+100°C
	BAM013M		**BAM013K**	
	BTL-P-1013-4R-PA		BTL-P-1012-4R-PA	
	PA 60 glass fiber reinforced		PA 60 glass fiber reinforced	
	approx. 10 g		approx. 10 g	
	any		any	
	–40...+100°C		–40...+100°C	







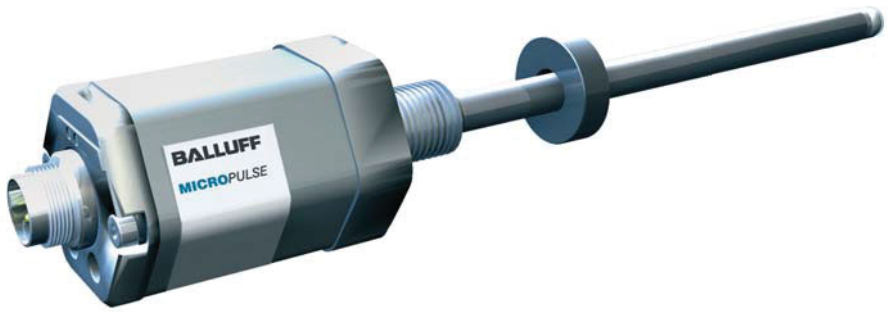




1000 bar
High-pressure resistant

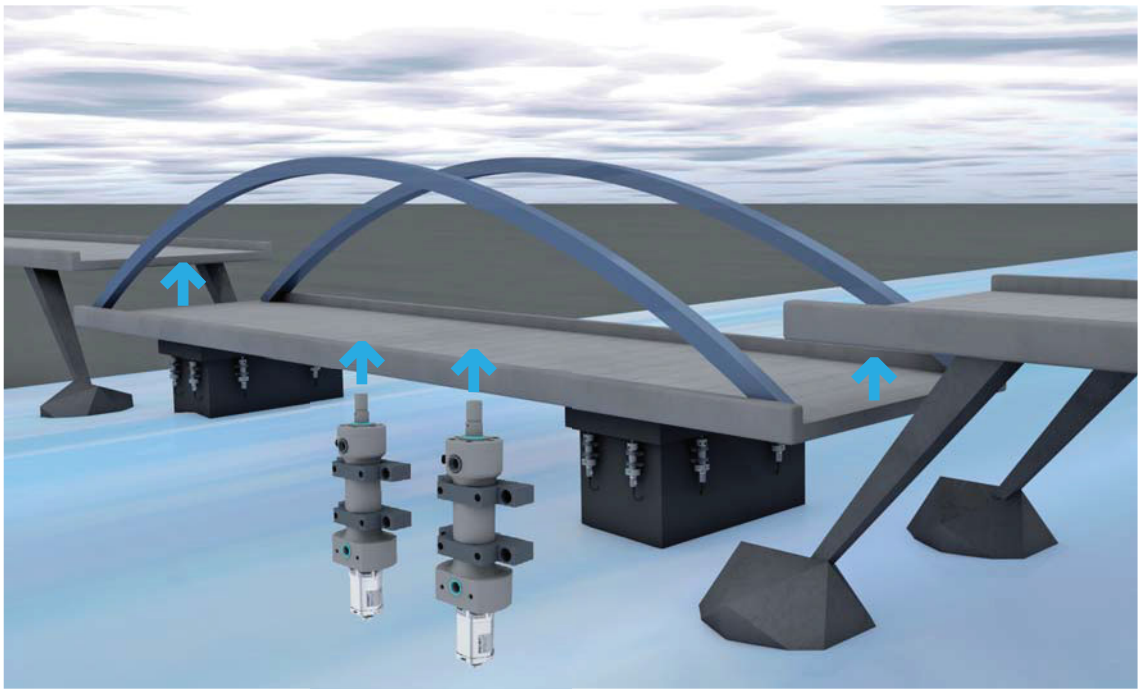
Micropulse CD transducers ensure that extreme loads are moved steadily and with precision. They are based on field-proven magnetostrictive position measurement technology. The absolute, contact-free principle is suitable for the reliable, high-precision and dynamic measurement of piston positions on hydraulic cylinders. The special flange and protective pipe design as well as the extremely robust stainless steel material make the Micropulse CD transducers ideal for installation as a feedback system in high-pressure and heavy-duty cylinders.

Features
- For pressures up to 1000 bar
- Measuring lengths 25...2000 mm
- Resolution down to 1 µm
- Degree of protection IP 67/68
- Temperature range –40...+85°C
- Connector or cable variants

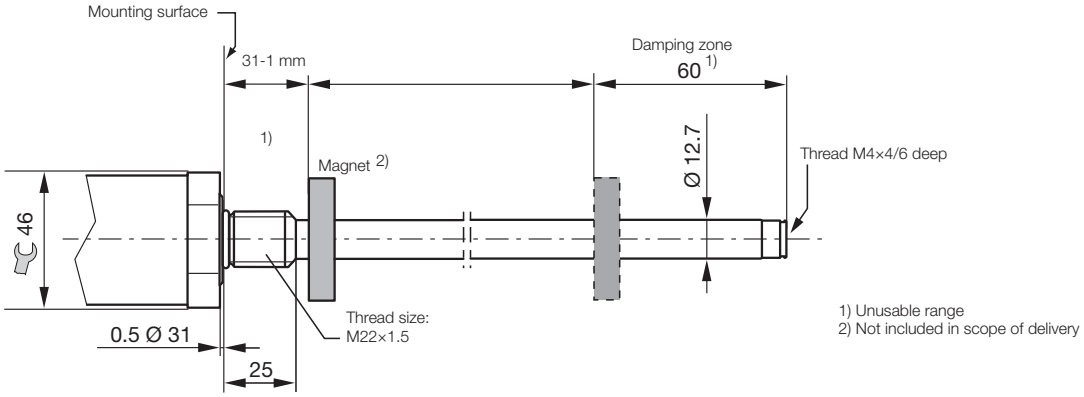


Structural design and calculations
- Active support of walls
- Bridge positioning and lifting technology
- Leveling structures
- Off-shore sector
- Tunnel construction

Industry applications
- Pumps and compressors
- Elevator and lifting technology
- Forging presses
- High-pressure hydraulics

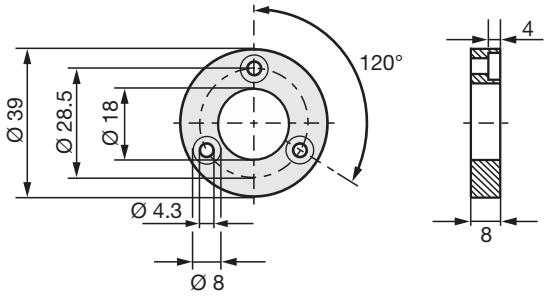


Heavy-duty cylinders raise the bridge to the planned road level after they are "floated" into position.

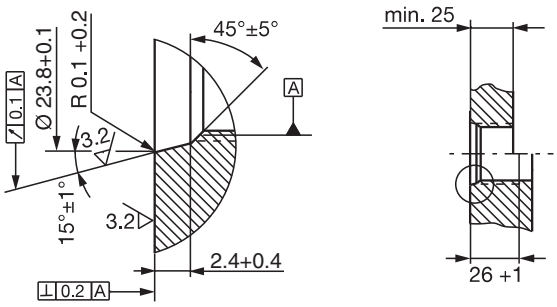


BTL-P-1018-3R

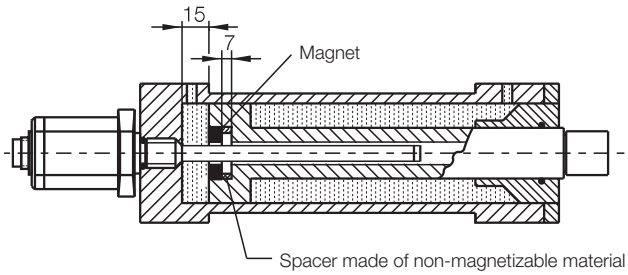
Weight: Approx. 19 g
Housing: Anodized aluminum



Tapped hole M22×1.5 acc. to ISO 6149, O-ring 19.3×2.2



The transducer has a mounting thread M22×1.5 (according to ISO). Depending on the version, the hole must be tapped before installation.



Please enter code for output signal, nominal stroke, design and connection in the Part number.

Scope of delivery

- Transducer
- Quick start instructions

Please order separately:
Calibration box, page 178
Magnet, page 223

Ordering example:

BTL_-_ _ _ _-M_ _ _ _-CD-_ _ _-_ _ _ _

Output signal

A Analog 0...10 V
G Analog –10...10 V
C Analog 0...20 mA
E Analog 4...20 mA
P digital pulse
S digital SSI

Nominal stroke [mm]

0025...2000 mm
in 1-mm increments

Connection

S32 Connector 8-Pin M16 (DIN)
KA05 PUR cable 5 m

Analog interface, see page 140; SSI interface, see page 146; digital pulse interface, see page 152; NEX, see page 214

Micropulse Transducers

Filling Level Sensor SF

- Highly accurate filling level sensor
- Unaffected by surface foam build-up
- With international approvals, such as 3-A Sanitary Standard, FDA and ECOLAB
- In stainless steel housing with Tri Clamp fastener
- Safe for sterilization (SIP) and cleaning (CIP)

Filling Level Sensor SF
Contents

MICROPULSE®

Filling Level Sensor SF
General data

100% stainless steel

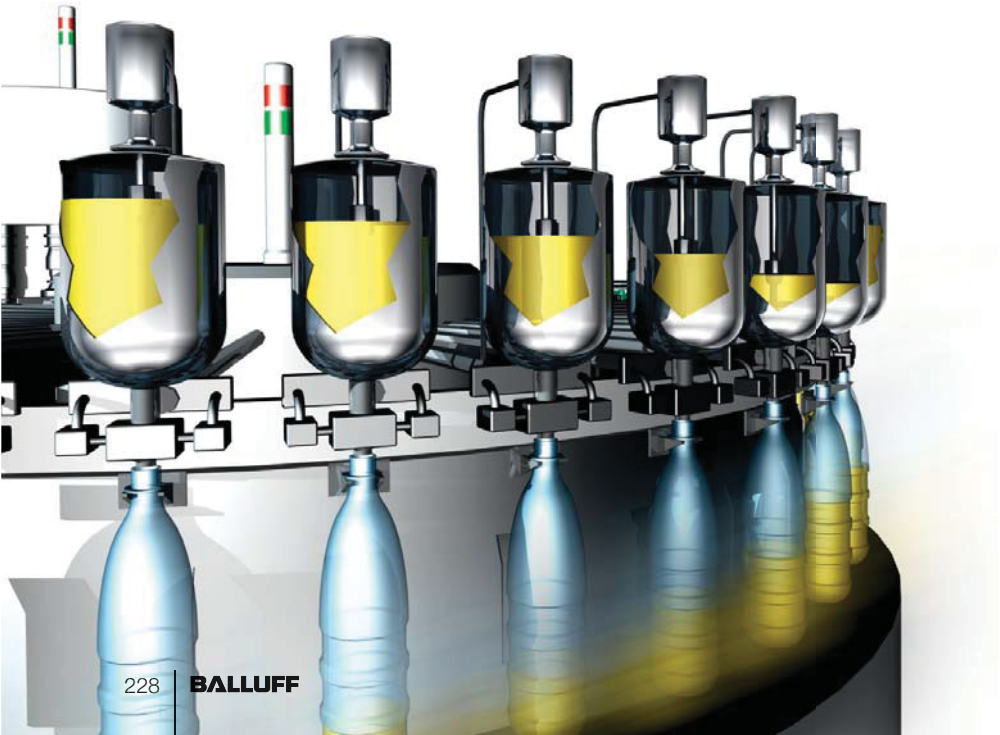
Maximum precision for food hygiene – internationally certified
The filling level sensor BTL-SF ensures continuously precise measurement in applications that have extreme hygiene requirements. Made from corrosion-free stainless steel with excellent surface quality and rounded edges, the sensor meets the highest international hygiene standards and fulfills all of the food industry's strict requirements.

Other benefits:
- Neutral for all liquids
- Unaffected by foam, thus delivering reliable filling level values
- Adjustment-free installation
- Easy to clean in installed state (CIP – clean in place)
- For process temperatures up to 130 °C (SIP – sterilization in place)
- Standardized interfaces ensure flexible installation
- Internationally certified quality ensures global marketing and sales of your system
- Rising and falling signal available

In the USA, 3-A Sanitary Standards Inc. formulates and monitors hygiene guidelines for devices used in the manufacture and packaging of milk and foodstuffs. Our products with this designation are 3-A authorized.

The FDA (Food and Drug Administration) oversees the U.S. food and drug industries and certifies devices, materials as well as systems in these industries. A product designation of this kind makes your system eligible for FDA approval.

The ECOLAB marking stands for resistance to aggressive cleaning agents. Devices with ECOLAB markings fulfill their standards.



For more information, visit us online!

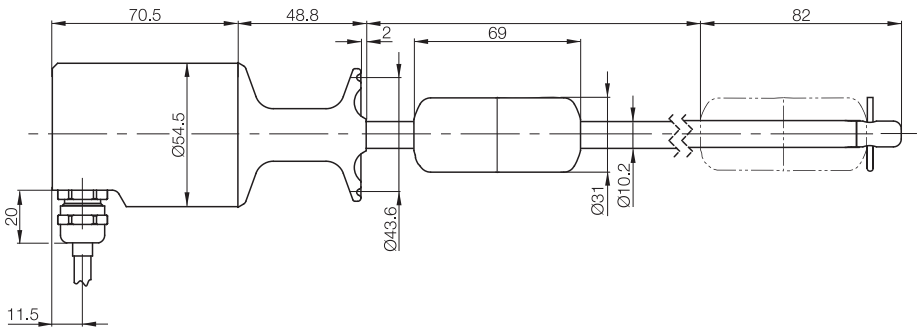
Filling Level Sensor SF
General data

IP69K

Series	**Rod SF BTL5**
Polarity reversal protected	yes
Overvoltage protection	36 V
Dielectric strength	500 V DC (GND to housing)
Degree of protection as per IEC 60529	IP 67/IP 69K (flange and tube)
Housing material	Stainless steel 1.4404
Flange and tube material	1.4404
Connection	Cable connection
Fastener	1.5" Tri Clamp as per SSI 3A standard 74-03
Pressure rating	300 bar (depending on float)
EMC testing	
Radio interference emission	EN 55016-2-3 (industrial and residential area)
Static electricity (ESD)	EN 61000-4-2/EN 61000-4-2 Severity level 3
Electromagnetic fields (RFI)	EN 61000-4-3/EN 61000-4-3 Severity level 3
Electrical fast transient bursts	EN 61000-4-4/EN 61000-4-4 Severity level 3
Conducted interference induced by high-frequency fields	EN 61000-4-6/EN 61000-4-6 Severity level 3
Surge voltage	IEC 61000-4-5/EN 61000-4-5 Severity level 2
Magnetic fields	IEC 61000-4-8/EN 61000-4-8 Severity level 4
Standard nominal stroke (mm)	50...2500 in 1 mm increments

Scope of delivery
- Transducer
- Quick start instructions

Please order separately:
Tri Clamp page 232
Float page 232
Seal page 232
Weld nipple page 232



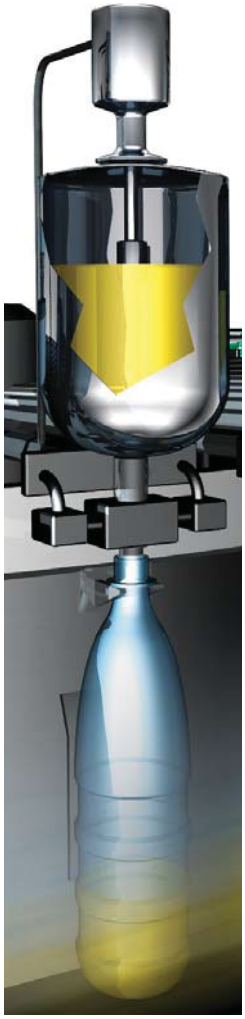
Filling Level Sensor SF
Analog interface

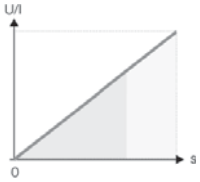
The industry-standard filling level sensor works with tried-and-tested Micropulse technology, absolute and contact-free magnetostrictive measurement, which has been associated with top reliability for years. In addition, it has analog interfaces and, due to this common standard signal, can be used in process automation.

Analog signal
A signal that can assume any value between a minimum and maximum continuously (almost) without increments is called an analog signal. The output signal for the filling level sensor BTL-SF is analog and directly proportional to the position of the float on the sensor tube.

Features
- Economically priced system solution
- Cable break monitoring using 4...20 mA signal
- Current signal, interference-free signal transfer
- High resolution and repeatability
- Rising and falling signal available

Variants
- Current (4...20 mA or 0...20 mA)
- Voltage (0...10 V or 10...0 V)





Series	
Output signal	
Transducer interface	
Customer device interface	
Part number	
Output voltage	
Output current	
Load current	
Max. residual ripple	
Load resistance	
System resolution	
Hysteresis	
Repeat accuracy	
Sampling rate	
Max. linearity deviation	
Temperature coefficient	
Supply voltage	
Current consumption	
Polarity reversal protected	
Overvoltage protection	
Dielectric strength	
Operating temperature	
Process temperature (130 °C over one hour)	

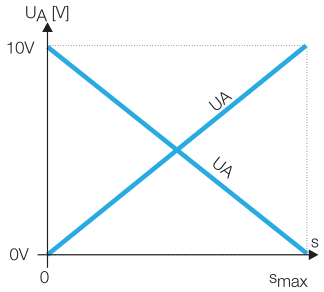
Scope of delivery
- Transducer
- Quick start instructions

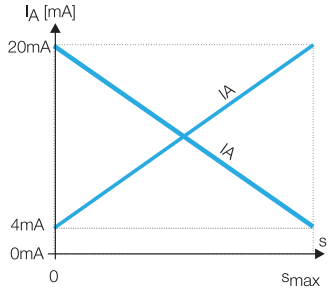
Please order separately:
Tri Clamp page 232
Float page 232
Seal page 232
Weld nipple page 232

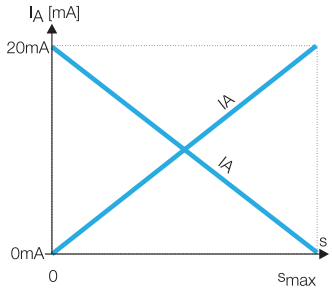
PTFE cable – LIF5Y-FC-5Y (7x0.25 mm²):
- Temperature-resistant up to 200 °C
- Good resistance to chemicals and oil

Filling Level Sensor SF
Analog interface

	Rod SF BTL5	Rod SF BTL5	Rod SF BTL5
	Analog	Analog	Analog
	A	**E**	**C**
	Analog	Analog	Analog
	BTL5-**A**11-M_ _ _ _-SF-_ _ _	BTL5-**E**1_-M_ _ _ _-SF-_ _ _	BTL5-**C**1_-M_ _ _ _-SF-_ _ _
	0...10 V and 10...0 V		
		4...20 mA or 20...4 mA	0...20 mA or 20...0 mA
	Max. 5 mA		
	≤ 5 mV		
		≤ 500 ohms (500 ohms)	≤ 500 ohms (500 ohms)
	≤ 0.1 mV	≤ 0.2 µA	≤ 0.2 µA
	≤ 4 µm	≤ 4 µm	≤ 4 µm
	System resolution/min. 2 µm	System resolution/min. 2 µm	System resolution/min. 2 µm
	$f_{STANDARD}$ = 500 Hz	$f_{STANDARD}$ = 500 Hz	$f_{STANDARD}$ = 500 Hz
	±100 µm to 500 mm of nominal stroke ±0.02% of 500 to max. nominal stroke	±100 µm to 500 mm of nominal stroke ±0.02% of 500 to max. nominal stroke	±100 µm to 500 mm of nominal stroke ±0.02% of 500 to max. nominal stroke
	≤ 40 ppm/K for nominal stroke 500 mm, float at center of measuring range	≤ 40 ppm/K for nominal stroke 500 mm, float at center of measuring range	≤ 40 ppm/K for nominal stroke 500 mm, float at center of measuring range
	20...28 V DC	20...28 V DC	20...28 V DC
	≤ 150 mA	≤ 150 mA	≤ 150 mA
	yes	yes	yes
	36 V	36 V	36 V
	500 V DC (ground to housing)	500 V DC (ground to housing)	500 V DC (ground to housing)
	–10...+85 °C	–10...+85 °C	–10...+85 °C
	–20...+100 °C	–20...+100 °C	–20...+100 °C







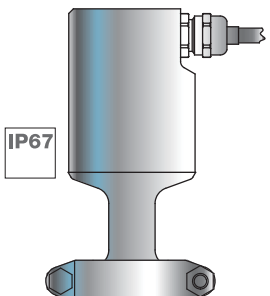
Ordering example:
BTL5-_1_-M_ _ _ _-SF-_ _ _

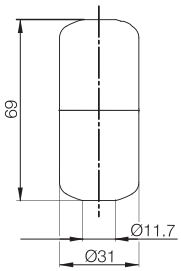
Output signal	Characteristic curves	Standard nominal stroke [mm]	Radial connection
A Analog 0...10 V	1 Rising and falling for A	50...2500 mm in 1 mm increments	K-radial design
C Analog 0...20 mA	0 Rising (for C and E)		F02 2 m PTFE cable
E Analog 4...20 mA	7 Falling (for C and E)		F05 5 m PTFE cable
			F10 10 m PTFE cable
			F15 15 m PTFE cable
			F20 20 m PTFE cable

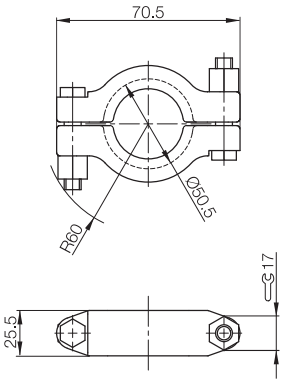
Filling Level Sensor SF
Floats and accessories

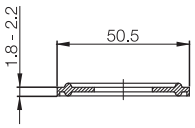


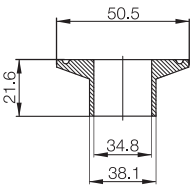

Description	Float	Tri Clamp (DIN 32676)	O-ring	Weld nipple
for Series	Rod SF BTL	Rod SF BTL	Rod SF BTL	Rod SF BTL
Ordering code	**BAM01A2**	**BAM01A5**	**BAM01A4**	**BAM01A3**
Part number	BTL-S-3112-4Z	BAM MC-XA-006-D38,1-5	BAM SE-XA-002-D38,1-S	BAM-AD-XA-003-D38.1-5
Material	Stainless steel 1.4404	USA ASTM 316 (1.4401)	Platinum catalyzed silicone	Part no. W. 1.4435 BN2 (Fe ≤ 0.5%) as per EB 10088
Weight	Approx. 30 g			
Operating temperature/ Storage temperature	–40...+130 °C			
Immersion depth in water	approx. 31 mm			
Pressure rating (static)	4 bar (58 psi)			

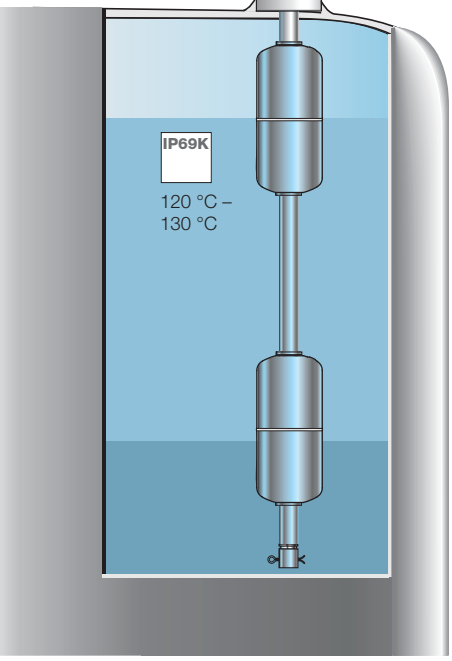






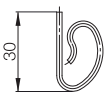






Process temperature:
maximum permissible temperature of the rod under the flange (with media contact).
Certain production processes require sterilization at 120...130°C for 0.5...1 hour, for instance.

Included in scope of delivery for float
- Float
- Instructions
- Cotter pin (spring pin 2×30)

Caution!
Approvals only issued through use of these components.
Please read the instructions in the user's guide before designing, installing, and commissioning!

Filling Level Sensor SF
Application

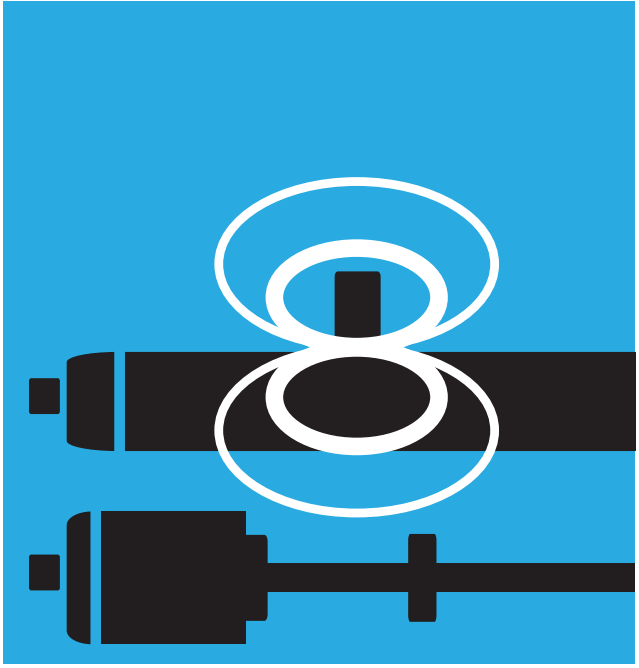
- Continuously precise measurement delivers excellent filling results
- 100% stainless steel ensures top hygiene standards and long service life
- International certificates ensure maximum quality

Maximum precision for food hygiene – internationally certified

The filling level sensor BTL-SF ensures continuously precise measurement in applications that have extreme hygiene requirements. Made from corrosion-free stainless steel with excellent surface quality and rounded edges, the sensor meets the highest international hygiene standards and fulfills all of the food industry's strict requirements. Take advantage of the best quality directly from the manufacturer.

Other benefits:

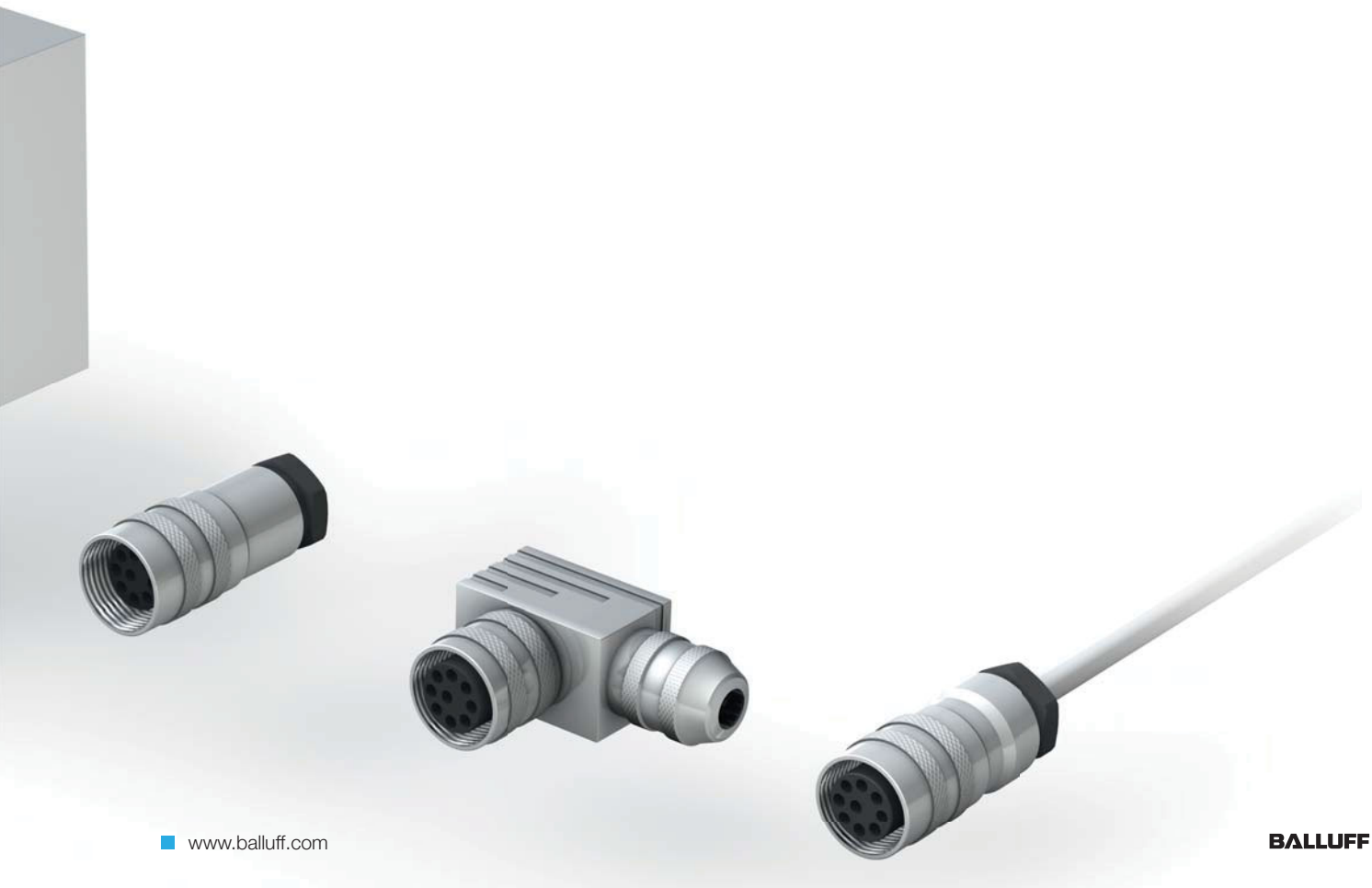
- Neutral for all liquids
- Unaffected by foam, thus delivering reliable filling level values
- Adjustment-free installation
- Easy to clean in installed state (CIP – clean in place)
- For process temperatures up to 130 °C (SIP – sterilization in place)
- Standardized interfaces ensure flexible installation
- Internationally certified quality ensures global marketing and sales of your system
- Rising and falling signal available



Micropulse Transducers

Contents

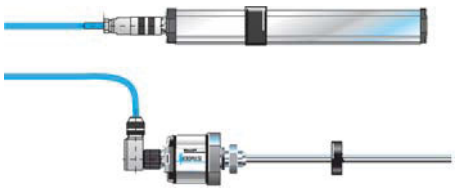
MICROPULSE®



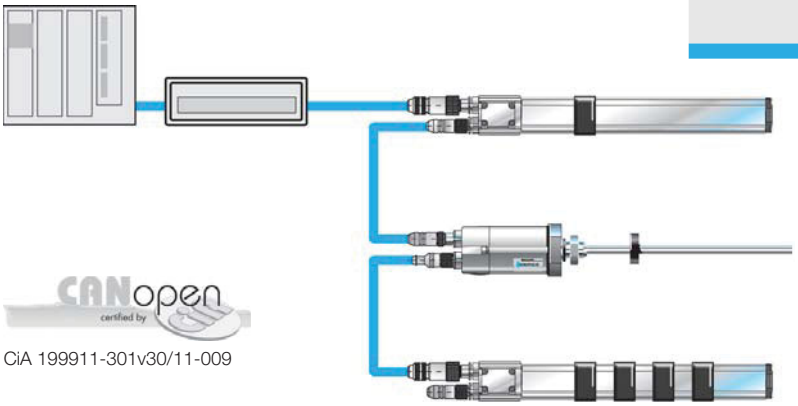
Connectors	**BKS-S 32M-_ _**	
for Series	BTL_-...-S 32	
	soldered contacts	
Design	M16, Straight, female	
Part number	BKS-S 32M-_ _	
Crimped contacts		
Solder connection	max. 0.75 mm²	
Housing material	Nickel-plated CuZn	
Contact	CuZn	
Contact surface	0.8 µm Au	
Cable strain relief	PG 9	
Cable diameter	6...8 mm	
Cable	Lif9Y-FC-11Y- 0	
Number of conductors x conductor cross-section	8×0.25 mm²	
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	
View of female solder side		

PIN	Color
1	YE
2	GY
3	PK
4	RD
5	GN
6	BU
7	BN
8	WH

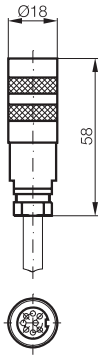
Connector for analog, pulse and SSI interfaces



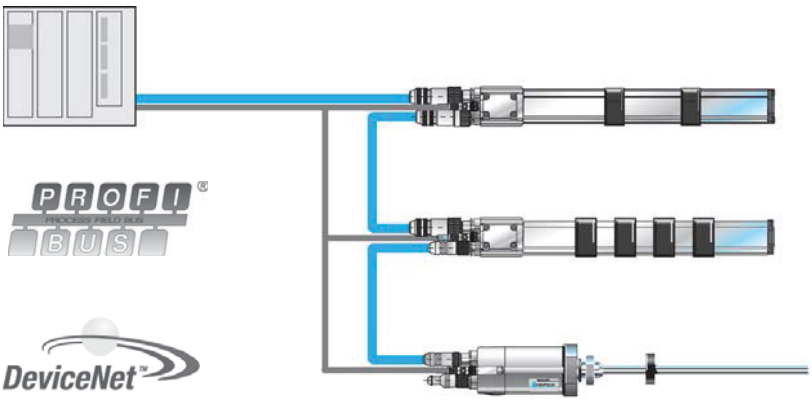
Connectors for CANopen interfaces



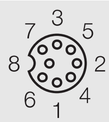
CiA 199911-301v30/11-009

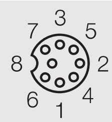


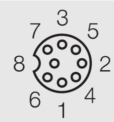
Connectors for Profibus DP and DeviceNet interfaces

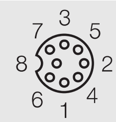


	BKS-S 32M-C-00	**BKS-S 33M-_ _**	**BKS-S 78M-00**	**BKS-S232-PU-_ _**	**BKS-S233-PU-_ _**
	BTL_-...-S 32	BTL_-...-S 32	BTL_-...-S 32	BTL_-_ _ _-S32	BTL_-_ _ _-S32
	crimped contacts	soldered contacts	soldered contacts		
	M16, Straight, female	M16, Angled, female	M16, Straight, male	M16, Straight, female	M16, Angled, female
	BKS-S 32M-C-00	BKS-S 33M-_ _	BKS-S 78M-00	BKS-S232-PU-_ _	BKS-S233-PU-_ _
	max. 0.5 mm²				
		max. 0.75 mm²	max. 0.75 mm²		
	Nickel-plated CuZn	Nickel plated ZnAlCu1	Nickel-plated CuZn	PUR	PUR
	CuZn	CuZn	CuZn	CuZn	CuZn
	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
	PG 9	PG 9	PG 9		
	6...8 mm	6...8 mm	6...8 mm		
		Lif9Y-FC-11Y- 0		Lif9Y-FC-11Y-0	Lif9Y-FC-11Y-0
	8×0.25 mm²	8×0.25 mm²		8×0.25 mm²	8×0.25 mm²
	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)









PIN	Color
1	YE
2	GY
3	PK
4	RD
5	GN
6	BU
7	BN
8	WH

PIN	Color
1	YE
2	GY
3	PK
4	RD
5	GN
6	BU
7	BN
8	WH

PIN	Color
1	YE
2	GY
3	PK
4	RD
5	GN
6	BU
7	BN
8	WH

PIN	Color
1	YE
2	GY
3	PK
4	RD
5	GN
6	BU
7	BN
8	WH

PIN	Color
1	YE
2	GY
3	PK
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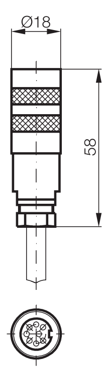
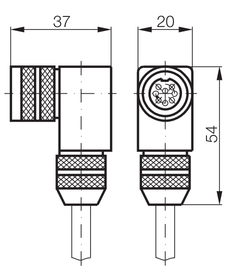
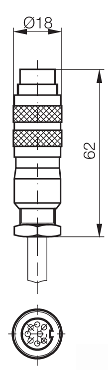
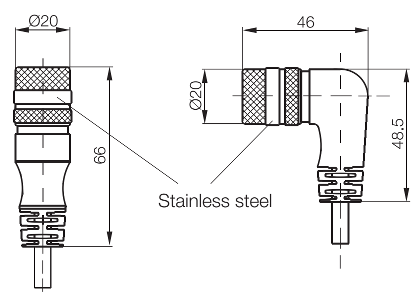








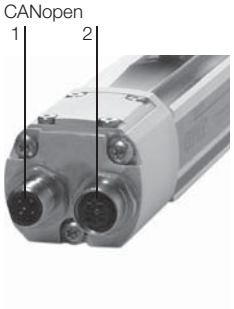
Please include the cable length with the part number.
Code 00 for user-assembly
(please use shielded cable).
Code 05, 10, 15, 20, 25, 30 m for finished cable assembly.

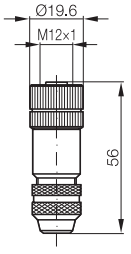
Micropulse Transducers
Profile P
Profile PF
Profile AT
Profile BIW
Rod
Rod Compact and Rod AR
Rod EX, T Redundant and CD
Filling Level Sensor SF
Accessories
Connectors
"Pigtail" Connector System
Evaluation Units
Profibus Modules P111
Digital Display CAM Controller
Basic Information and Definitions

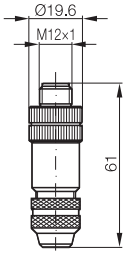
Connectors for CANopen and DeviceNet interfaces

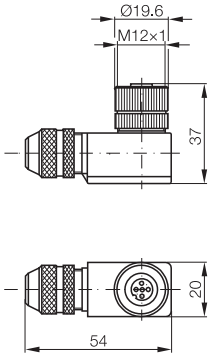
Connectors	**BKS-S 92-00**	**BKS-S 94-00**	**BKS-S 93-00**	**BKS-S 95-00**
for Series	BTL_-H_ _ _-S92/S93/S94 Screw terminals	BTL_-H_ _ _-S92/S93/S94 Screw terminals	BTL_-H_ _ _-S92/S93/S94 Screw terminals	BTL_-H_ _ _-S92/S93/S94 Screw terminals
Design	5-pin, female	5-pin, male	5-pin, female	5-pin, male
Part number	BKS-S 92-00	BKS-S 94-00	BKS-S 93-00	BKS-S 95-00
Screw terminal	max. 0.75 mm²	max. 0.75 mm²	max. 0.75 mm²	max. 0.75 mm²
Housing material	Nickel-plated CuZn	Nickel-plated CuZn	Nickel-plated CuZn	Nickel-plated CuZn
Contact	CuZn	CuZn	CuZn	CuZn
Contact surface	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
Cable strain relief	PG 9	PG 9	PG 9	PG 9
Cable diameter	6...8 mm	6...8 mm	6...8 mm	6...8 mm
Number of conductors × conductor cross-section				
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)
Knurled nut				
Finish				
O-ring				
Resistor				
Coding	A	A	A	A
Slot on transducer	1	2	1	2
View of female coupling side				
	PIN Signal 1 CAN_GND 2 +24 V 3 GND (0 V) 4 CAN_HIGH 5 CAN_LOW	PIN Signal 1 CAN_GND 2 +24 V 3 GND (0 V) 4 CAN_HIGH 5 CAN_LOW	PIN Signal 1 CAN_GND 2 +24 V 3 GND (0 V) 4 CAN_HIGH 5 CAN_LOW	PIN Signal 1 CAN_GND 2 +24 V 3 GND (0 V) 4 CAN_HIGH 5 CAN_LOW

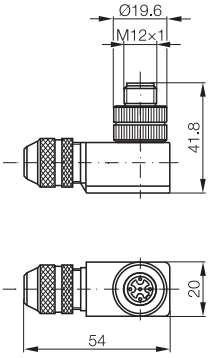
CANopen



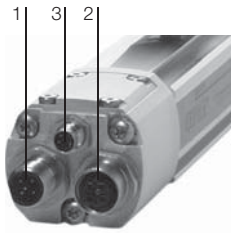








DeviceNet



Slot 3
Power supply for DeviceNet:
BKS-S48-15-CP-... page 243

	BKS-S 92-TA1	BKS-S137-19-PC-_ _	BKS-S151-19-PC-_ _	BKS-S 94-R01	BKS-S137-19/GS92-PC_ _
	BTL_-H_ _ _-S92	BTL_-H_ _ _-S92/S93/S94	BTL_-H_ _ _-S92/S93/S94	BTL_-H_ _ _-S92/S93/S94	BTL_-H_ _ _-S92/S93/S94
	T-splitter, 2 × female, 1 × male	5-pin, female	5-pin, male	Terminating resistor, male	Male/female extension
	BKS-S 92-TA1	BKS-S137-19-PC-_ _	BKS-S151-19-PC-_ _	BKS-S 94-R01	BKS-S137-19/GS92-PC_ _
	PA	PUR	PUR	TPU	PUR
	CuZn	CuZn	CuZn	CuZn	CuZn
	Ni	0.8 µm Au	0.8 µm Au	0.8 µm Au	0.8 µm Au
		7.2±0.2 mm	7.2±0.2 mm		
		5×0.25 mm²	5×0.25 mm²		5×0.34 mm²
	IP 67	IP 67	IP 67	IP 68	IP 67
	CuZn	CuZn	CuZn	CuZn	CuZn
	2.5 µm Ni	2.5 µm Ni	2.5 µm Ni	2.5 µm Ni	2.5 µm Ni
	HBR	Viton	Viton	Viton	Viton
				121 Ω	
	A	A	A	A	A
	1*	1	2	2	1/2

PIN	Signal
1	–
2	–
3	–
4	121 Ω
5	

*Only for BTL5-H1...-M-P/B-S92

Please include the cable length with the part number!

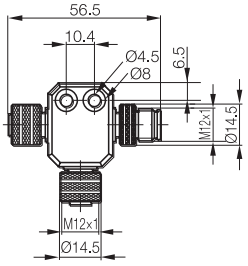
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m

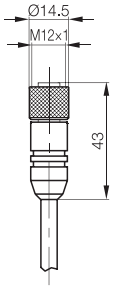
Please include the cable length with the part number!

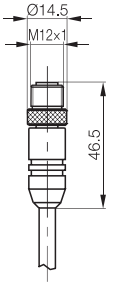
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m

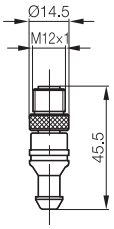
Please include the cable length with the part number.

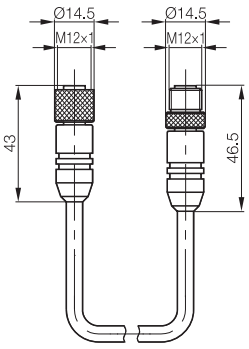
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m







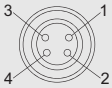


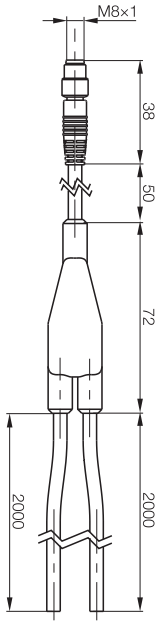


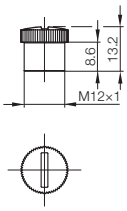
Please order the clear view cover separately.

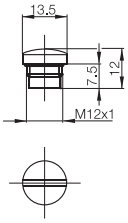
Order designation: BTL5-A-CP01-K

M8 Y-connectors for CANopen

Connectors	1×M8 straight/2×3-wire		
Designation	Y-connector	M12 locking screw	M12 locking screw
Design	Male		
Use	Splitter boxes	IP 65 screw plug for unused ports	for connector type M12×1
Ordering code	**BCC08JZ**	**BAM01C2**	**BAM0114**
Part number	BKS-S 75-TB4-05-PU-00,05/02/02	BAM CS-XA-002-M12-A	BKS-12-CS-01
Supply voltage U_S	10...30 V DC		
Number of conductors × conductor cross-section	4×0.34 mm²		
Connection	Molded-in		
Degree of protection as per IEC 60529	IP 67		
Ambient temperature T_a	–25...+85 °C	–20...+80 °C	
Housing material	PUR	Plastic	Brass
View of female/male side	 PIN 1: brown PIN 2: white PIN 3: blue PIN 4: black		





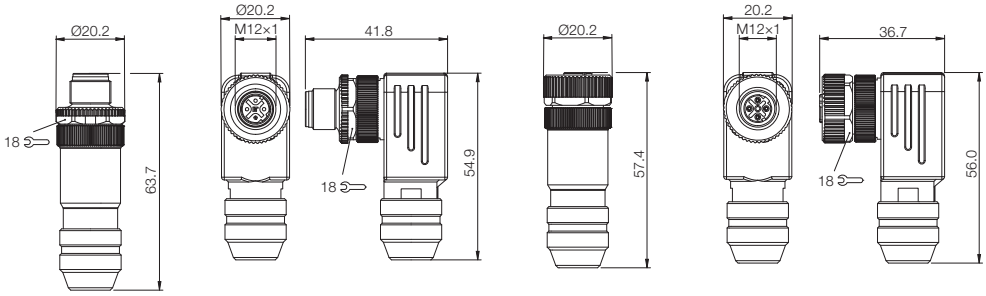


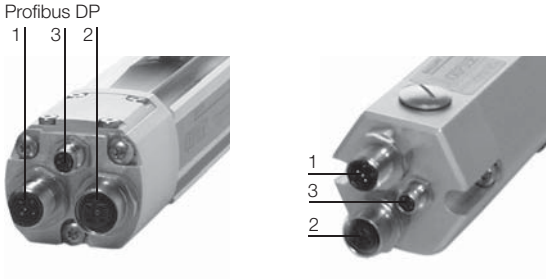



Connectors	M12	M12	M12	M12
Design	B-coded 5-pin	B-coded 5-pin	B-coded 5-pin	B-coded 5-pin
Use	Male	Male	Female	Female
Ordering code	**BCC0714**	**BCC0716**	**BCC0715**	**BCC0717**
Part number	BCC M475-0000-2B-000-01X575-000	BCC M485-0000-2B-000-01X575-000	BCC M475-0000-1B-000-01X575-000	BCC M485-0000-1B-000-01X575-000
Supply voltage U_S	10...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC
Number of conductors × conductor cross-section	5x max. 0.75 mm²	5x max. 0.75 mm²	5x max. 0.75 mm²	5x max. 0.75 mm²
Cable diameter	6...8 mm	6...8 mm	6...8 mm	6...8 mm
Connection	Screw terminal	Screw terminal	Screw terminal	Screw terminal
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)
Ambient temperature T_a	–25...+85 °C	–25...+85 °C	–25...+85 °C	–25...+85 °C
Housing material	CuZn	CuZn	CuZn	CuZn
Shielded design	yes*	yes*	yes*	yes*
Coding	B	B	B	B
Slot on transducer	2	2	1	1
View of female/male side				

*Knurled ring used
Knurled nut

Previously BKS-S 105-00	**Previously BKS-S 106-00**	**Previously BKS-S 103-00**	**Previously BKS-S 104-00**
00,3 = Length of 0.3 m	00,3 = Length of 0.3 m	00,3 = Length of 0.3 m	00,3 = Length of 0.3 m
02 = Length of 2 m	02 = Length of 2 m	02 = Length of 2 m	02 = Length of 2 m
05 = Length of 5 m	05 = Length of 5 m	05 = Length of 5 m	05 = Length of 5 m
10 = Length of 10 m	10 = Length of 10 m	10 = Length of 10 m	10 = Length of 10 m



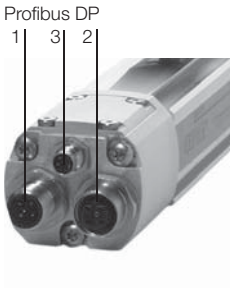


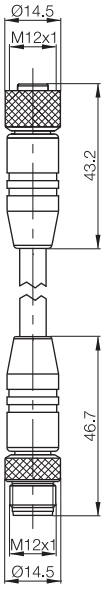
Connector for M12. 5-pin, B-coded for Profibus DP

Connector diagram and wiring			
Configuration			
Design			
Use	Female/male	Female	
Supply voltage U_S	300 V	300 V	
Cable material	PUR	PUR	
Color	Violet	Violet	
Number of conductors × conductor cross-section	2×0.38 mm²	2×0.38 mm²	
Degree of protection as per IEC 60529	IP 67	IP 67	
Ambient temperature T_a	–25...+80 °C	–25...+80 °C	
Housing material	PUR	PUR	
Knurled nut	Nickel-plated CuZn	Nickel-plated CuZn	
Coding	B	B	
Slot on transducer	1/2	1	

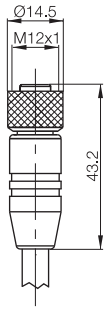
	Ordering code			
	Part number			
Cable length	**Ordering code**	**BCC0A12**		
0.6 m	Part number	BCC M415-M412-3B-329-PS72N1-006		
Cable length	**Ordering code**	**BCC0A13**		
1 m	Part number	BCC M415-M412-3B-329-PS72N1-010		
Cable length	**Ordering code**	**BCC0A14**	**BCC070Y**	
2 m	Part number	BCC M415-M412-3B-329-PS72N1-020	BCC M415-0000-1B-031-PS72N1-020	
Cable length	**Ordering code**	**BCC0A15**	**BCC070Z**	
5 m	Part number	BCC M415-M412-3B-329-PS72N1-050	BCC M415-0000-1B-031-PS72N1-050	
Cable length	**Ordering code**	**BCC0A16**	**BCC0710**	
10 m	Part number	BCC M415-M412-3B-329-PS72N1-100	BCC M415-0000-1B-031-PS72N1-100	
Cable length	**Ordering code**	**BCC0A17**	**BCC0A0K**	
15 m	Part number	BCC M415-M412-3B-329-PS72N1-150	BCC M415-0000-1B-031-PS72N1-150	
Cable length	**Ordering code**	**BCC0A18**	**BCC0A0L**	
20 m	Part number	BCC M415-M412-3B-329-PS72N1-200	BCC M415-0000-1B-031-PS72N1-200	
Cable length	**Ordering code**			
30 m	Part number			

Previously BKS-S103/GS103-CP-_ _
00,3 = Length of 0.3 m
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m



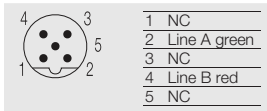


Previously BKS-S103-CP-_ _
00,3 = Length of 0.3 m
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m



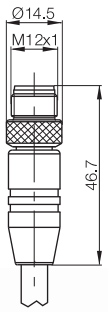
Please order the clear view cover separately!
Order designation: BTL5-A-CP01-K

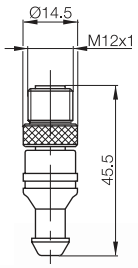
Connector for M12. 5-pin, B-coded for Profibus DP

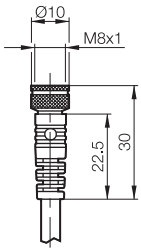
	 1 NC 2 Line A green 3 NC 4 Line B red 5 NC		
		M12 terminating resistor	M8 power supply cord
		5-pin, B-coded	
	Male	Male	Female
	300 V	10...30 V DC	
	PUR		PUR
	Violet		Black
	2×0.38 mm²		2×0.25 mm²
	IP 67	IP 67	IP 67
	–25...+80 °C	–40...+85 °C	
	PUR	Plastic	PUR
	Nickel-plated CuZn		
	B	B	
	2	2	3
		BCC0718	
		BCC M415-0000-2B-R01	
	BCC0A0Y		**BCC0069**
	BCC M412-0000-2B-031-PS72N1-020		BKS-S 48-15-CP-02
	BCC0A0Z		**BCC006A**
	BCC M412-0000-2B-031-PS72N1-050		BKS-S 48-15-CP-05
	BCC0A10		**BCC006C**
	BCC M412-0000-2B-031-PS72N1-100		BKS-S 48-15-CP-10
			BCC006E
			BKS-S 48-15-CP-20
			BCC006F
			BKS-S 48-15-CP-30

previously BKS-S105-CP-_ _

00,3 = Length of 0.3 m
02 = Length of 2 m
05 = Length of 5 m
10 = Length of 10 m





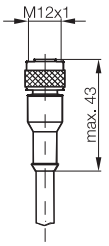


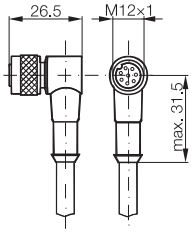
M12 female straight and right-angle connectors, 8-pin, customized assembly

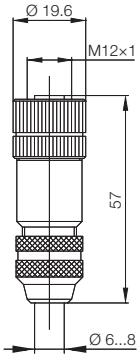


Connector diagram and wiring				
	PIN Color 1 YE 2 GY 3 PK 4 RD 5 GN 6 BU 7 BN 8 WH	PIN Color 1 YE 2 GY 3 PK 4 RD 5 GN 6 BU 7 BN 8 WH	PIN Color 1 YE 2 GY 3 PK 4 RD 5 GN 6 BU 7 BN 8 WH	
for Series	BTL_-…-S115	BTL_-…-S115	BTL_-…-S115	
Design	M12, female, straight, 8-pin	M12, female, angled, 8-pin	8-pin, female	
Ambient temperature T_a	-25...90 °C	-25...90 °C		
Housing material	PUR	PUR	Nickel-plated CuZn	
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)	
Cable material	PUR	PUR		
Number of conductors × conductor cross-section	8×0.25 mm²	8×0.25 mm²	max. 0.75 mm²	
Cable diameter D	6.6 ±0.2 mm	6.6 ±0.2 mm	6...8 mm	
Min. bending radius	dynamic 5× D, static 2× D	dynamic 5× D, static 2× D		
Coding				
Slot on transducer				

	Ordering code			**BCC00YA**	
	Part number			BKS-S115-00	
Cable length	**Ordering code**	**BCC00YE**	**BCC00YU**		
2 m	Part number	BKS-S115-PU-02	BKS-S116-PU-02		
Cable length	**Ordering code**	**BCC00YF**	**BCC00YW**		
5 m	Part number	BKS-S115-PU-05	BKS-S116-PU-05		
Cable length	**Ordering code**	**BCC00YH**	**BCC00YY**		
10 m	Part number	BKS-S115-PU-10	BKS-S116-PU-10		
Cable length	**Ordering code**	**BCC00YJ**	**BCC00YZ**		
15 m	Part number	BKS-S115-PU-15	BKS-S116-PU-15		
Cable length	**Ordering code**	**BCC00YK**	**BCC00Z0**		
20 m	Part number	BKS-S115-PU-20	BKS-S116-PU-20		
Cable length	**Ordering code**	**BCC00YL**	**BCC00Z1**		
25 m	Part number	BKS-S115-PU-25	BKS-S116-PU-25		
Cable length	**Ordering code**	**BCC00YM**	**BCC00Z2**		
50 m	Part number	BKS-S115-PU-50	BKS-S116-PU-50		





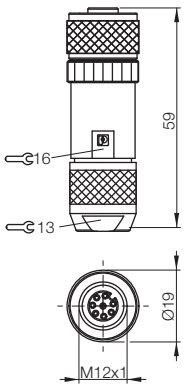


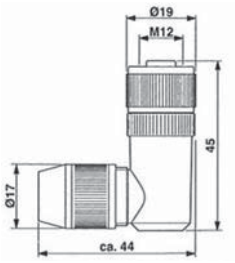
Adapter BKS-S115 to BKS-S 32
Ordering code:
BKS-S115/GS32-PU-00,2

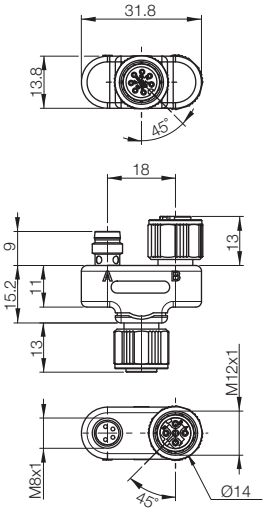
Accessories

M12 female straight and angled connector, 8-pin, user-configurable for VARAN and EtherCAT

			
	M12 female, straight, 8-pin	M12 female, angled, 8-pin	M12/M8 Y-plug splitter
	–25...+85 °C	–25...+85 °C	–25...+85 °C
	CuZn	CuZn	TPU
	IP 67 (when screwed into place)	IP 67 (when screwed into place)	IP 67 (when screwed into place)
	8×0.14...0.25 mm²	8×0.14...0.25 mm²	
	4...8 mm	4...8 mm	
			I = A, III = D
			C
	BCC04MC	**BCC04ME**	**BCC0CK4**
	BCC M478-0000-1A-000-43X834-000	BCC M488-0000-1A-000-43X834-000	BCC M418-M314-M415-U0038-000



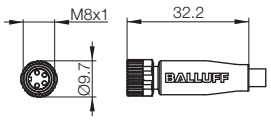


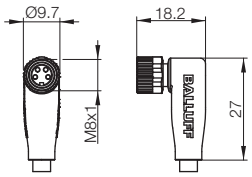


M8 connector, female, 4-pin, fabricated and for EtherCAT

Connector diagram and wiring		
Configuration	M8 connector, straight, molded, fabricated	M8 connector, angled, molded, fabricated
Design	4-pin	4-pin
Use	Female	Female
Supply voltage U_S	30 V AC/DC	30 V AC/DC
Cable material	PUR	PUR
Color	Black	Black
Number of conductors × conductor cross-section	4×0.34 mm²	4×0.34 mm²
Degree of protection as per IEC 60529	IP 67	IP 67
Ambient temperature T_a	–25...+80 °C	–25...+80 °C

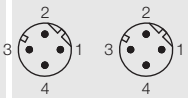
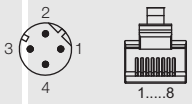
	Ordering code		
	Part number		
Cable length 2 m	**Ordering code**	**BCC02N5**	**BCC02NH**
	Part number	BCC M314-0000-10-014-PS0434-020	BCC M324-0000-10-014-PS0434-020
Cable length 5 m	**Ordering code**	**BCC02N6**	**BCC02NJ**
	Part number	BCC M314-0000-10-014-PS0434-050	BCC M324-0000-10-014-PS0434-050
Cable length 10 m	**Ordering code**	**BCC02N7**	**BCC02NK**
	Part number	BCC M314-0000-10-014-PS0434-100	BCC M324-0000-10-014-PS0434-100
Cable length 15 m	**Ordering code**		
	Part number		
Cable length 20 m	**Ordering code**		
	Part number		

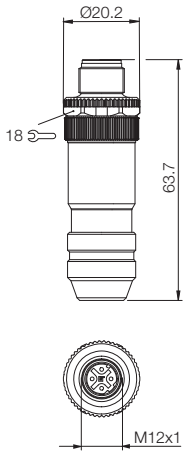


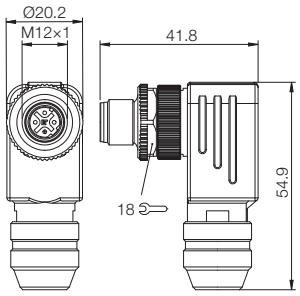


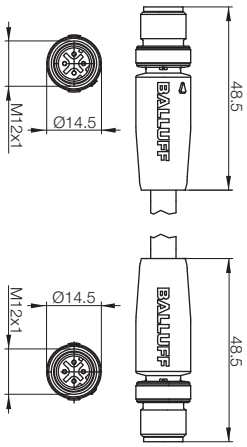
M12 connector, M12 connection cable 4-pin, for EtherCAT

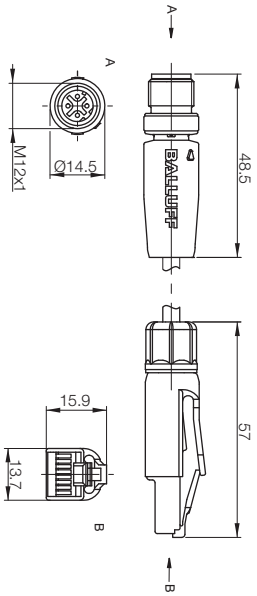



				
	M12 connector, straight	M12 connector, angled	M12 connection cable, straight/straight	M12 connection cable, straight/RJ45 straight
	4-pin, D-coded	4-pin, D-coded	4-pin, D-coded	4-pin, D-coded
	Male	Male	Male/male	Male/male
	60 V AC/DC	60 V AC/DC	60 V AC/DC	60 V AC/DC
			PUR	PUR
			Green	Green
	4×0.75 mm²	4×0.75 mm²	4×22 AWG	4×22 AWG
	IP 67	IP 67	IP 68	IP 68/IP 20
	–25...+85 °C	–25...+85 °C	–20...+60 °C	–20...+60 °C
	BCC03WZ	**BCC03Y0**		
	BCC M474-0000-2D-000-51X475-000	BCC M484-0000-2D-000-51X475-000		
			BCC04K1	**BCC04K7**
			BCC M414-M414-6D-331-PS54T2-020	BCC M414-E834-8G-668-PS54T2-020
			BCC04K2	**BCC04K8**
			BCC M414-M414-6D-331-PS54T2-050	BCC M414-E834-8G-668-PS54T2-050
			BCC04K3	**BCC04K9**
			BCC M414-M414-6D-331-PS54T2-100	BCC M414-E834-8G-668-PS54T2-100
			BCC04KH	**BCC04ZJ**
			BCC M414-M414-60-331-PS54T2-150	BCC M414-E834-8G-668-PS54T2-150
			BCC04K4	**BCC04KA**
			BCC M414-M414-6D-331-PS54T2-200	BCC M414-E834-8G-668-PS54T2-200



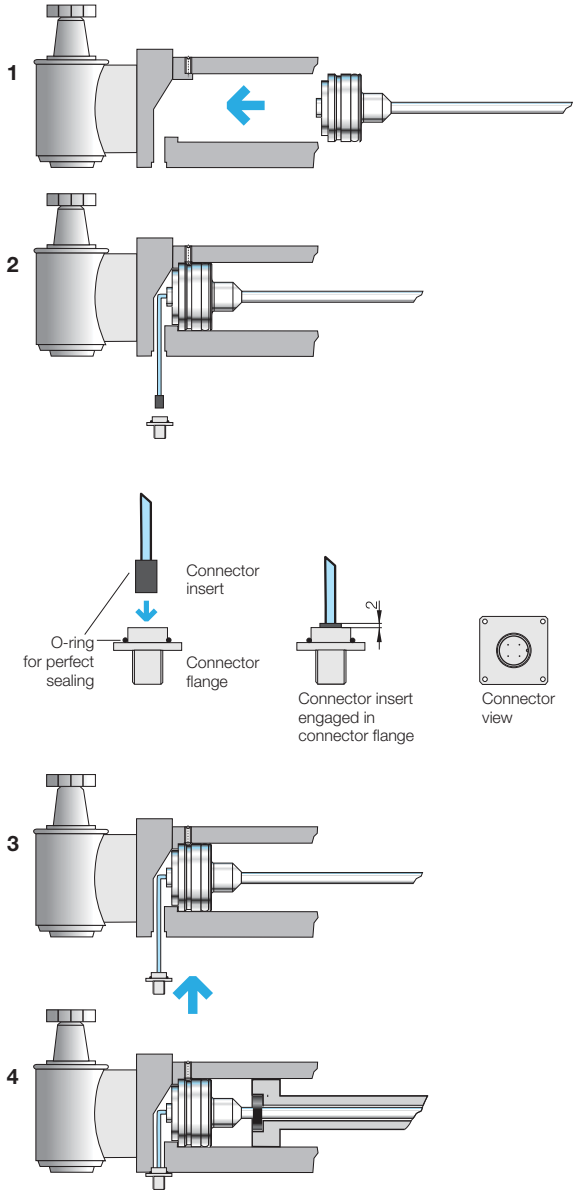






"Pigtail" connector system, 4-pin ZA0N and ZA0B for BTL6-…E2/E28…

A simple "click" and the IP67 plug-in connector is ready
Push the position measurement system Micropulse AR into the hydraulic cylinder. Insert the connector insert into the connector flange (1), let it click (2), secure the connector flange (3), and the IP-67 connector (4) is ready.

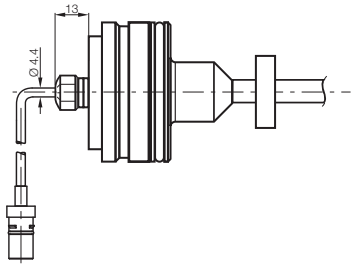


Series		
…**KA** 00,20-**ZA0_**	PUR cable 0.2 m	Connector system for transducers with cable outlet
…**KA** 00,30-**ZA0_**	PUR cable 0.3 m	
…**LA** 00,07-**ZA0_**	Stranded wire 0.07 m	Connector system for transducers with stranded wire output
…**LA** 00,15-**ZA0_**	Stranded wire 0.15 m	
…**LA** 00,20-**ZA0_**	Stranded wire 0.20 m	
…**LA** 00,30-**ZA0_**	Stranded wire 0.30 m	

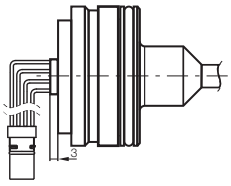
Pin	-ZA0N	-ZA0R
1	10...30 V	
2	not assigned [1]	Output signal
3	GND [2]	
4	Output signal	not assigned [1]
		Pin assignment (top view of the plug), 4-pin round plug M12

[1] Unassigned wires can be connected with GND by the controller, but not with the shielding.
[2] Reference potential for supply voltage and EMC GND.

Connector system with cable outlet -KA-



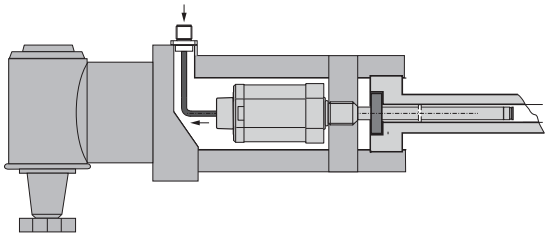
Connector system with stranded wire output -LA-

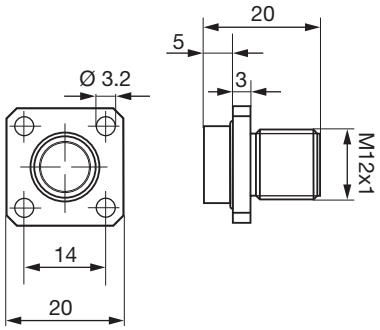


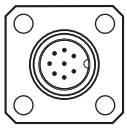
"Pigtail" connector system, 8-pin
ZA10 and ZA15 for BTL6 rod design H, K, W, A, Z, Y

Series ZA10
Housing: Nickel-plated brass
BTL_-…-___-KA00,20-ZA10, PUR cable 0.2 m
BTL_-…-___-KA00,30-ZA10, PUR cable 0.3 m

Series ZA15
Housing: Stainless steel 1.4404
BTL_-…-KA00,20-ZA15, PUR cable 0.2 m
BTL_-…-KA00,30-ZA15, PUR cable 0.3 m







Pin assignment S115 Standard,
see detailed user's guide.

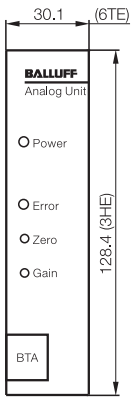
Mating connector
Page 244

Analog evaluation units

Features

- The evaluation units are configured in a Eurocard format for use in 19" racks and card holders / top-hat rail fitting.
- The measured values are updated at a frequency of max. 2 kHz, so that the current position can be captured with negligible lag even at high speeds.
- High resolution (down to 0.01 mm) provided by microcontroller-controlled digitizing.
- Data format can be switched between binary, BCD or gray (only BTM-H) in parallel.
- SSI data format (only BTM-H).
- Interference-free data transmission between evaluation unit and transducer provided by RS485/422 differential drivers, with cable lengths up to 500 m.
- Error output immediately reports a cable break, defect or missing Magnet.

Series		**BTA-A**
Output signal	Travel signal	Analog
	velocity	Analog
Input interface (transducer)		**P**
Part number		BTA-A1_-_ _ _ _
Features		Resolution 0.1 mV/0.2 µA, LED function indicator, Zero point adjustment 15%, Span adjustment 15%, Velocity output, Error output (relay)
Transducer nominal stroke		50...5500 mm
Design		Edge connector, 32-pin, DIN 41612 F, 19" plug-in card
Supply voltage		20...28 V DC
Current consumption		130 mA at 24 V DC
Operating temperature		0...60 °C
Update time for standard		1 kHz
Interface		Analog voltage
Output signals	Displacement signals	0...10 V and 10...0 V
	Velocity	±10 V at ±2.5 m/s
Accessories (please order separately)		Card holder 48-pin Form F/627164



Micropulse analog evaluation unit
Please enter code for output signal and nominal stroke in the part number.

Micropulse digital evaluation unit
Please enter code for output signal and nominal stroke in the part number.

Ordering example:

BTA-A1_-_ _ _

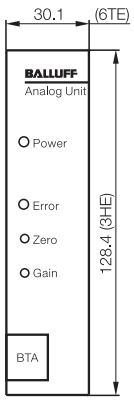
Output signal

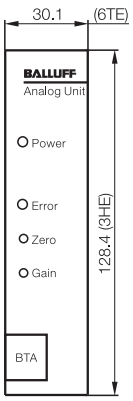
0 Rising (for C and E) only for current output
7 Falling (for C and E) only for current output
1 Rising/falling only for voltage output

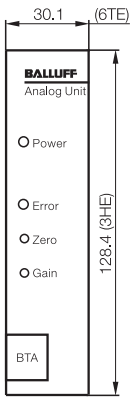
Nominal stroke

Transducer in [mm]

	BTA-C	BTA-E	BTA-G
	Analog	Analog	Analog
	Analog	Analog	Analog
	P	**P**	**P**
	BTA-C1_-_ _ _ _	BTA-E1_-_ _ _ _	BTA-G1_-_ _ _ _
	Resolution 0.1 mV/0.2 µA, LED function indicator, Zero point adjustment 15%, Span adjust 15%, Velocity output, Error output (relay)	Resolution 0.1 mV/0.2 µA, LED function indicator, Zero point adjustment 15%, Span adjust 15%, Velocity output, Error output (relay)	Resolution 0.1 mV/0.2 µA, LED function indicator, Zero point adjustment 15%, Span adjustment 15%, Velocity output, Error output (relay)
	50...5500 mm	50...5500 mm	50...5500 mm
	Edge connector, 32-pin, DIN 41612 F, 19" plug-in card	Edge connector, 32-pin, DIN 41612 F, 19" plug-in card	Edge connector, 32-pin, DIN 41612 F, 19" plug-in card
	20...28 V DC	20...28 V DC	20...28 V DC
	130 mA at 24 V DC	130 mA at 24 V DC	130 mA at 24 V DC
	0...60 °C	0...60 °C	0...60 °C
	1 kHz	1 kHz	1 kHz
	Analog voltage, current	Analog voltage, current	Analog voltage
	0...10 V and 10...0 V, 0...20 mA	0...10 V and 10...0 V, 4...20 mA	–10...+10 V and +10...–10 V
	±10 V at ±2.5 m/s	±10 V at ±2.5 m/s	±10 V at ±2.5 m/s
	Card holder 48-pin Form F/627164	Card holder 48-pin Form F/627164	Card holder 48-pin Form F/627164





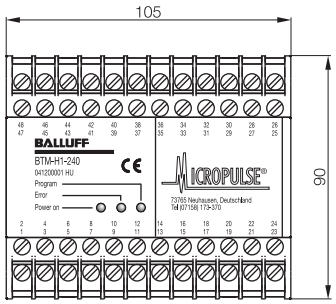


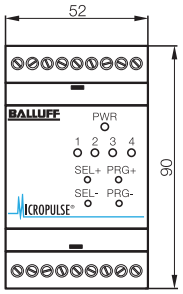
Analog and digital evaluation units

Series		BTM-H1	BTM-_1
Output signal	Travel signal	digital	Analog
	velocity		Analog
Input interface (transducer)		**P**	**P**
Part number		BTM-H1_-_ _ _	BTM-_1_-_ _ _
Features		Resolution of 0.01 mm, 0.025 mm, 0.1 mm, 1 mm, BCD, binary, Gray code, zero point adjustment, direction signal, DATA READY, min./max. programming, ENABLE, DATA HOLD, bus-compatible, Error output. Replaces evaluation units: BTA-D, BTA-H, BTA-P	16-bit resolution Up to 4 magnets on a single transducer can be processed individually. Analog velocity output. 100% programmable measuring range, error output
Transducer nominal stroke		50...5500 mm	25...4000 mm
Design		Plastic housing for mounting on standard top-hat rail EN 50022-35	Plastic housing for mounting on standard top-hat rail EN 50022-35
Supply voltage		20...28 V DC	20...28 V DC
Current consumption		Max. 500 mA	Max. 300 mA
Operating temperature		0...60 °C	0...70 °C
Update time for standard		2 kHz	2 kHz
Interface		Digital 22-bit parallel BCD, binary, Gray code, 24-bit synchronous serial (SSI) Gray code	Analog, voltage or current see Ordering code
Output signals	Travel signals	Digital TTL 5 V DC (BTM-H1-340) PNP source driver, 24 V DC (BTM-H1-240)	Analog, voltage or current see ordering code
	velocity		Analog ±10 V programmed to 1000 mm/s, adjustable over a range of 50 mm/s...10 m/s
Accessories (please order separately)			

Micropulse digital evaluation unit
Please enter code for output signal and nominal stroke in the part number.

Micropulse analog module
Please enter code for output signal and version in the part number.





Ordering examples:

BTM-H1-_ _ _

Output driver

240	Source driver (PNP with short circuit protection 10...30 V) and 24-bit synchronous serial data transmission (SSI)
340	Tri-state TTL output and 24-bit synchronous serial-data transmission (SSI)

BTM-_1-_ _ _

Output signal | **Versions**

A	0...10 V, 10...0 V –10...10 V, 10...–10 V	101	1 analog output, 1 magnet
E	4...20 mA, 20...4 mA 0...20 mA, 20...0 mA	102	2 analog outputs, 2 magnets
		103	3 analog outputs, 3 magnets
		104	4 analog outputs, 4 magnets

BTM-_1-102-VM1000

Output signal | **Versions** | **Speed**

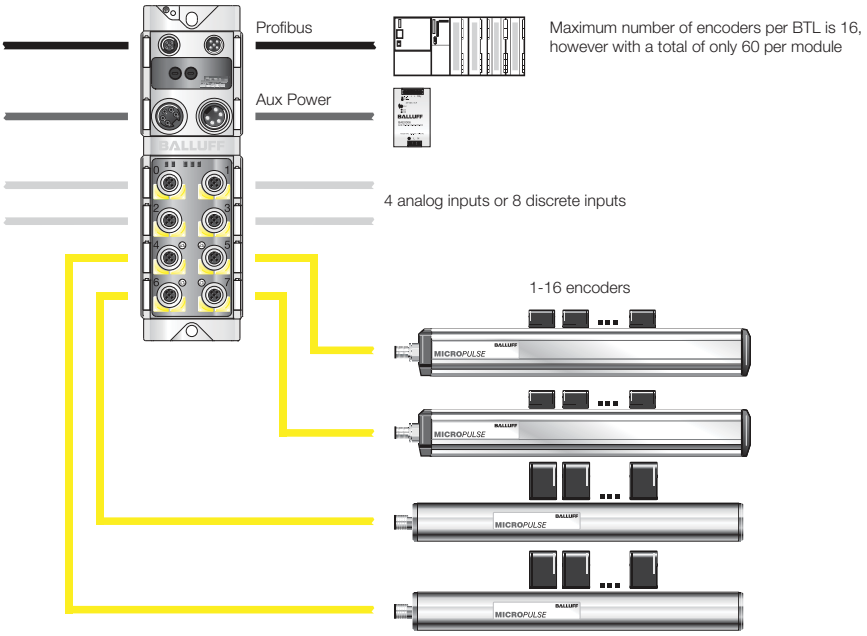
A	0...10 V, 10...0 V –10...10 V, 10...–10 V	1	Analog output	±10 V at a speed of 1000 mm/s
E	4...20 mA, 20...4 mA 0...20 mA, 20...0 mA	2	Magnet with speed	

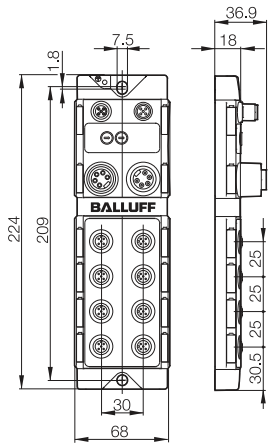
Profibus modules P111 for BTL

Digital inputs

Analog inputs

Fieldbus	Profibus	Profibus
Design	4× P111 or M1	4× P111 or M1
Ordering code	**BNI001A**	**BNI002H**
Part number	BNI-PBS-551-000-Z001	BNI-PBS-552-000-Z001
Supply voltage U_S	18...30 V DC	18...30 V DC
Connection: Fieldbus	M12, B-coded	M12, B-coded
Supply voltage connection	7/8", 5-pin, female and male	7/8", 5-pin, female and male
Connection: I/O ports	M12, A-coded, 5-pin, female	M12, A-coded, 5-pin, female
Connection: P111 port	M12, A-coded, 8-pin, female	M12, A-coded, 8-pin, female
No. of I/O ports	8	8
No. of digital inputs	8	
No. of analog inputs		4
No. of P111 inputs	4	4
Max. load current for sensors/channel	1 A	1 A
Total current U_{Sensor}	9 A	9 A
Degree of protection as per IEC 60529	IP 67 (when screwed into place)	IP 67 (when screwed into place)
Operating temperature T_a	0...+55 °C	0...+55 °C
Dimensions (L×W×H)	224×68×36.9	224×68×36.9
Housing material	Nickel-plated GD-Zn, matt finish	Nickel-plated GD-Zn, matt finish

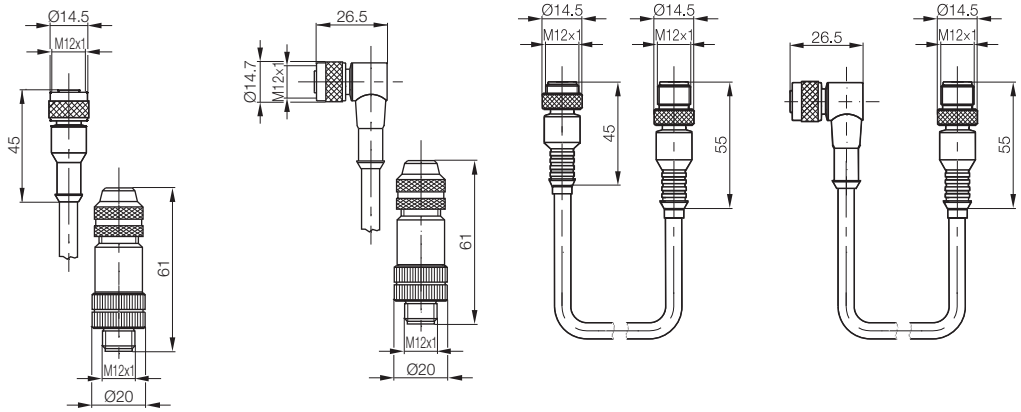




Profibus modules P111 for BTL

Design	8-pin, female	8-pin, female	8-pin, pin, female	8-pin, pin, female
Use	8-pin, pin for Profibus modules BNI-PBS 0-3 BTL	8-pin, pin for Profibus modules BNI-PBS 0-3 BTL	for Profibus modules BNI-PBS 0-3 BTL	for Profibus modules BNI-PBS 0-3 BTL
Part number	BIS Z-501-PU1-_ _/E	BIS Z-502-PU1-_ _/E	BIS Z-501-PU1-_ _/M	BIS Z-502-PU1-_ _/M
Connector	M12	M12	M12	M12
Cable diameter	6.9 mm	6.9 mm	6.9 mm	6.9 mm
Degree of protection* as per IEC 60529	IP 67 when attached	IP 67 when attached	IP 67	IP 67
Number of conductors × conductor cross-section	8×0.25 mm²	8×0.25 mm²	8×0.25 mm²	8×0.25 mm²
Ambient temperature range	–40...+85 °C	–40...+85 °C	–40...+85 °C	–40...+85 °C
Plug in M12 pin scope of delivery	BKS-S117-00	BKS-S117-00		
Cable	One end molded-in, other end pigtailed	One end molded-in, other end pigtailed	Both ends molded-on	Both ends molded-on

* When plugged in



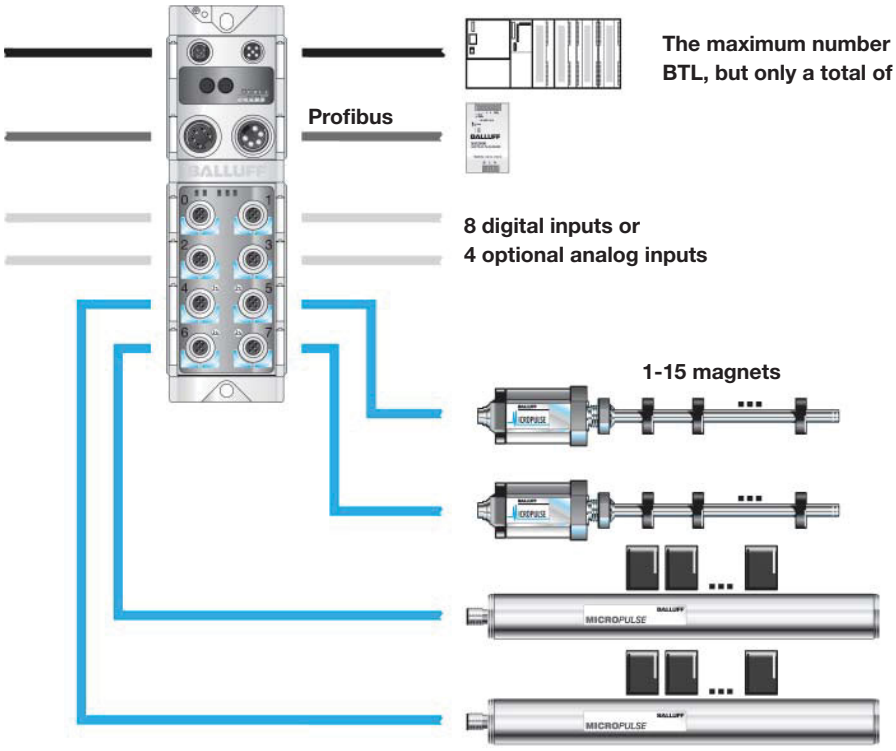
Please include the cable length with the part number:

0,5	=	Length	5 m
10	=	Length	10 m
20	=	Length	20 m
25	=	Length	25 m
50	=	Length	50 m

Please include the cable length with the part number:

00,5	=	Length	0.5 m
01	=	Length	1 m
02	=	Length	2 m
05	=	Length	5 m

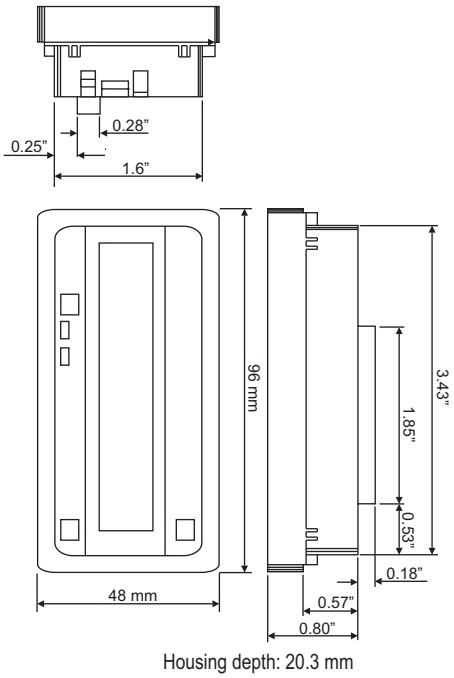
Profibus modules P111 for BTL



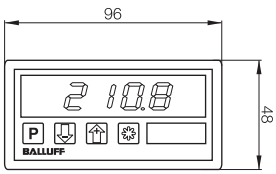
The maximum number of magnets is 16 per BTL, but only a total of 60 per module

Series	**BDD 640**	**BDD 640**	**BDD 640**	**BDD-UM 3023**
	Digital display for analog input signals	Digital display for analog input signals	Digital display for analog input signals	Digital display for analog input signals
	Voltage / current	Voltage / current	Voltage / current	Voltage / current
Part number	BDD 640-R3A-0-00-E-00	BDD 644-R3A-0-54-E-00	BDD 645-R3A-5-53-E-00	BDD-UM 3023
■ Features	■ 16-bit analog input ■ 5-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Programmable decimal point ■ Voltage input: 0-10Vdc ■ Current input of 0-20 mA or 4-20 mA ■ 67 ms update rate ■ Scalable display range ■ Input power: +24 Vdc ±20% ■ 1/8 DIN housing, panel mountable	■ 16-bit analog input ■ 4 programmable PNP outputs ■ 5-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Programmable decimal point ■ Voltage input: 0-10Vdc ■ Current input of 0-20 mA or 4-20 mA ■ 67 ms update rate ■ Scalable display range ■ Input power: +24 Vdc ±20% ■ 1/8 DIN housing, panel mountable	■ 16-bit analog input ■ 2 programmable PNP outputs ■ 16-bit analog output (0-10 Vdc or 4-20 mA), fully scalable ■ 5-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Programmable decimal point ■ Voltage input: 0-10Vdc ■ Current input of 0-20 mA or 4-20 mA ■ 67 ms update rate ■ Scalable display range ■ Input power: +24 Vdc ±20% ■ 1/8 DIN housing, panel mountable	■ 12-bit analog input ■ 4-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Programmable decimal point ■ Voltage input of 0-10 Vdc ■ Current input: 0-20 mA or 4-20 mA ■ Scalable display range ■ Input power: +24 Vdc ±20% ■ 200 ms update rate

Shown with optional NEMA 4X IP65 enclosure
part number BDD Z-001

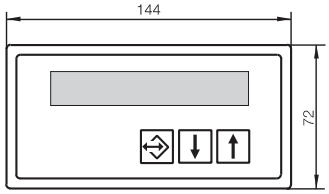


Housing depth: 20.3 mm

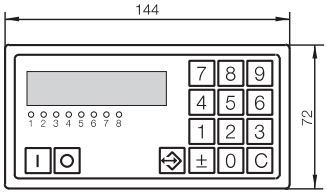


Housing depth 55.5 mm

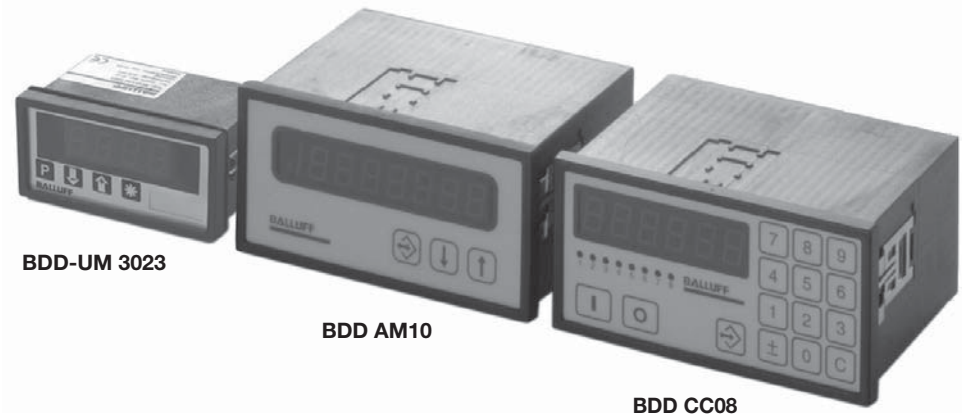
	BDD AM10	**BDD AM10**	**BDD CC08**	**BDD CC08**
	Digital display for START/STOP interface	Digital display for Synchronous Serial Interface (SSI)	CAM controller for START/STOP interface	CAM controller for Synchronous Serial Interface (SSI)
	BTL5/BTL6/BTL7 P-interface	BTL5/BTL7 SSI interface	BTL5/BTL7 P-interface	BTL5/BTL7 SSI interface
	BDD-AM 10-1-P	BDD-AM 10-1-SSD	BDD-CC 08-1-P	BDD-CC 08-1-SSD
	■ 7 1/2-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Scalable measured values ■ Programmable decimal point ■ Adjustable zero point ■ Input power: 10-32 Vdc ■ 2 programmable setpoint outputs ■ 1 configurable input ■ Insulated DIN housing, panel mountable (mounting clamps included)	■ 7 1/2-digit display w/sign ■ LED display, 14 mm-high, red 7-segment digits ■ Scalable measured values ■ Programmable decimal point ■ Adjustable zero point ■ Input power: 10-32 Vdc ■ 2 programmable setpoint outputs ■ 1 configurable input ■ Insulated DIN housing, panel mountable (mounting clamps included)	■ 8 programmable outputs ■ 8 directional switching points ■ 6 digit display w/sign ■ LED display, 14-mm high red 7-segment digits ■ Switching points can be monitored using the LEDs on front panel ■ 300 switching points can be distributed over 15 programs ■ Dynamic dead time compensation for each individual switching point ■ Multiple BDD-CC 08 units can be wired in parallel ■ Input power: 10-32 Vdc ■ Integrated transducer supply voltage 300 mA, 24 Vdc ■ Insulated DIN housing, panel mountable (mounting clamps included)	■ 8 programmable outputs ■ 8 directional switching points possible ■ 6 digit display w/sign ■ LED display, 14-mm high red 7-segment digits ■ Switching points can be monitored using the LEDs on front panel ■ 300 switching points can be distributed over 15 programs ■ Dynamic dead time compensation for each individual switching point ■ Multiple BDD-CC 08 units can be wired in parallel ■ Input power: 10-32 Vdc ■ Integrated transducer supply voltage 300 mA, 24 Vdc ■ Insulated DIN housing, panel mountable (mounting clamps included)



Housing depth 110 mm

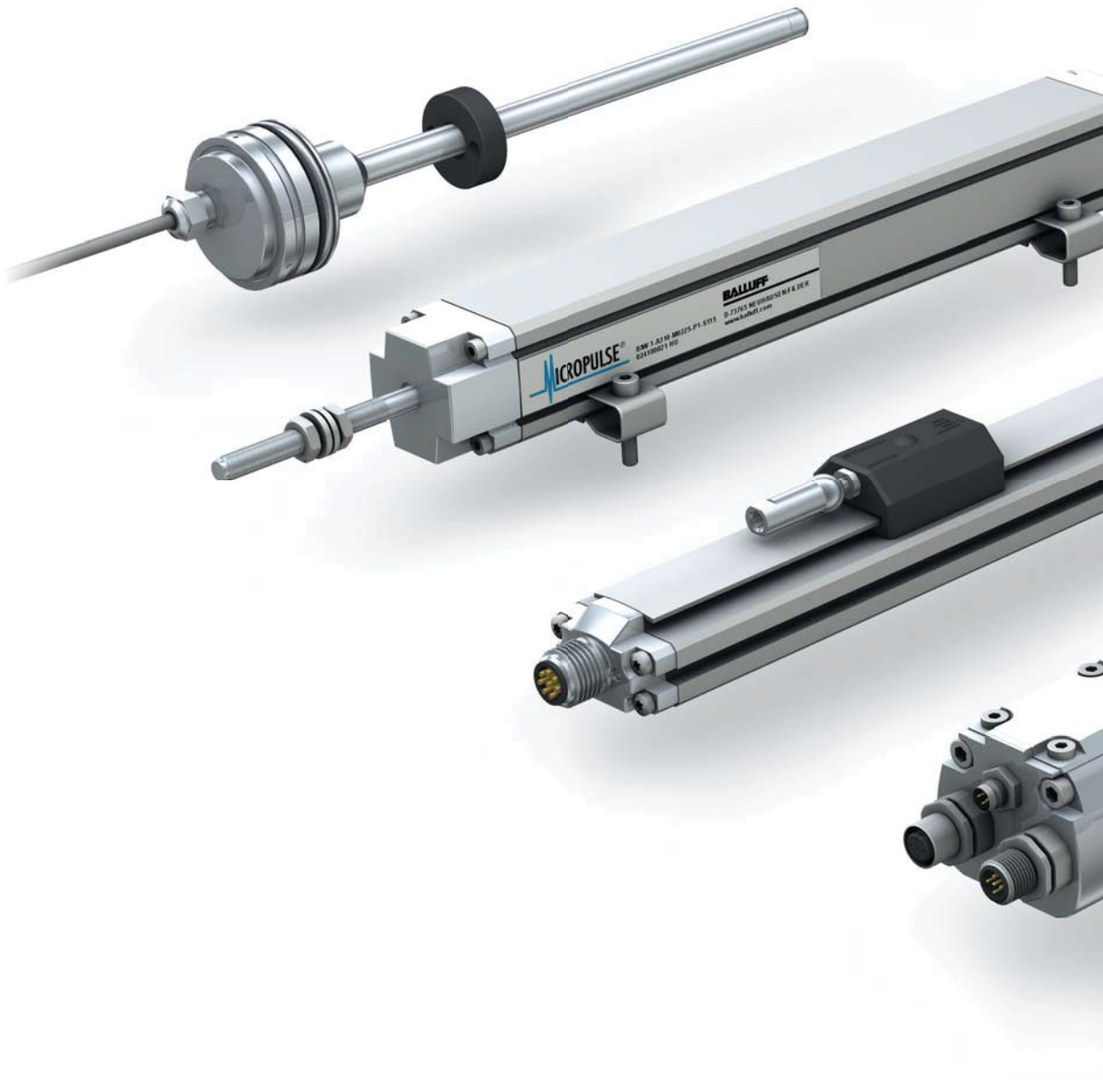


Housing depth 110 mm

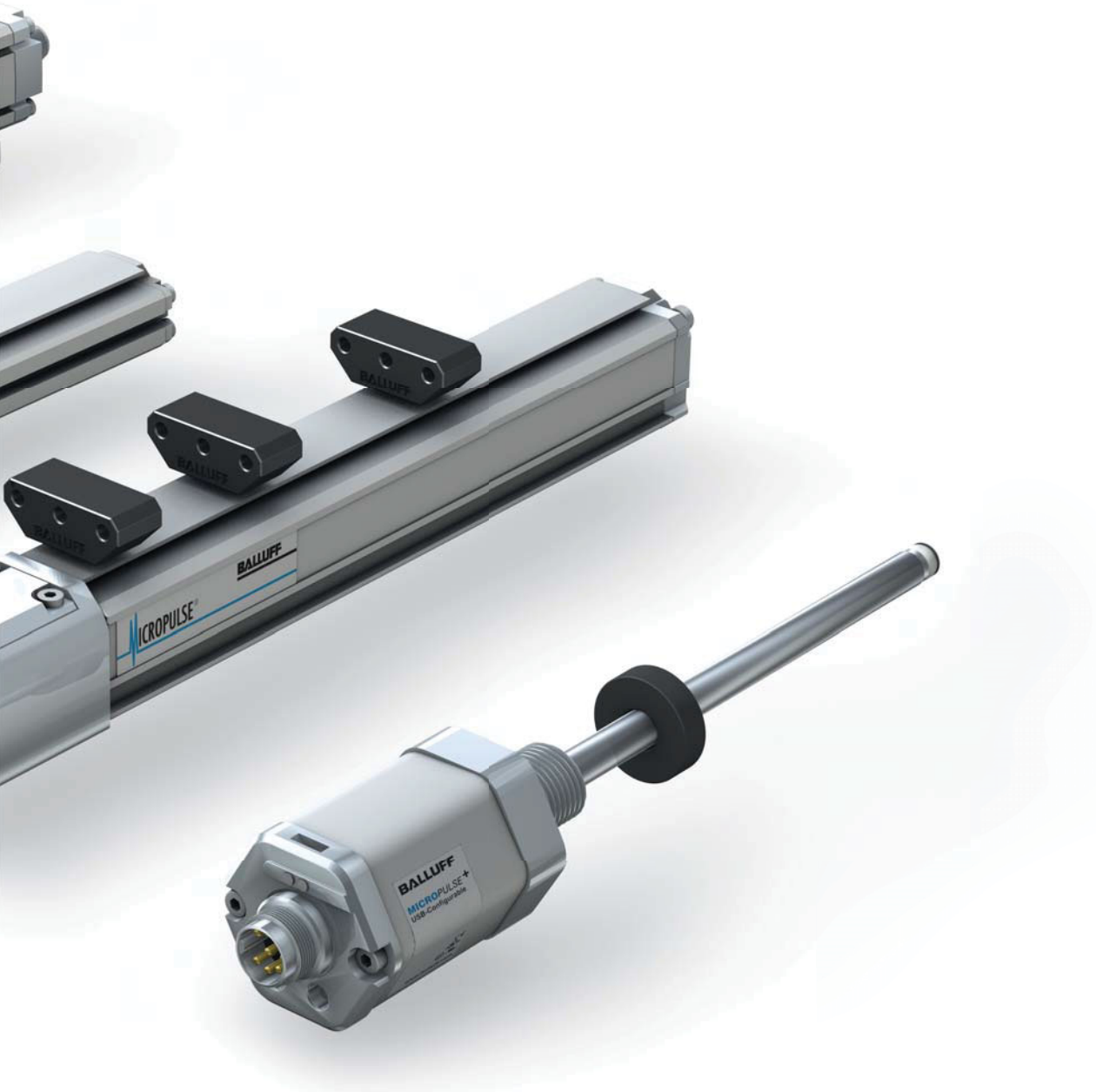


Micropulse Transducers
Profile P
Profile PF
Profile AT
Profile BIW
Rod
Rod Compact and Rod AR
Rod EX, T Redundant and CD
Filling Level Sensor SF
Accessories
Connectors
"Pigtail" Connector System
Evaluation Units
Profibus Modules P111
Digital Display CAM Controller
Basic Information and Definitions

Micropulse Transducers



Basic Information and Definitions
Contents



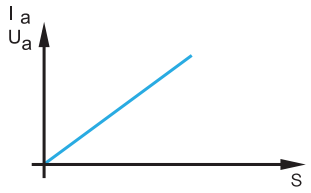
Definitions

Output signal, characteristic curve, resolution, sensitivity

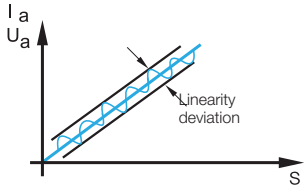
The characteristic curve describes the relationship between the output signal and the input signal. The slope of the curve represents the sensitivity of the device.
The sensitivity (resolution) is the quotient of the input signal change and the change in the output signal. On Micropulse transducers, the input signal change is the change in the position of the magnet and the output signal change is the change in the electrical output signal.

Linearity

A measuring device has a linear characteristic curve and a constant sensitivity when the relationship between the input and output variable is represented by a straight line (linear function). Linear scales are assumed for the X and Y-axes. A characteristic curve is not linear if it is not a straight line.



Linear function



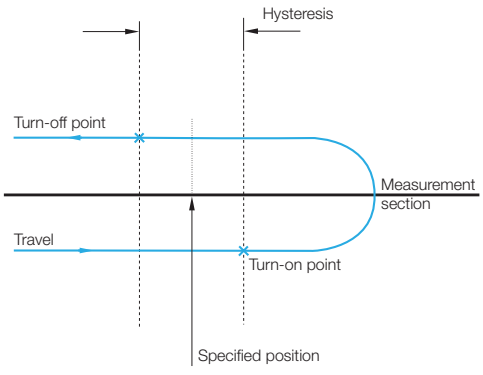
Linearity deviation from a linear function

Linearity deviation

A linearity deviation is the maximum deviation from a straight line that connects the zero point of a measuring range with the end point (full scale). There is a linear relationship between the position or path to be measured and the output signal for a voltage, current or digitized output information. The linearity characteristic curve of magnetostrictive transducers does not change during the life of the system. The curve, however, can be corrected.

Hysteresis

Hysteresis is the signal difference resulting when arriving at a certain position, traveling beyond it and then returning to this position from the other direction.

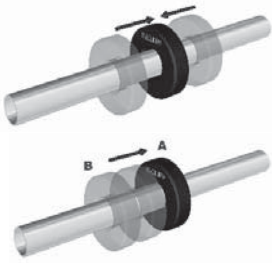


Reproducibility

Reproducibility is moving to a certain position from different directions. Reproducibility is the sum of the hysteresis and the resolution.

Repeat accuracy

Repeat accuracy is the value resulting when moving to the same position from the same direction under unchanging ambient conditions.



SYNC mode

The absolute positioning information of the position measuring system is determined and transmitted synchronously to the read cycle of the electronic evaluation unit, e.g. an axis controller or a regulating controller.

Incremental

After the system is switched on, the measured value currently available is not defined. A reference run to a defined point, a reference point, is necessary in order to obtain a position value. The position value is calculated by adding or subtracting individual, equal increments from the reference point.

Absolute

The measured value for the current position is available immediately after the system is switched on. An absolute coded digital signal or an analog value is assigned to each position, e.g. along a measurement section. A reference run is not required.

Temperature coefficient, formula

The temperature coefficient is the relative change of a physical variable with changing temperature. The temperature dependency of variable y can be approximated at least for a limited temperature range by using temperature coefficient α with linear relationship $y = y0\ (1 + \alpha \times \Delta T)$.

Temperature coefficient

The temperature coefficient indicates the relative change in length as temperature changes. This means that temperature factors change the output value by the indicated amount.

Zero point

The zero point is the position with the lowest output value along the measuring range. The zero point can be set by the user for some transducer models. The zero point must lie within the measuring range.

Sampling rate

The sampling rate is the frequency at which the output information is updated. It can be the same as the number of measurements per second. A high sampling rate for rapidly changing positions is important if a process is time-critical.

Rated length

The rated length is the usable area, i.e. the available path/length measurement range (also see the characteristic curve). The rated length is always shorter than the overall length of the transducer.

Damping zone

The damping zone is the area in which the second (undesired) magnetostrictive wave is damped. This area is always outside of the measuring range. Depending on the transducer model, either an erroneous output signal or an error signal will be output if the magnet is allowed to travel into this zone, which must not be considered valid information.

Definitions

Intrinsically safe "i"
Coding "Ex i"

A circuit is intrinsically safe if it does not permit a spark or thermal effect that could ignite an explosive atmosphere as defined by Group IIA, IIB or IIC, whereby the test conditions prescribed in the standard must be applied. The test conditions take into account normal operation and certain fault conditions.
The implementation of intrinsically safe circuits results in certain restrictions pertaining to the selection of components for electrical and electronic circuits.
In addition, the permissible load on the components as compared with normal industrial applications must be reduced:

- **for the voltage in terms of electrical stability, and**
- **for the current in terms of heating**

Flameproof encapsulation "d"
Coding "Ex d"

Parts that could ignite a potentially explosive atmosphere must be housed in an enclosure:

- **that can withstand the pressure resulting from the explosion of an explosive mixture inside the housing, and**
- **that prevents the internal explosion from igniting the potentially explosive atmosphere surrounding the housing.**

Non-incendive "n"
Coding "Ex n"

Devices in this category are intended for use in areas where an explosive atmosphere is not expected. Even if the atmosphere were to become explosive, in all probability it would be infrequent and only for a short period of time.
A manufacturer's certificate is provided, confirming that the product satisfies requirements for the use of electrical equipment in potentially explosive areas according to EN 60079-15.
This designation combines multiple methods of ignition protection.

e1 type approval

e1 type approval is granted by the German Federal Motor Transport Authority (KBA) and confirms that special motor vehicle standards have been maintained.
The devices may be mounted on vehicles that travel on public roads. The standards describe EMC conditions under which the devices must operate without failure. e1 approved Micropulse transducers are indicated by "-SA265-" in the part designation.

FDA

The FDA (Food and Drug Administration) oversees the U.S. food and drug industries and certifies devices, materials as well as systems in these industries. A product designation of this kind makes your system eligible for FDA approval.

Filling level sensor

The magnetostrictive working principle is also ideal for the continuous high-precision measurement of fluid filling levels. The measuring section and electronic evaluation unit are enclosed inside a housing made from stainless steel. Stainless steel floats with permanent integrated magnets mark the current filling level in the tank or vessel. The design of the sensors meets international hygiene standards.

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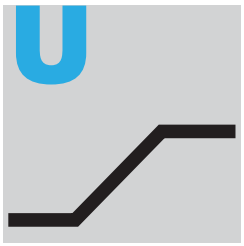
FDA

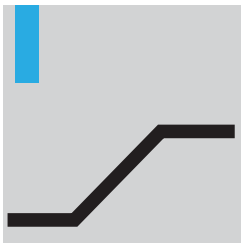
ECOLAB

LISTED

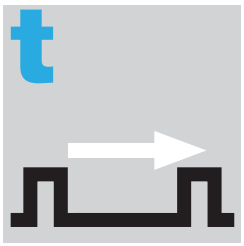
MICROPULSE®



Analog
voltage output
The output voltage is directly proportional to the position of the magnet along the measurement section.
The most important parameter for analog outputs is the refresh rate and residual ripple of the output signal.
Many transducers on the market attain the specified values for output ripple only by means of low-pass filtering. This always carries with it an undesirable time delay of the output signal.
Micropulse transducers attain the specified signal quality without low-pass filters, instead using an improved circuit design. This means fast update times with low levels of ripple and noise in the output signal.
Micropulse transducers with voltage output have 2 outputs, one rising characteristic and one falling.
Versions can be provided with 0...10 V (10...0 V) and –10...10 V (10...–10 V).



Analog
current output
The output current is directly proportional to the position of the magnet along the measurement section.
Analog current interfaces of 0...20 mA and 4...20 mA are standard in numerous applications and in many industries. Current interfaces are substantially less sensitive than analog voltage interfaces with respect to scattered interference voltages. A 500 Ω resistor can be used to convert the 0...20 mA signal into a voltage of 0...10 V. The 4...20 mA signal provides a simple form of cable break monitoring, since a current of 4 mA has to flow even at the measuring range zero point.
Micropulse transducers with current output are available with rising or falling signals.

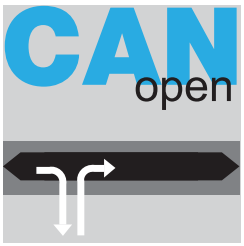


Pulse interface

The time between a query and reply signal is directly proportional to the position of the magnet along the measuring section.
These pulses are transmitted using RS485/422 differential line drivers, guaranteeing noise-free signal transmission over distances of up to 500 m.
The great advantage of these interfaces is noise-free signal transmission using a simple and economical interface. Interfaces with tristate outputs allow multiplexing of several Micropulse transducers.
Appropriate control cards are available.

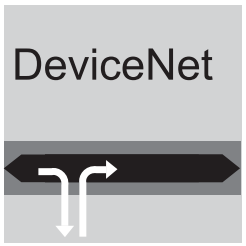
Synchronous serial interface (SSI)

The position of the magnet along the measurement section is sent to the controller serially in a data word. Micropulse transducers with an SSI interface can be connected directly to controllers or to axis control cards with an SSI interface. The transmission of data from the sensor to the controller is synchronized by the controller's clock. Transducers with 16, 24 or 25-bit data words are available depending on the required resolution. The ±30 µm maximum linearity deviation of the SSI Micropulse transducer over the entire length, the max. 5 kHz update frequency and a resolution of 1 µm make SSI Micropulse transducers an ideal feedback sensor – even in the most demanding positioning and control applications.



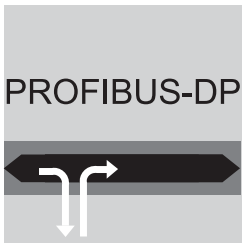
CANopen

The position of the magnet along the measuring section is sent over the CAN bus to the controller in what are known as **P**rocess **D**ata **O**bjects or PDOs. Micropulse transducers work with standard CANopen protocols as per CiA DS 301 and with the standard device profile as per DS406. CANopen offers greater flexibility because of the large number of configuration options for the transducer. For example, the resolution is programmable for 5, 10, 20 or 100 µm – depending on your application. Alternatively you can select whether both position and velocity information is to be sent to your controller. Cyclically or on-demand. And there's more: Up to 4 so-called software cams can be defined in the active measuring range. Each status change to one of these cams is transmitted to the controller using high-priority emergency messages.



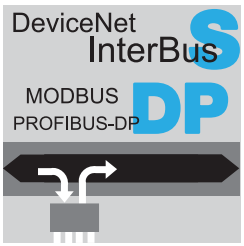
DeviceNet

DeviceNet is a fieldbus network that permits communication between basic sensors/ actuators as well as programmable logic controllers. Micropulse transducers transmit the absolute position and the velocity to the controller in the form of a 4-byte value with a maximum cycle time of 1 ms. The communication parameters and the objects available to the Micropulse transducer can be parameterized using the electronic device data sheet (EDS file).



Profibus DP

The **P**rocess **D**ata **U**nit sends position and velocity information for the transducer to the controller via the Profibus DP. Micropulse transducers operate according to EN 50170 and support the Profibus DP encoder profile and multi-magnet operation.
Micropulse transducers can be parameterized using the GSD file. The position resolution can be adjusted at 5 µm increments and the velocity resolution at 0.1 mm/s increments.
A zero point and working ranges can be configured individually for each magnet.



WAGO/Phoenix Contact BUS interface modules

One flexible way of connecting Micropulse transducers to various bus systems is to use interface modules available from WAGO and Phoenix Contact. These provide the option of transmitting the positioning information from several transducers through a single bus interface to the supervisory controller within a single bus cycle.
The resolution and zero point of the transducers with the pulse interface can be programmed using the respective bus interface. For further technical data and ordering bus interface modules, contact WAGO and Phoenix Contact.

VARAN bus

VARAN is an open, real time Ethernet bus system. Micropulse AT VARAN position measuring systems detect the movements of highly dynamic axes in complex applications.
The real time Ethernet system is extremely economical, easy to implement and simple to program. VARAN networks in combination with controllers, such as from Sigmatek, are widespread on the market.
VARAN is fully integrated in hardware and designed according to IEEE 802.3 for standard Ethernet physics.
The simple design guarantees extremely rapid cycle times while achieving maximum data security and reducing implementation costs.

IO-Link

IO-Link is a point-to-point connection within any network. An IO-Link system consists of an IO-Link device such as a sensor or actuator, an IO-Link master and wiring. The IO-Link master is either an integrated/modular IP 20 module for central operation in the control cabinet or as a remote IO module in IP 65/67 form of protection for tough applications directly in the field.
Master modules are available with all current field bus protocols. The Micropulse PF IO-Link device is coupled to the master via a maximum 20 m long standard sensor/actuator line. The Micropulse PF IO-Link works at COM3 communication speed (230kB), which can achieve a process data cycle of 1 ms with a 1.1 master.
Data transmission between the master and the device utilizes three-conductor physics well-known in the world of standard sensor/actuators. A standard UART protocol is used. The exact nature of the data packets defines the IO-Link protocol. Via IO-Link, the user interface can be mapped based on an IODD (IO Device Description) in the engineering system. Due to the continuous flow of information, all data is centrally and permanently saved, so that configuration is possible and reproducible at any time. More information about IO-Link: www.io-link.com.

EtherCAT

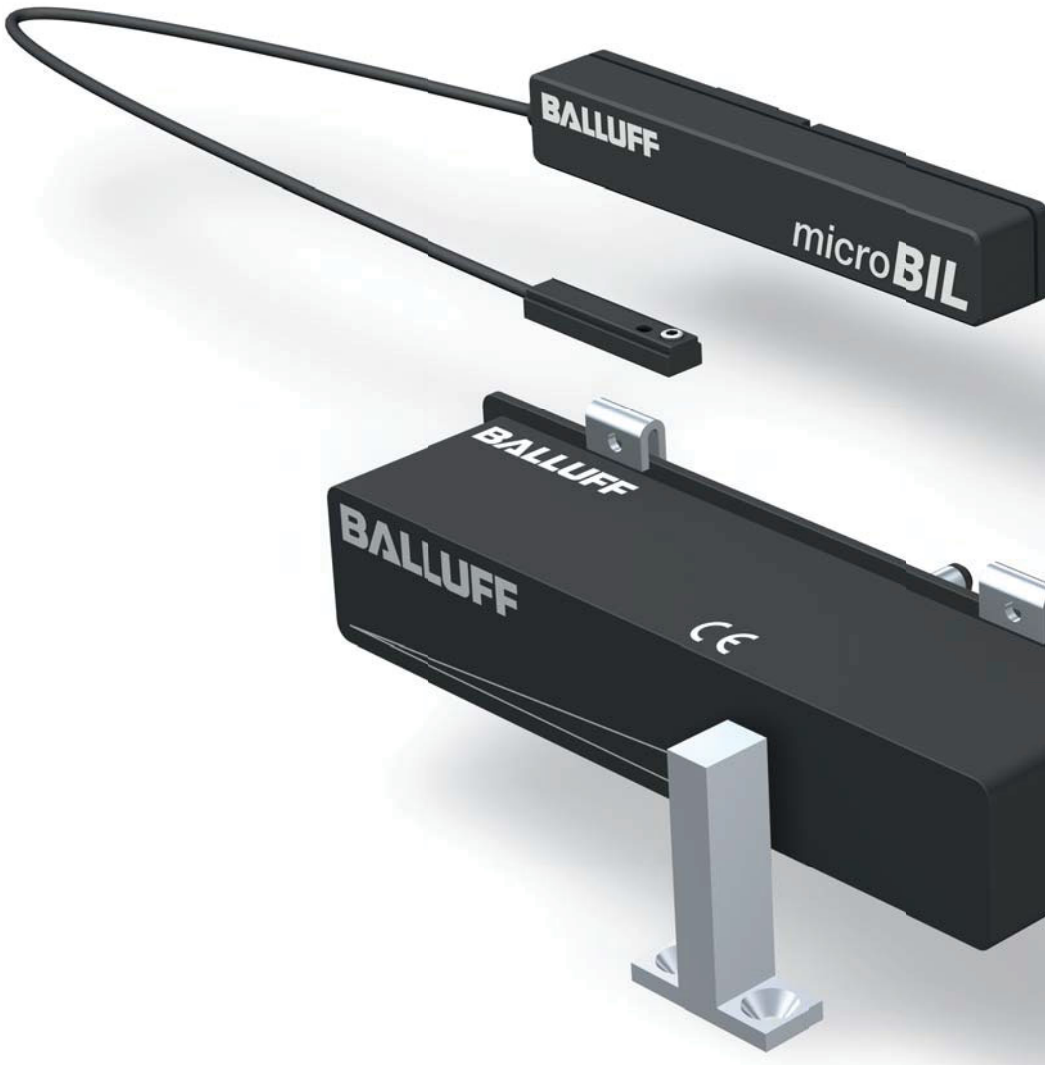
Micropulse position measuring systems with an EtherCAT interface are the ideal nodes in an EtherCAT network when dealing with controlling and positioning with precision down to the micrometer.
Multi-position capable up to 16 axes, path and speed, monitored working ranges with diagnostics: These characteristics are used in automation and drive technology.
EtherCAT is an Ethernet-based bus system. The protocol is disclosed as the IEC61188 type 12 (EtherCAT) IEC standard and is suitable for hard and soft real time requirements. The structure of the standard Ethernet frame sent by the master is structured according to IEEE 802.3.
EtherCAT slave devices take the data intended for them while the telegram goes through the device. Likewise, input data is inserted into the telegram as it goes through the device. This results in short cycle times that can be significantly below 100 µs, making them ideal for application areas in drive and automation technology. EtherCAT offers extensive diagnostic options with precise and quick error detection.

Inductive Position Sensors

Inductive position sensors are typically used in automation equipment and toolmaking wherever adjustment values and positions have to be monitored in very tight spaces.

These displacement sensors are perfect for use in situations where no contact, being able to provide absolute measurement and having a compact design are critical features.

The fully enclosed design achieves a IP 67 degree of protection and makes these sensors resistant to stresses related to shock and vibration.



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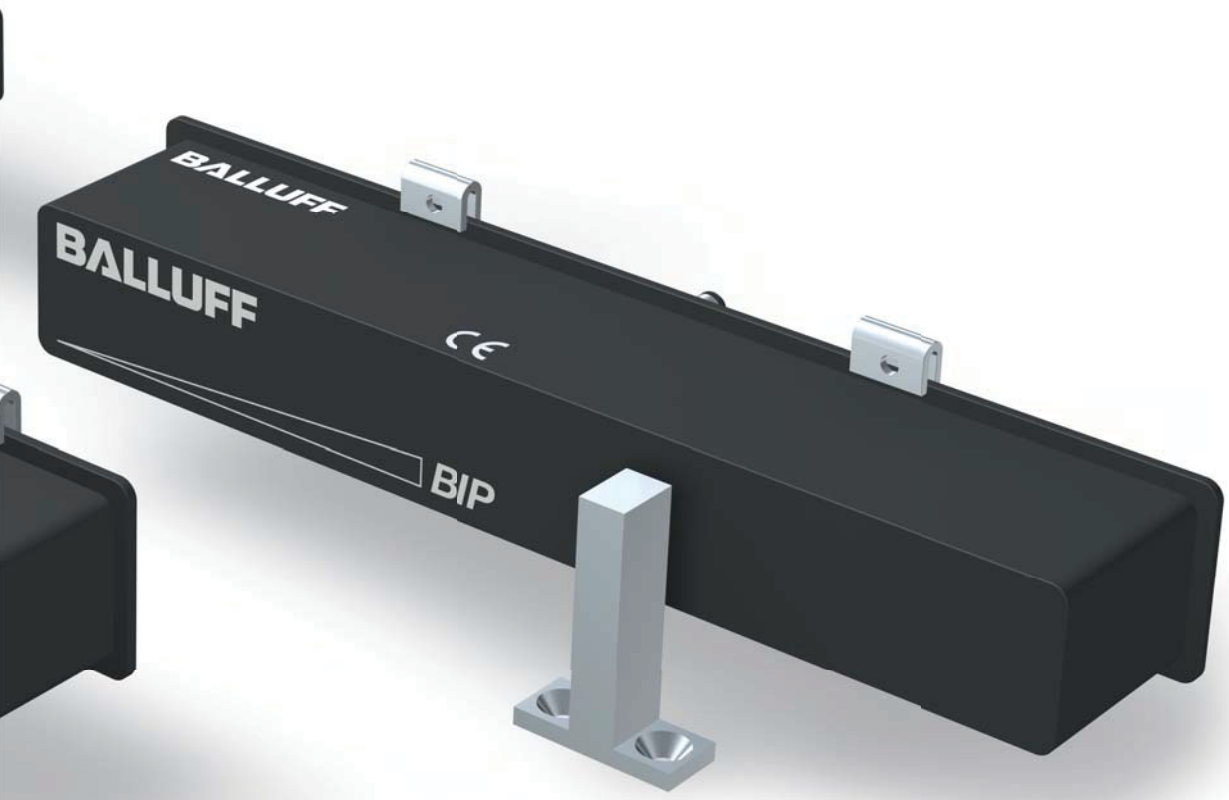
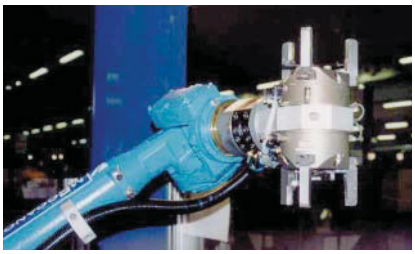


Basic information and definitions can be found on page 288.

Applications

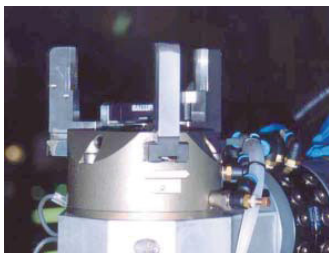
BIL

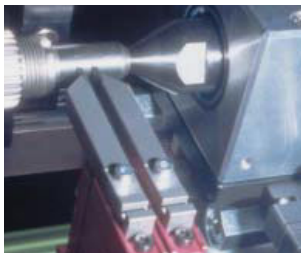
Balluff magneto-inductive position sensors provide absolute analog position feedback in stroke lengths up to 160 mm. Analog position sensors BIL measure **without contact and absolutely using a passive magnet**. The compact design means these sensors can be easily integrated into the application even when mounting space is extremely tight.



Micro-BIL

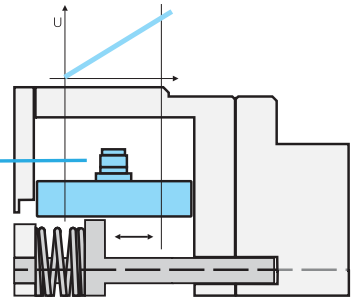
The Micro-BIL detects the absolute position on pneumatic miniature grippers or compact cylinders using integrated permanent magnets; the sensor element can be easily
installed in the T-slot. The analog output signal allows you to individually and flexibly detect end-of-travel and intermediate positions on gripper jaws or pistons.



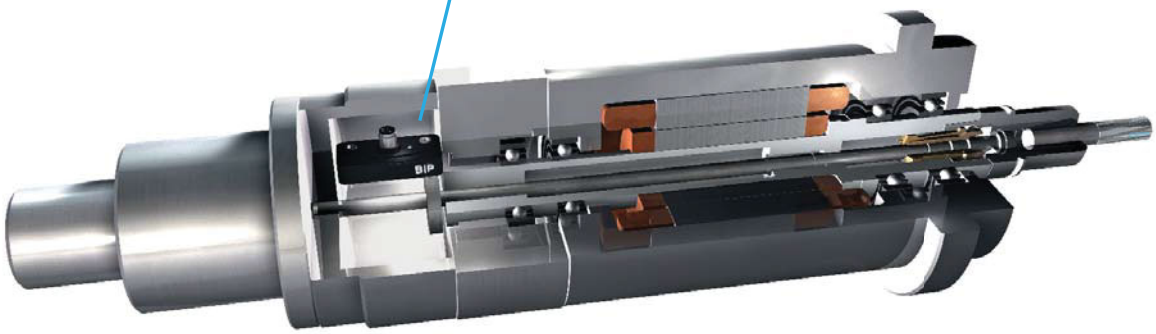


BIP
The inductive positioning sensor BIP is an accurate measuring system for detecting the position of metallic objects.

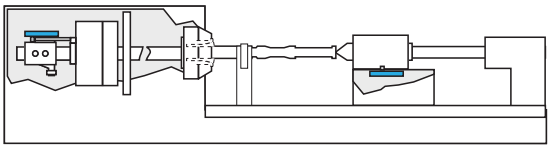
Applications
The main application area of the BIP is linear position monitoring of drive spindles and clamping devices for tools and workpieces.



The optimal sensor for monitoring clamping distance
Position sensor BIP in use at a drive spindle for tools



Applications
BIP position sensors are ideal for integrated production monitoring because their unmatched effective length ratio makes installation possible in even the most confined applications.



Compact and absolute

SMART*SENS*

SMART*SENS*

SMART*SENS*

Series		**Micro-BIL**	**BIL 60**	**BIL 160**	
Measuring range		0...10 mm	0...60 mm	0...160 mm	
Teachable analog output					
Resolution		±25 µm	±0.15 mm	±0.4 mm	
Linearity		±0.3 mm	±1 mm	±2.4 mm	
Repeat accuracy		±30 µm	±60 µm	±0.5 mm	
Interfaces					
Output	0...10 V	■	■	■	
	4...20 mA	■	■	■	
IO-Link					
Target/magnet					
Magnet		■	■	■	
Metal					
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Inductive Position Sensors
Summary




	BIP 14	BIP 40	BIP 70	BIP 103
	0...14 mm	0...40 mm	0...70 mm	0...103 mm
	■	■	■	■
	14 µm	40 µm	80 µm	80 µm
	±250 µm	±400 µm	±300 µm	±400 µm
	±80 µm	±100 µm	±80 µm	±80 µm
	■	■	■	■
	■	■	■	■
	■	■		
	■	■	■	■
	284	284	286	286

Inductive Position Sensors

Magneto-inductive position sensors BIL

Magneto-inductive position sensors BIL provide absolute analog position feedback in stroke lengths up to 160 mm.
The magneto-inductive analog position sensor measures without contact, using a passive magnet.

Magneto-inductive Position Sensors BIL
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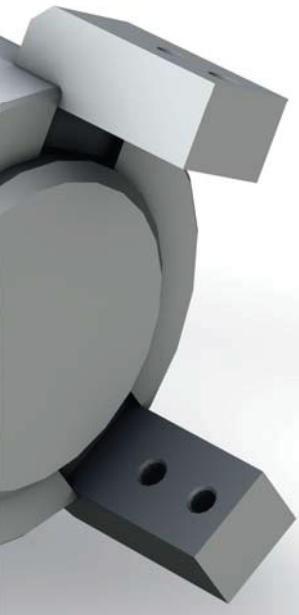


Magneto-inductive Position Sensors Micro BIL

Summary

BIL features

- Wear-free since the position is detected without contact
- Insensitive to shock and vibration
- Absolute output signal: Voltage or current (cable break monitoring possible)
- Housing cross-section 15×15 mm
- Simple installation

Features of the Micro-BIL

- Wear-free since the position is detected without contact
- Insensitive to shock and vibration
- Absolute output signal: Voltage or current (cable break monitoring possible)
- Adjustable measuring range, magnetic field strength
- Easy to install in the T-slot

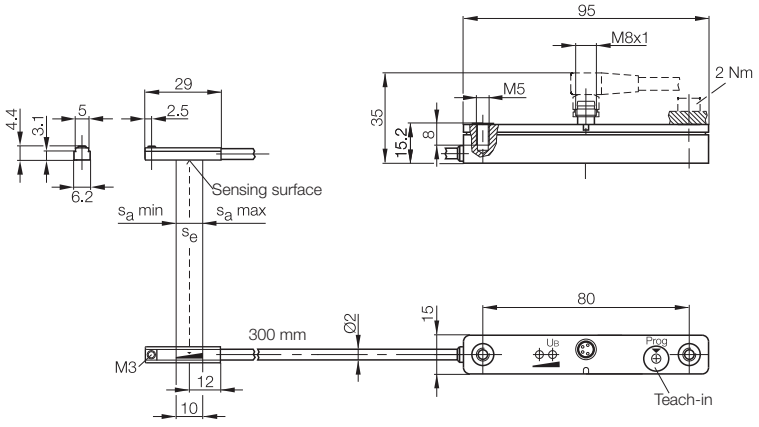
Optional mounting brackets and screws are recommended for attaching the Micro-BIL. Please order accessories separately.
See page 280

Magneto-inductive Position Sensors Micro BIL

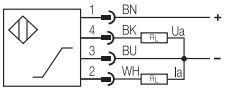
General data

Output signal U_{out}		**Voltage 0...10 V or**
Output signal I_{out}		**Current 4...20 mA**
Working range s_w		0...10 mm
Linear range s_l		0...10 mm
Ordering code		**BIL0002**
Part number		BIL ED0-B010P-02/30-S75
Supply voltage U_S		At voltage output U_{out}: U_S = 15...30 V DC, At current output I_{out}: U_S = 10...30 V DC
Field strength, axial H_n		10 kA/m typical
–3dB width of the axial field distribution, typical (typical axial field strength – parallel to sensing surface)		2.5 mm
Residual ripple		≤ 10% of U_e
Rated insulation voltage U_i		75 V DC
Effective distance s_e		5 mm
Load resistance R_L		At voltage output U_{out}: R_L = ≥ 2 kΩ, At current output I_{out}: R_L = ≤ 500 Ω
No-load supply current I_0 at U_e		≤ 30 mA
Polarity reversal protected		yes
Short-circuit protected		yes
Ambient temperature T_a		–10...70 °C
Repeat accuracy R_{BWN}		≤ ±30 µm
Non-linearity		±0.3 mm
Temperature coefficient TC	Typical	+4 µm/K
In the optimum range	Min.	+2 µm/K
from 10...50 °C	max	+10 µm/K
Power-on indicator		yes
Programming indicator		yes
Degree of protection as per IEC 60529		IP 67
Housing material		PA fiberglass reinforced
Connection		Plug connector
Approval		cULus
Recommended connector		BKS-S 74/BKS-S 75

Adjustment to different magnetic field strengths is possible at the touch of a button. The technical data refer to reference measurements. Different grippers/cylinders with differing magnetic fields may affect the technical data.



Connection wiring diagram



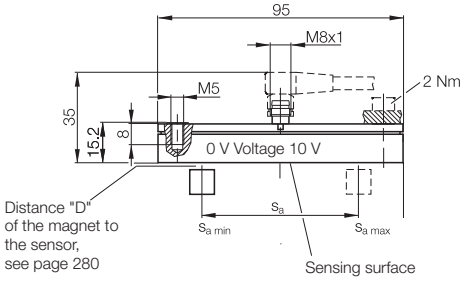
Connect either the voltage or current output.

Magneto-inductive Position Sensors BIL
General data

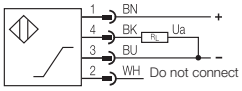
Output signal U_{out}		**Voltage 0...10 V, out-of-range 11 V**
Output signal I_{out}		
Working range s_w		0...60 mm
Linear range s_l		5...55 mm
Ordering code		**BIL0001**
Part number		BIL AMD0-T060A-01-S75
Supply voltage U_S		15...30 V DC
Residual ripple		≤ 10% of U_e
Rated insulation voltage U_i		75 V DC
Effective distance s_e		30 mm
Load resistance R_L		≥ 2 kΩ
No-load supply current I_0 at U_e		≤ 30 mA
Polarity reversal protected		yes
Short-circuit protected		yes
Ambient temperature T_a		–10...+75 °C
Repeat accuracy R_{BWN}		≤ ±60 µm
Linearity		≤ ±1 mm
Limit frequency (–3 dB)		1500 Hz
Measuring speed		≤ 5 m/s
Temperature coefficient TC	Typical	+5 µm/K
In the optimum range	Min.	–20 µm/K
from +10...+50 °C	max	+30 µm/K
Power-on indicator		yes
Out-of-range indicator		yes
Degree of protection as per IEC 60529		IP 67
Housing material		PA mod.
Connection		Plug connector
Approval		cULus
Recommended connector		BKS-S 74/BKS-S 75

Out-of-range function

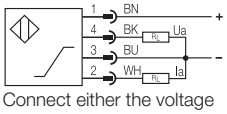
Magnet within working range:
- Output voltage 0...10 V or output current 4...20 mA
- LED not on
- Magnet outside the working range:
- Output voltage approx. 11 V or output current approx. 22 mA
- LED lights up



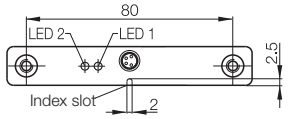
BIL AMD0...



BIL EMD0.../BIL ED0...



Connect either the voltage or current output.

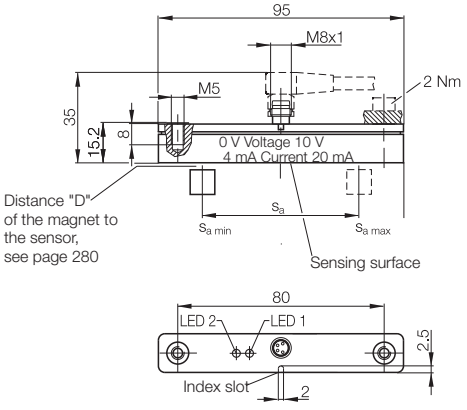


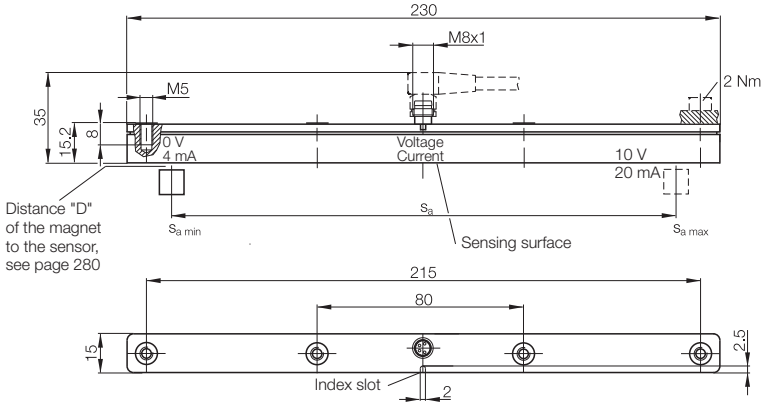
Optional mounting brackets and screws are recommended for attaching the BIL.

Please order accessories separately. See page 280

General data

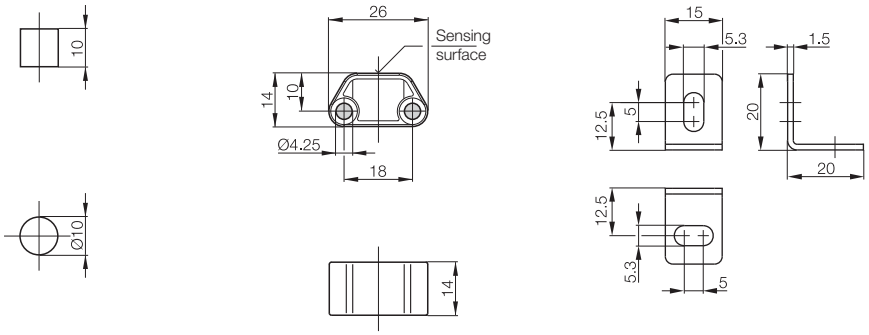
	Voltage 0...10 V, out-of-range 11 V or current 4...20 mA, out-of-range 22 mA	**Voltage 0...10 V or Current 4...20 mA**
	0...60 mm	0...160 mm
	5...55 mm	0...160 mm
	BIL0006	**BIL0004**
	BIL EMD0-T060A-01-S75	BIL ED0-P160A-01-S75
	At voltage output U_{out}: U_S = 15...30 V DC, At current output I_{out}: U_S = 10...30 V DC	At voltage output U_{out}: U_S = 15...30 V DC, At current output I_{out}: U_S = 10...30 V DC
	≤ 10% of U_e	≤ 10% of U_e
	75 V DC	75 V DC
	30 mm	80 mm
	At voltage output U_{out}: RL = ≥ 2 kΩ, At current output I_{out}: R_L = ≤ 500 Ω	At voltage output U_{out}: R_L = ≥ 2 kΩ, At current output I_{out}: R_L = ≤ 500 Ω
	≤ 30 mA	≤ 25 mA
	yes	yes
	yes	yes
	–10...+75 °C	–10...+75 °C
	≤ ±60 µm	≤ ±500 µm
	≤ ±1 mm	≤ ±2.4 mm
	1500 Hz	300 Hz
	≤ 5 m/s	≤ 5 m/s
	+5 µm/K	–40 µm/K
	–20 µm/K	+120 µm/K
	+30 µm/K	–200 µm/K
	yes	no
	yes	no
	IP 67	IP 67
	PA mod.	PA mod.
	Plug connector	Plug connector
	cULus	cULus
	BKS-S 74/BKS-S 75	BKS-S 74/BKS-S 75



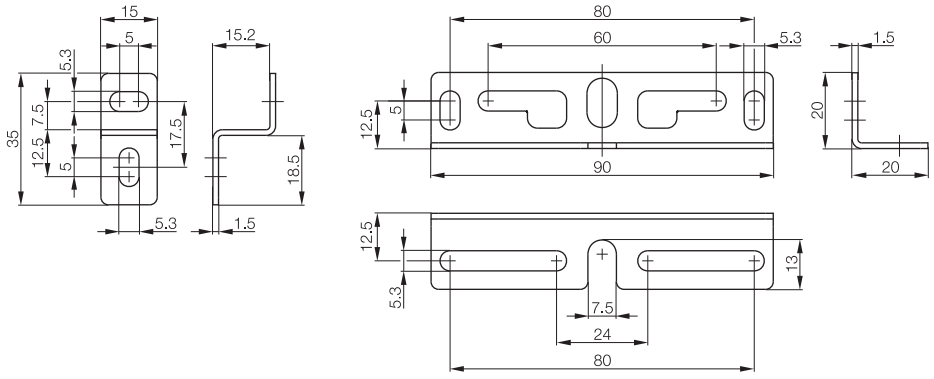


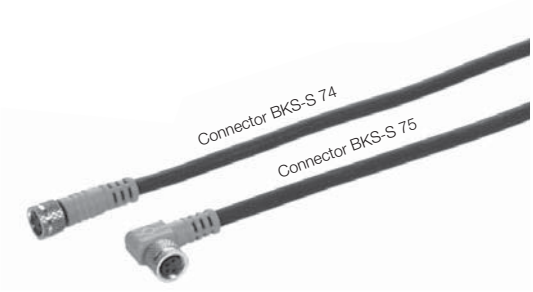
Accessories

Description	Magnet	Magnet	Mounting brackets
Size	Ø 10×10 mm	26×14×14 mm	
Ordering code	**BAM0176**	**BAM0177**	**BAM00K4**
Part number	BIL 000-MH-A	BIL 001-MH-A	BIL 01-HW-1
Material	Hard ferrite	PA fiberglass reinforced	Stainless steel
Distance "D"	2 mm	1 mm	

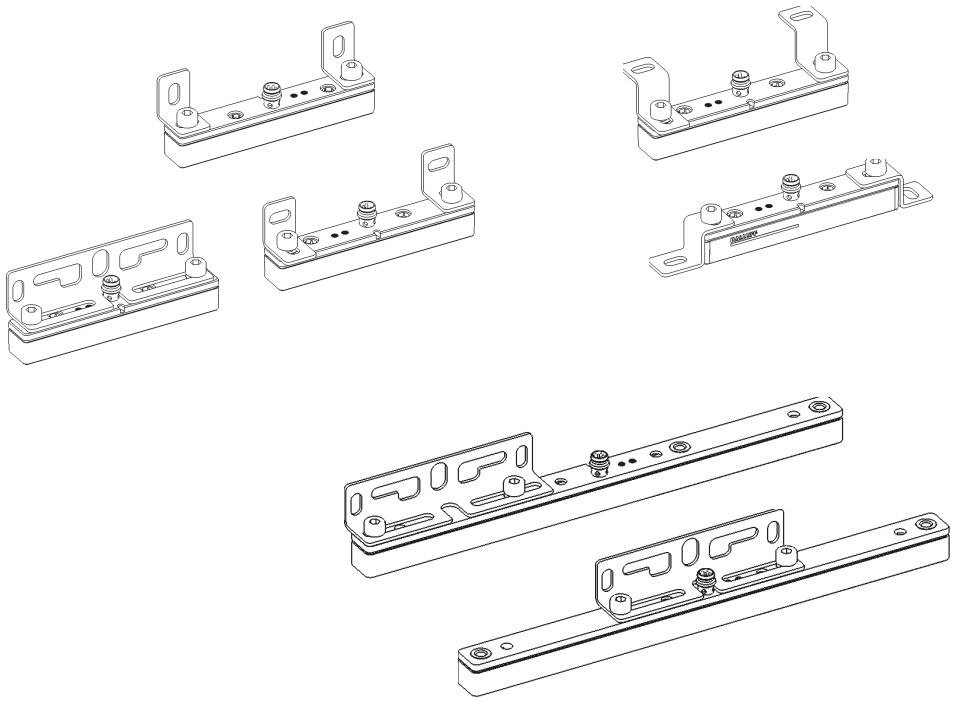


Description	Mounting brackets	Mounting brackets
Ordering code	**BAM00K5**	**BAM00K6**
Part number	BIL 01-HW-2	BIL 01-HW-3
Material	Stainless steel	Stainless steel





Mounting examples

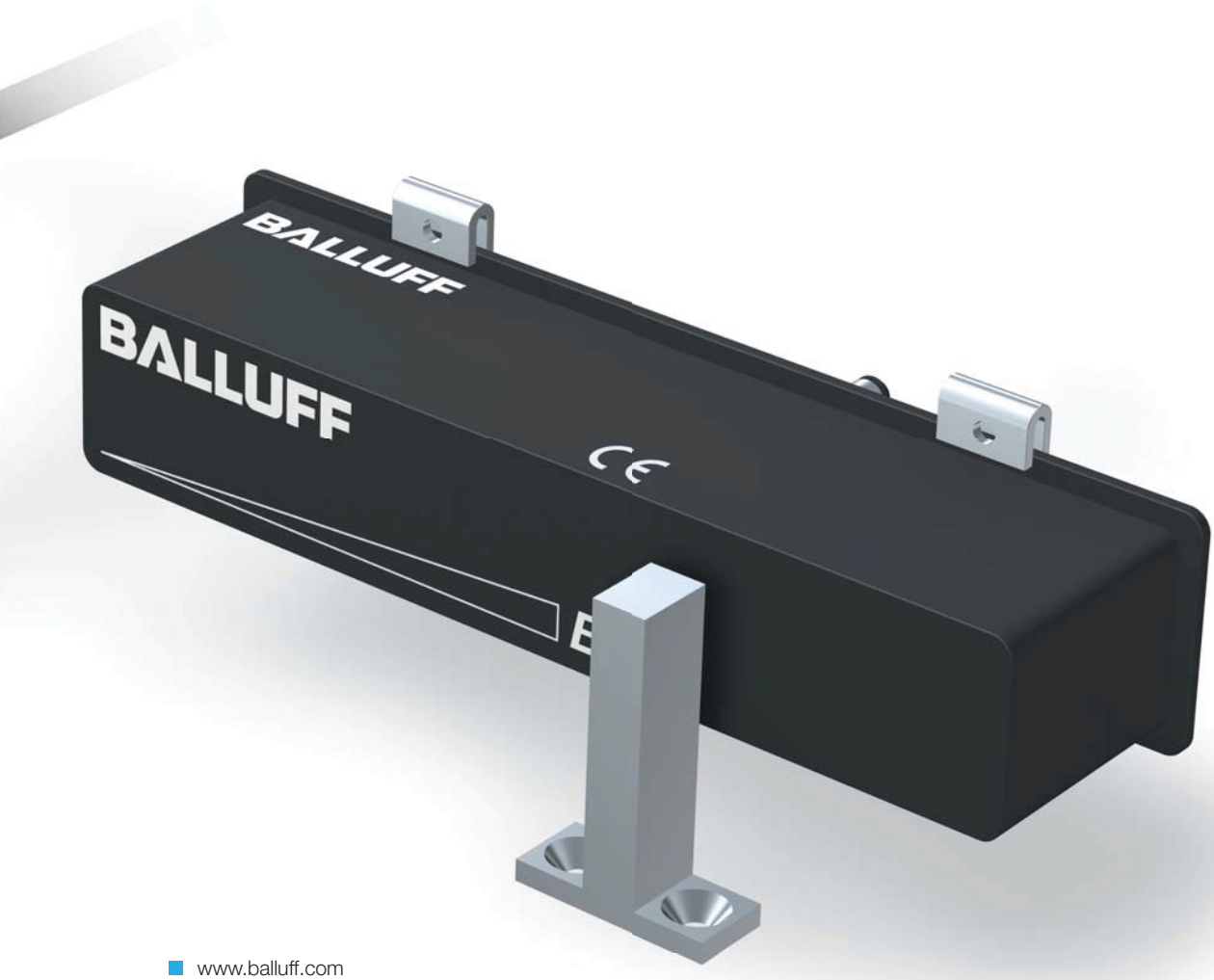


Inductive Position Sensors

Inductive Position Sensors BIP

Balluff magneto-inductive position sensors provide absolute position feedback in lengths up to 103 mm. Position sensors BIP measure without contact using a passive steel target. The compact design means these sensors can be easily integrated into the application even when mounting space is extremely tight. Even the magnet can be designed as an integral part of an application. Analog and digital interfaces ensure easy usability.

Inductive Position Sensors BIP
Contents

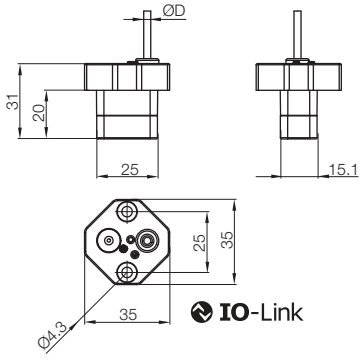


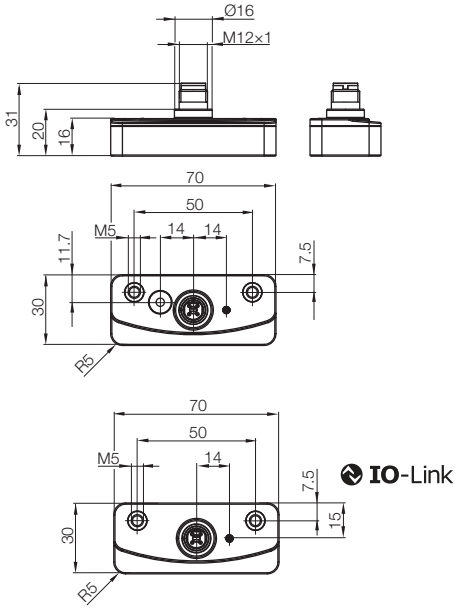
- Absolute measuring principle, several measuring ranges, teachable
- High repeat accuracy and precision
- Optimal linearity and low temperature drift
- Optimized housing design for clamping distance monitoring
- Distance-proportional IO-Link output signal
- Standard output 0...10 V, 4...20 mA

IO-Link

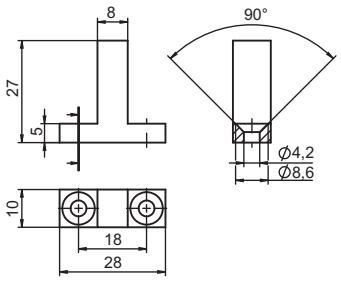
Ordering code	
Part number	
Output signal	
Length of measuring range is teachable	
Detection range	
Target width (EC80)	
Target distance	
Resolution	
Repeat accuracy	
Linearity deviation	
Ambient temperature	
Connection	
Supply voltage	
Housing material	
LED function indicator	

	BIP0001	BIP0007	BIP0008	BIP0002	BIP0004	BIP0005
	BIP AD0-B014-01-EP02	BIP LD2-T014-01-EP02	BIP CD2-B014-01-EP02	BIP AD2-B040-02-S4	BIP LD2-T040-02-S4	BIP CD2-B040-02-S4
	0...10 V	IO-Link	4...20 mA	0...10 V	IO-Link	4...20 mA
	7...14 mm			20...40 mm		
	0...14 mm			0...40 mm		
	8 mm			14 mm		
	0.5...2 mm			1...3 mm		
	14 µm			40 µm		
	±80 µm			±100 µm		
	±250 µm			±400 µm		
	–25...+70 °C			–25...+85 °C		
	2 m cable			M12 connector		
	15...30 V (IO-Link 18...30 V)			15...30 V (IO-Link 18...30 V)		
	PA			PA		
	yes			yes		



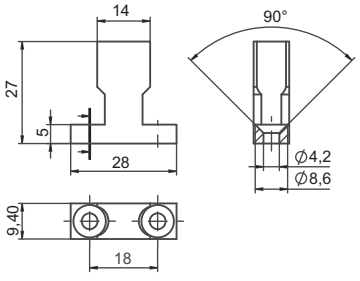


BAM TG-XE-001



BAM TG-XE-010

The position encoder must have a width of 14 mm and cover the sensing surface of the sensor orthogonally to the measuring direction.



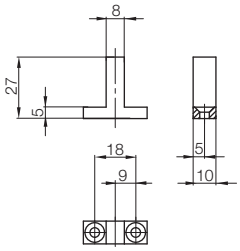
Optimized effective length

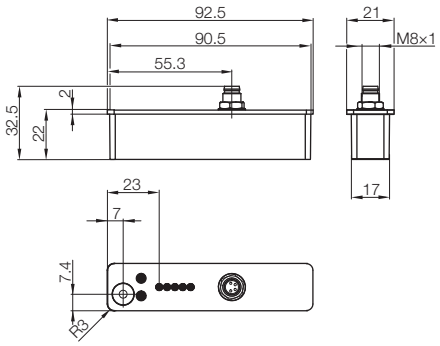

teachable

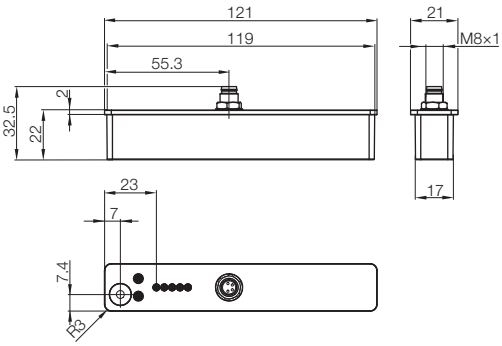

teachable

Ordering code	BIP000C	BIP000E
Part number	BIP ED2-B070-03-S75	BIP ED2-B103-03-S75
Output signal	0...10 V and 4...20 mA	0...10 V and 4...20 mA
Length of measuring range is teachable	35...70 mm	51.5...103 mm
Detection range	0...76.5 mm	0...105 mm
Target width (EC80)	8 mm	8 mm
Target distance	1...3 mm	1...3 mm
Resolution	80 µm	80 µm
Repeat accuracy	±80 µm	±80 µm
Linearity deviation	±300 µm	±400 µm
Ambient temperature	–25...+85°C	–25...+85°C
Connection	M8 connector	M8 connector
Supply voltage	16...30 V	16...30 V
Housing material	PBT	PBT
LED function indicator	yes	yes

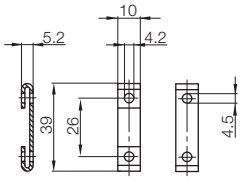
Please order **Metal Target** separately.
Type designation: BAM TG-XE-001
Ordering code: BAM01CP







Two fastening clips incl. screws are included in the delivery.

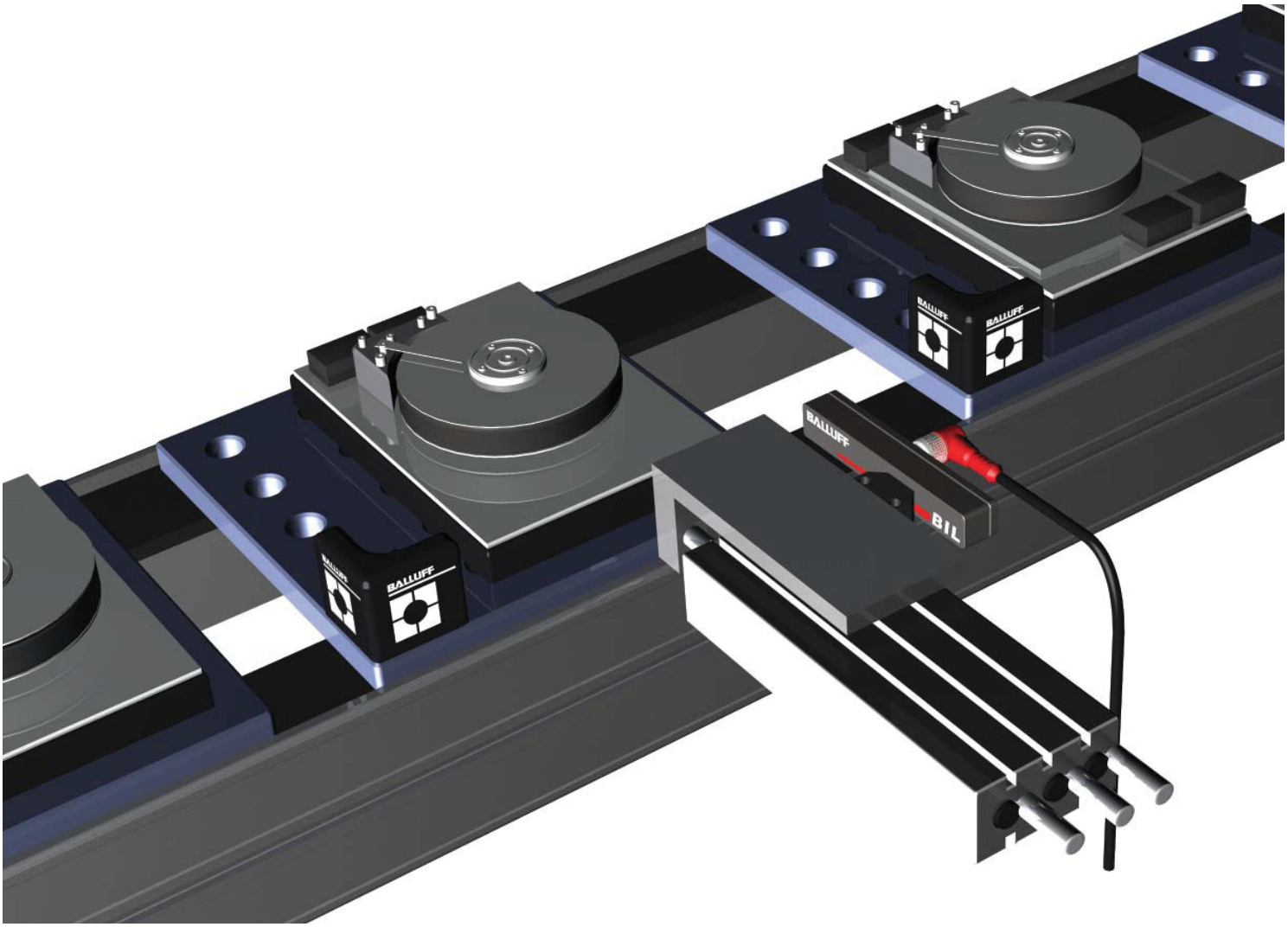


- Absolute measuring principle, several measuring ranges, teachable
- High repeat accuracy and precision
- Wide working temperature range and low temperature drift
- Optimized housing design, IP 67 degree of protection
- Standard output 0...10 V, 4...20 mA

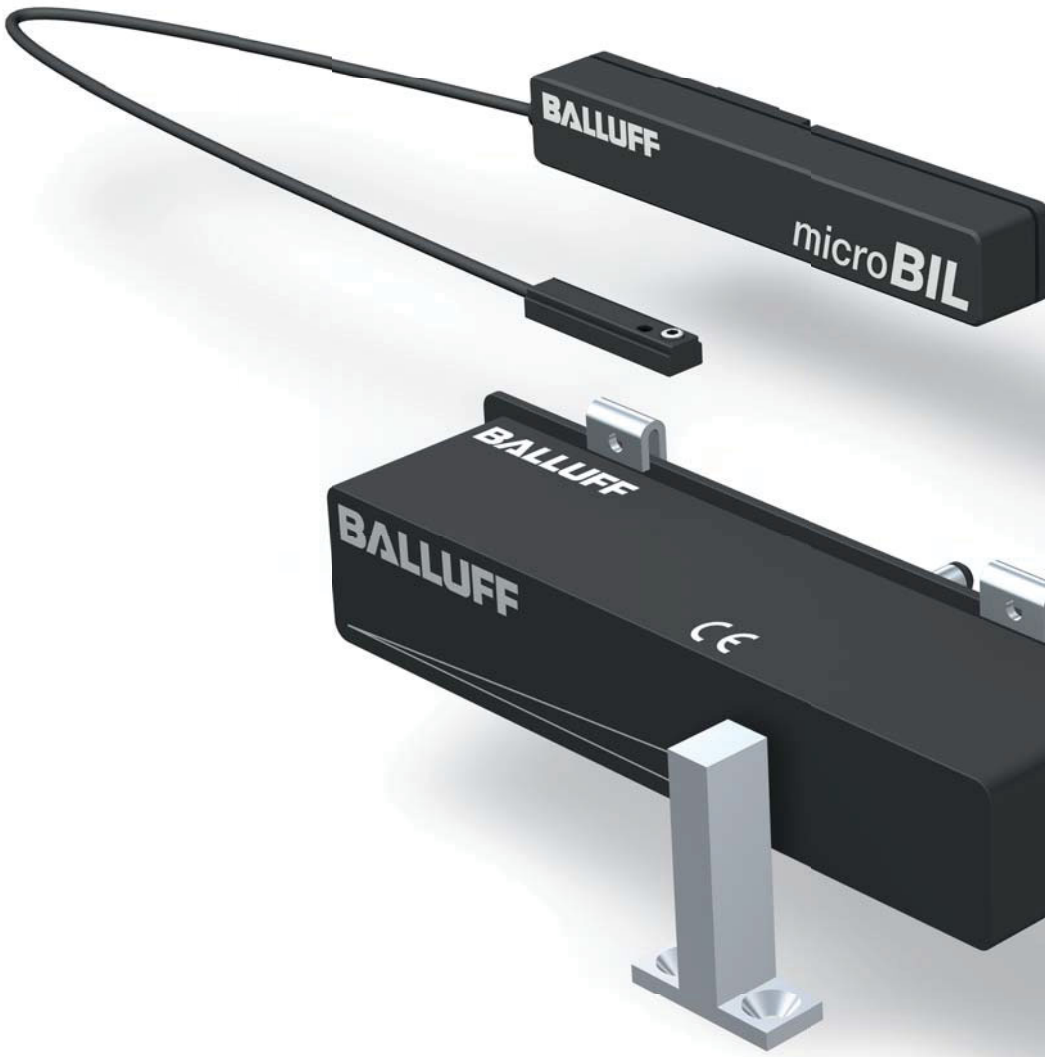
Inductive Position Sensors BIP
Application

Inductive position sensors detect linear motion and provide a position-dependent output signal.
The compact design makes them easy to integrate and monitor assembly and joining processes.

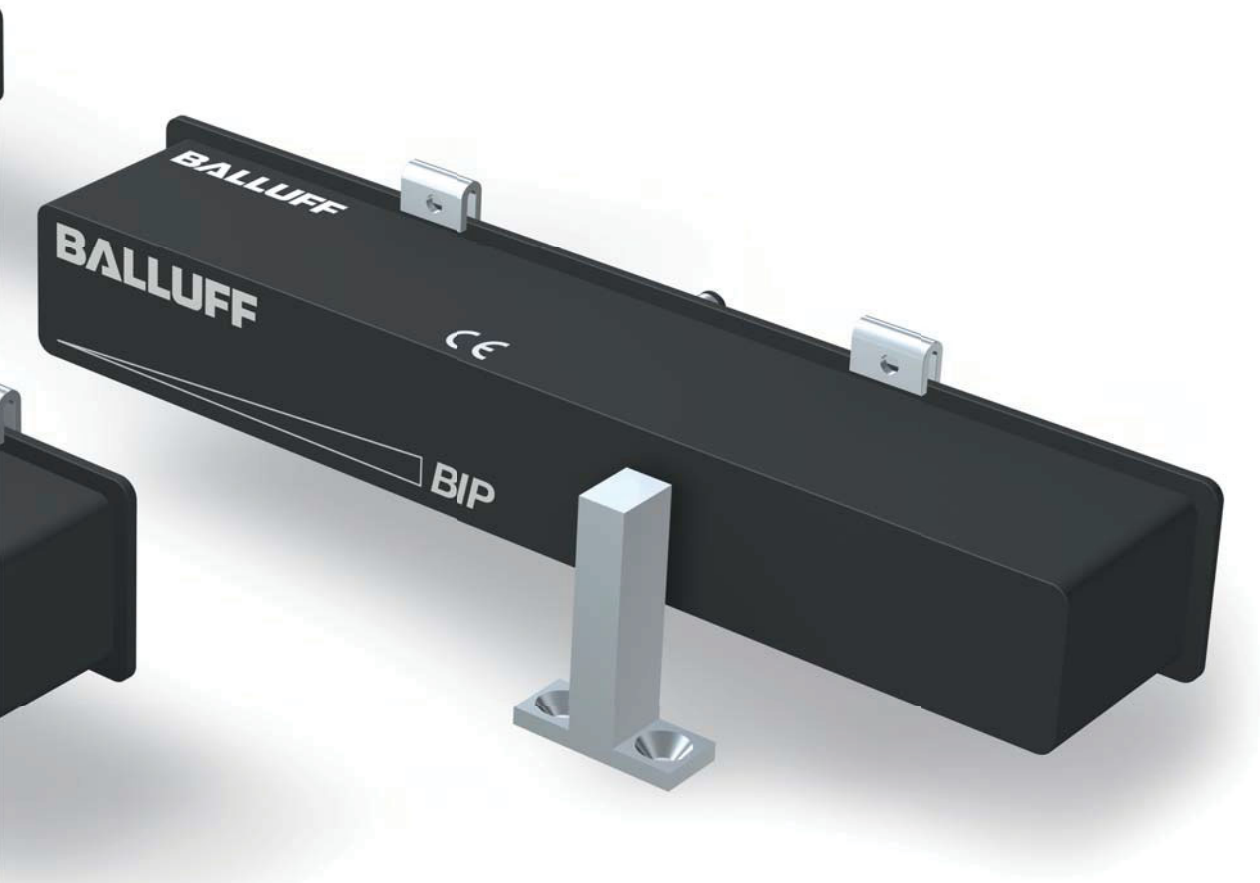
- Compact and easy to integrate
- Wear-free
- Absolute measuring principle
- Analog output signal or IO-Link



Inductive Position Sensors



Basic Information and Definitions
Contents



Definitions

Position sensors with analog output

Position sensors with analog output are sensors that generate a continually varying output signal that depends on the distance between its sensing surface and the location of the magnet relative to the sensor.

Working range s_w

Working range s_w is the travel path usable for position detection.

Effective distance s_e

Effective distance s_e is the point in the middle of the linear range s_l and is used as the reference point for other specifications.

Linear range s_l

Linear range s_l corresponds to the working range where the displacement sensor exhibits a defined linearity.

Non-linearity

Non-linearity specifies the maximum deviation of the characteristic from a straight reference line. This value applies to the linear range.

Measuring speed

Measurement speed indicates the ability to detect the position of an object moving with linear motion. The direction of movement of the object is assumed to be parallel to its sensing face.

Response time

Response time is the time a sensor requires to reliably and steadily change the output signal. The specified time, which has been determined at the maximum measuring speed, includes both the electrical response time of the sensor and the time for the mechanical change of the damping state.

Slope

Slope is a measure of the sensitivity of the sensor with respect to a distance change. This physical relationship can be calculated for position sensors as follows:

$$\text{Slope S [V/mm]} = \frac{U_{out}\ \text{max} - U_{out}\ \text{min}}{s_w\ \text{max} - s_w\ \text{min}}$$

or

$$\text{Slope S [mA/mm]} = \frac{I_{out}\ \text{max} - I_{out}\ \text{min}}{s_w\ \text{max} - s_w\ \text{min}}$$

Temperature drift

Temperature drift is the shift a point experiences on the actual output curve at different temperatures. Temperature drift is described by the temperature coefficient.

Temperature coefficient TC

Temperature coefficient TC describes the deviation of the sensor output signal under the effect of a temperature change, and thus represents a quality criterion for the sensor as well.

Tolerance T

Tolerance T is a variable that defines the manufacturing tolerance band of the output curve, thereby determining the maximum sample deviation.

Repeat accuracy R

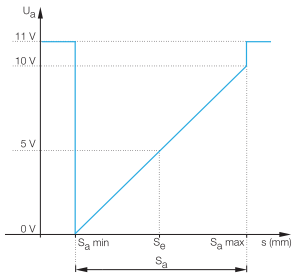
Repeat accuracy R is the value of output signal changes under defined conditions, expressed as a percentage of the upper distance. The measurement must be taken in the lower, upper and center area of the linear range. It corresponds to the repeat accuracy R of proximity switches and is determined under the same standardized conditions (EN 60947-5-2).
Position sensors with analog output achieve the value R of ≤ 5% defined in the standard.

Repeat accuracy R_{BWN}

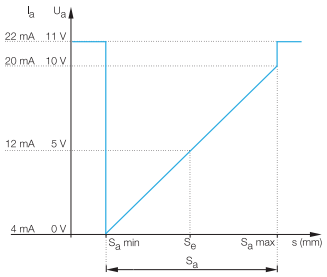
Repeat accuracy R_{BWN} describes the precision an analog sensor achieves when moving to a measuring point multiple times. This value, specified based on Balluff Factory Standard (BWN Pr. 44), describes the maximum deviation from this measuring point.

Output curves

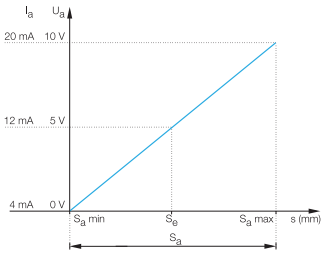
BIL AMD0...



BIL EMD0.../ BIP ED2...



BIL ED0.../ BIP AD.../ BIP CD...



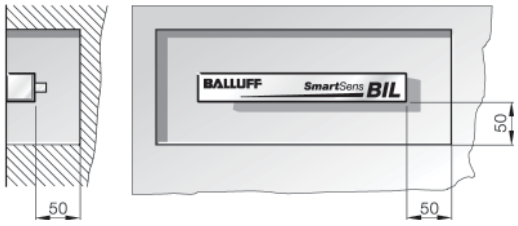
Installation notices

It is recommended that the BIL and magnet be installed or attached to non-magnetizable materials, such as non-ferrous metals, austenitic steels, plastics, etc. This applies to the installation of both the sensor and the magnet.

Magnetizable materials may affect the geometry and strength of the effective encoder magnetic field.

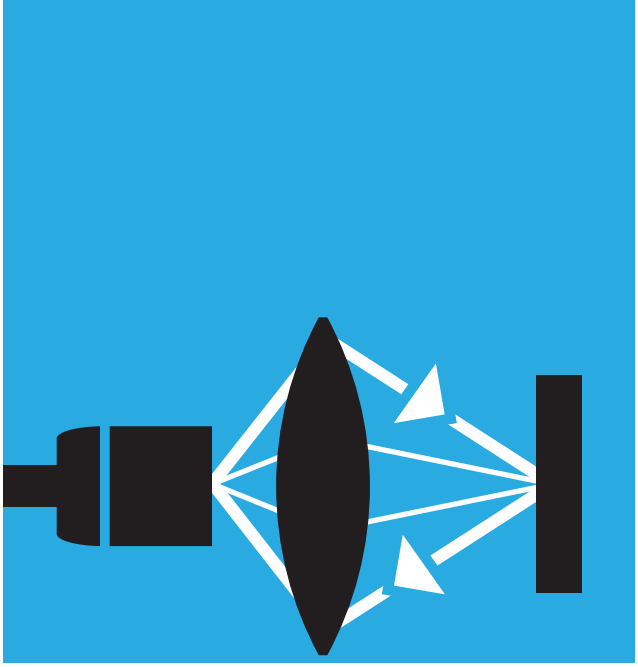
Magnetic fields near the BIL can affect the output signal depending on their location and strength. This also applies to magnets neighboring BIL sensors.

Recommended minimum distances from magnetizable materials or other BIL sensors



Values in mm

An area free of metals should be maintained all the way around the BIP's sensing surface in order to minimize the effects on the measuring signal caused by the installation material (see notes in the user's guide).
Invalid measurement signals may result if the sensor detects another metal part aside from the magnet.

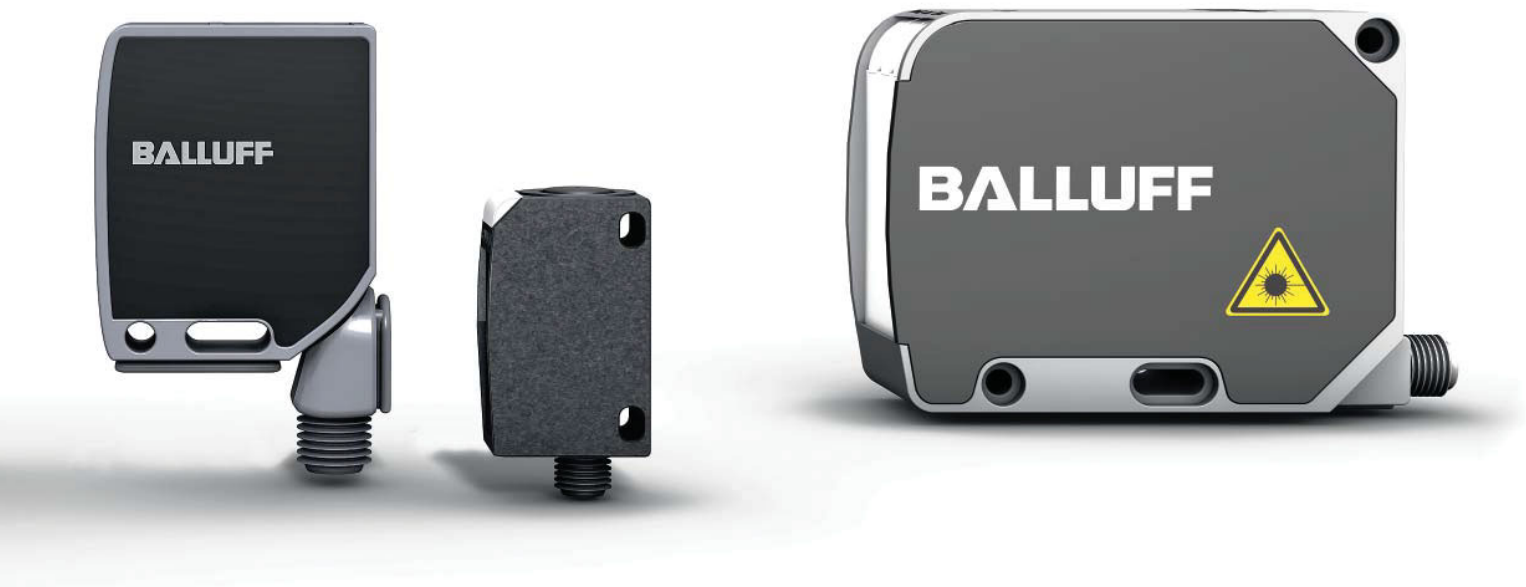


Photoelectric Distance Sensors

Photoelectric distance sensors are used when distances to objects need to be measured or monitored or their precise position is to determined. They support positioning tasks, material flow controls and level detections in the most diverse of applications – also across large distances.

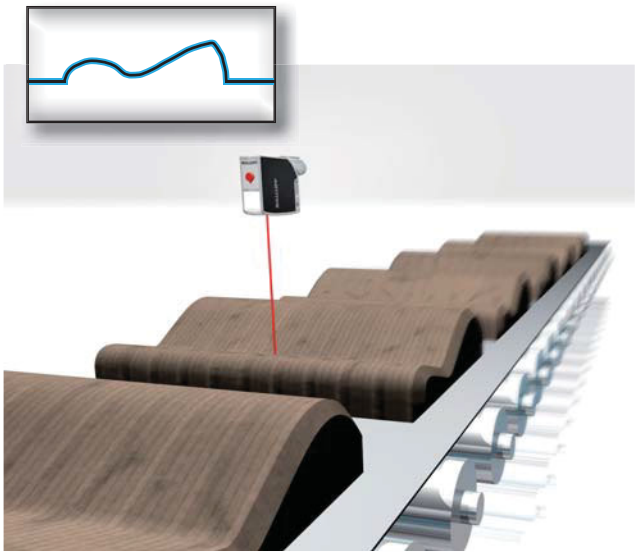
Users have a wide range of output signals available. Depending on the type, these include analog current and voltage outputs or serial interfaces. However, variants with IO-Link are available for a simple and efficient connection to higher-level control systems.

Photoelectric Distance Sensors
Contents

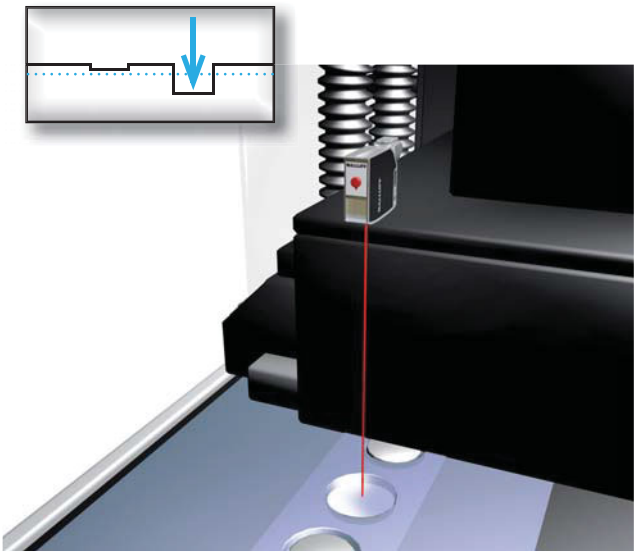


Optical distance sensors are used when distances of objects need to be measured or monitored with precise position determination. Distance measurement is based on either the triangulation principle or time of flight.
PSD elements or CCD arrays are used for the receiving elements, with the emitter consisting of a red light or laser light source.
Analog current and voltage values, serial interfaces and digital outputs are available to the user.

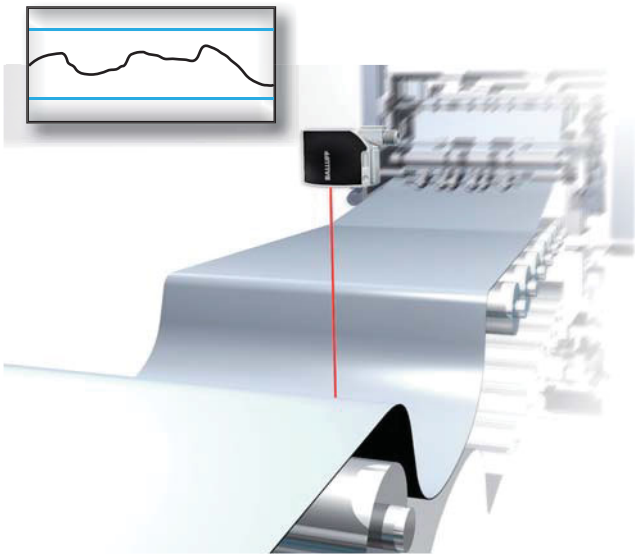
Applications
- Control tasks
- Sensing
- Object positioning
- Level detection



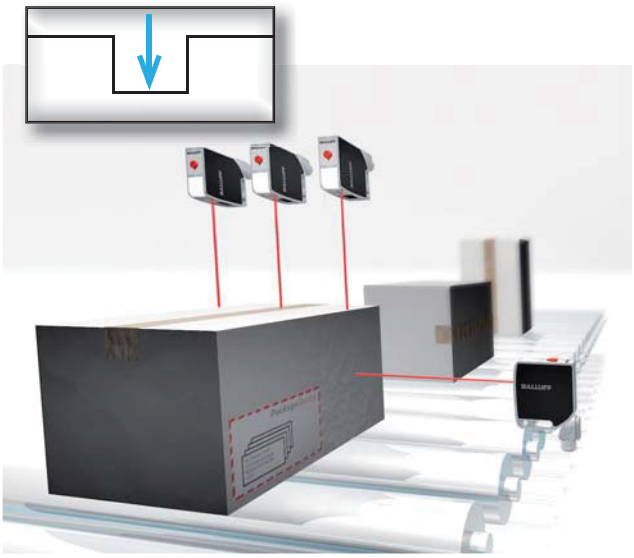
Contour checking
Optical distance sensors continuously detect dimensions or contours on tongue and groove boards. Analog sensing detects individual defects and gradual deviations directly for permanent monitoring of the production process.



Blister packaging
Optical distance sensors monitor the packaging process, optimize product filling and increase system productivity.
Before foil packaging is closed up, a BOD 21M checks the individual compartments and detects missing or extra items.



Sag monitoring
Film and web material has to be transported at a uniform speed in order to be processed with precision. Tension-free material transport succeeds using the BOD 21M, which dynamically detects the height of the sag section.



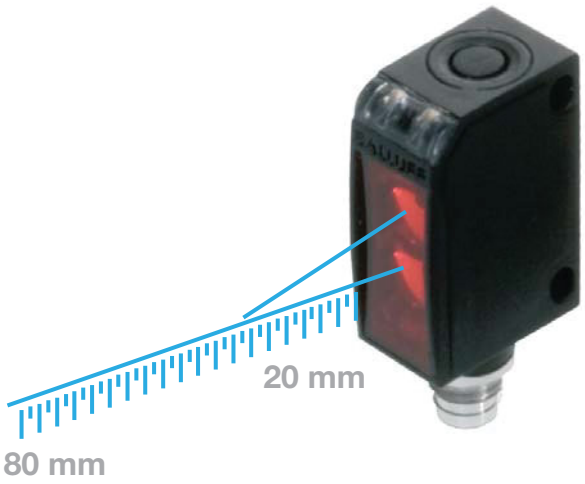
Adaptive feed
Multiple optical distance sensors measure components, assembled units and packages on a conveying line. BOD 21M sensors evaluate the outer dimension and contour so that these various parts can be transported to the next appropriate process steps. The rugged metal housing guarantees long service life of the installation.

Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

■ **Ordering code**
□ Part number

Type		Working range	Resolution	Light type		Analog output			Output						U_S		Connection					Page
				Red light	Laser light	0...10 V	1...10 V	4...20 mA	RS485 interface	PNP transistor	IO-Link	2× PNP transistor	Alarm output		15...30 V DC	18...30 V DC	M8 connector, 4-pin	M12 connector, 4-pin	M12 connector, 5-pin	M12 connector, 8-pin	Cable	
Distance sensor																						
BOD000H	BOD 6K-RA01-S75-C	20...80 mm	n.a.	■		■				■					■		■					296
BOD000F	BOD 6K-RA01-C-02	20...80 mm	n.a.	■		■				■					■						■	296
BOD000L	BOD 21M-LA01-S92	25...45 mm	30 µm		■		■					■				■			■			298
BOD000P	BOD 21M-LB01-S92	25...45 mm	30 µm		■			■				■				■			■			298
BOD000M	BOD 21M-LA02-S92	20...200 mm	100...200 µm		■		■					■				■			■			299
BOD000R	BOD 21M-LB02-S92	20...200 mm	100...200 µm		■			■				■				■			■			299
BOD000N	BOD 21M-LA04-S92	20...500 mm	100...500 µm		■		■					■				■			■			299
BOD000T	BOD 21M-LB04-S92	20...500 mm	100...500 µm		■			■				■				■			■			299
BOD0002	BOD 26K-LA01-S4-C	45...85 mm	80 µm		■	■										■			■			301
BOD0001	BOD 26K-LA01-C-06	45...85 mm	80 µm		■	■										■					■	301
BOD0004	BOD 26K-LA02-S4-C	45...85 mm	0.1% of Wh		■	■										■			■			301
BOD0003	BOD 26K-LA02-C-06	45...85 mm	0.1% of Wh		■	■										■					■	301
BOD0005	BOD 26K-LB04-S115-C	30...100 mm	0.1% of Wh		■			■				■				■				■		303
BOD000C	BOD 26K-LBR04-S115-C	30...100 mm	0.1% of Wh		■			■	■			■				■				■		303
BOD0006	BOD 26K-LB05-S115-C	80...300 mm	0.1% of Wh		■			■				■				■				■		305
BOD000E	BOD 26K-LBR05-S115-C	80...300 mm	0.1% of Wh		■			■	■			■				■				■		305
BOD0007	BOD 26K-LB06-S92-C	30...100 mm	0.1% of Wh		■			■		■						■			■			307
BOD0008	BOD 26K-LB07-S92-C	80...300 mm	0.1% of Wh		■			■		■						■			■			307
BOD000U	BOD 63M-LA02-S115	200...2000 mm	1 mm		■	■						■	■		■					■		309
BOD0010	BOD 63M-LB02-S115	200...2000 mm	1 mm		■			■				■	■		■					■		309
BOD0012	BOD 63M-LI06-S4	200...6000 mm	1 mm	■	■						■							■				309
BOD000W	BOD 63M-LA04-S115	200...6000 mm	1 mm		■	■						■	■		■					■		311
BOD0011	BOD 63M-LB04-S115	200...6000 mm	1 mm		■			■				■	■		■					■		311
BOD0015	BOD 66M-RA01-S92-C	100...600 mm	0.5 mm	■			■			■						■			■			313
BOD0016	BOD 66M-RB01-S92-C	100...600 mm	0.5 mm	■				■		■						■			■			313
BOD0013	BOD 66M-LA04-S92-C	200...2000 mm	5 mm		■		■			■						■			■			315
BOD0014	BOD 66M-LB04-S92-C	200...2000 mm	5 mm		■			■		■						■			■			315

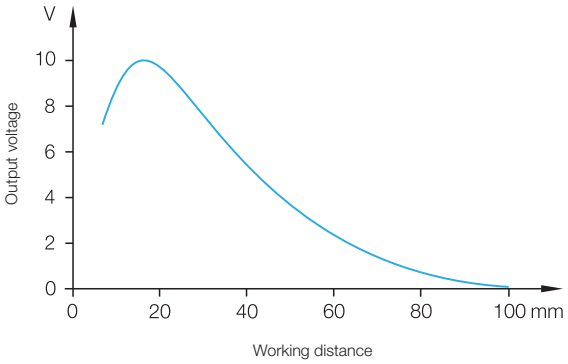
The **BOD 6K** provides a distance-proportional analog output signal with falling voltage over a fixed measuring range of 20 to 80 mm. With a switching output adjustable using teach-in, the sensor can also be used as a sensing device with background suppression.



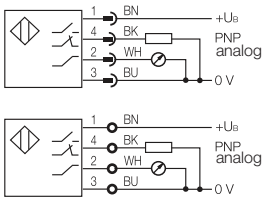
Features

- Fixed measuring range between 20...80 mm
- Analog output 0...10 V
- Adjustable background suppression
- PNP, NO/NC switching output
- Teach-in
- Disable buttons
- Connector or cable version

Analog output BOD 6K-RA01



Wiring diagrams



Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00UH**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connector
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
Shielded M8, 4-pin	Straight	PUR	Black	5 m	**BCC02N6**
Shielded M8, 4-pin	Angled	PUR	Black	5 m	**BCC02NJ**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

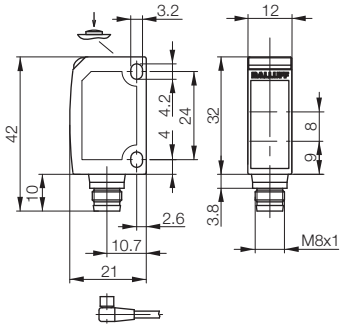
BOD 6K distance sensors

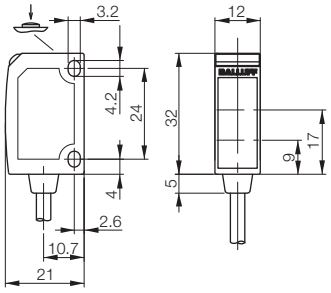
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series			**BOD 6K**	**BOD 6K**
Working range			**20...80 mm**	**20...80 mm**
Measuring range			**60 mm**	**60 mm**
PNP	NO/NC	**Ordering code**	**BOD000H**	**BOD000F**
		Part number	BOD 6K-RA01-S75-C	BOD 6K-RA01-C-02
Supply voltage U_B			15...30 V DC	15...30 V DC
Analog output			0...10 V (max. 3 mA)	0...10 V (max. 3 mA)
No-load supply current I_0 max.			≤ 30 mA at 24 V DC	≤ 30 mA at 24 V DC
Output current			100 mA	100 mA
Cutoff frequency			200 Hz	200 Hz
Switching type			Light/dark switching (selectable)	Light/dark switching (selectable)
Polarity reversal/short-circuit protected			Yes/Yes	Yes/Yes
Settings			Teach-in	Teach-in
Emitter, light type			LED, red light	LED, red light
Wavelength			660 nm	660 nm
Light spot diameter			5×5 mm at 60 mm	5×5 mm at 60 mm
Power-on indicator			Green LED	Green LED
Output function indicator			Yellow LED	Yellow LED
Response time			0.5 ms	0.5 ms
Switching frequency f			1 kHz	1 kHz
Degree of protection as per IEC 60529			IP 67	IP 67
Ambient temperature T_a			–20...+60 °C	–20...+60 °C
Permissible ambient light			5 klx	5 klx
Material		Housing	ABS	ABS
		Optical surface	PMMA	PMMA
Connection			M12 connector, 4-pin	2 m PVC cable, 26 AWG

Measurement values referenced to 100×100 mm, 90% reflective Kodak gray card.

Connector orientation



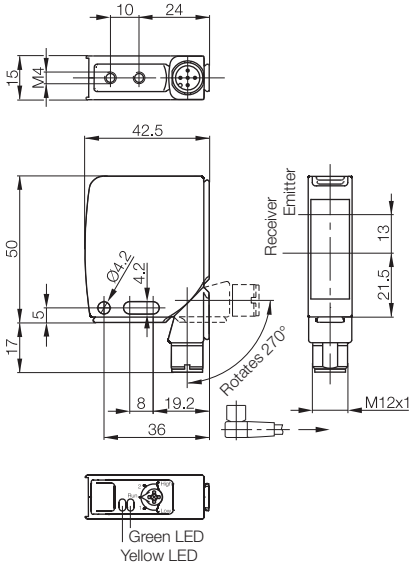


The BOD 21M is connected using a 5-pin M12 plug.
The connector orientation can be set over a range of 270°, allowing the BOD 21M to be attached in any position.

Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

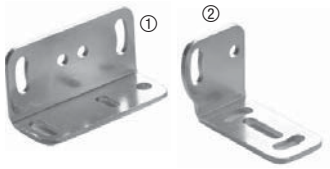
Series		BOD 21M	BOD 21M
Working range		25...45 mm	25...45 mm
Measuring range		20 mm	20 mm
2× PNP NO/NC	Ordering code	BOD000L	BOD000P
	Part number	BOD 21M-LA01-S92	BOD 21M-LB01-S92
Supply voltage U_B		18...30 V DC	18...30 V DC
Analog output		1...10 V (max. 3 mA)	4...20 mA
Settings		Teach-in (rotary switch)	Teach-in (rotary switch)
Switching type		Light/dark switching	Light/dark switching
Emitter, light type		Laser, pulsed red light	Laser, pulsed red light
Wavelength		630 nm	630 nm
Laser class		2	2
Light spot diameter		Ø1 mm at 45 mm	Ø1 mm at 45 mm
Temperature drift		≤ 0.2 %/°K	≤ 0.2 %/°K
Resolution		30 µm	30 µm
Linearity		~0.5%	~0.5%
Ready delay		≤ 300 ms	≤ 300 ms
On/off delay		≤ 7 ms	≤ 7 ms
Switching frequency f		≤ 70 Hz	≤ 70 Hz
Power-on indicator		Green LED	Green LED
Output function indicator		Yellow LED	Yellow LED
Degree of protection as per IEC 60529		IP 67	IP 67
Polarity reversal/short-circuit protected		Yes	Yes
Permissible ambient light		5 klx	5 klx
Ambient temperature T_a		–10...+50 °C	–10...+50 °C
Material	Housing	Gd-Zn	Gd-Zn
	Optical surface	Glass	Glass
Connection		M12 connector, 5-pin	M12 connector, 5-pin

Measured values referenced to Kodak gray card 90% reflective.
– Connector orientation



Recommended accessories
(please order separately)

Description	Ordering code
① Mounting bracket	BAM00T9
② Mounting bracket	BAM00TA



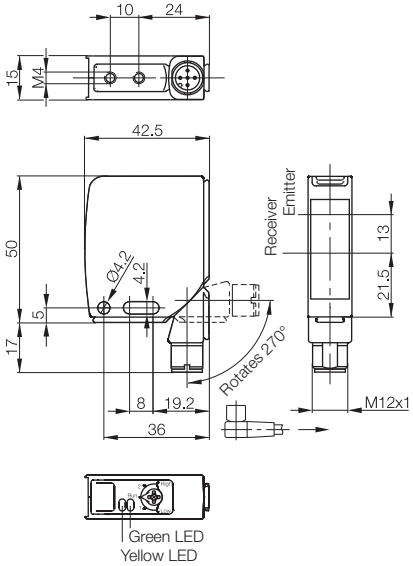
You can find special accessories for photoelectric sensors in the Object Detection Catalog.

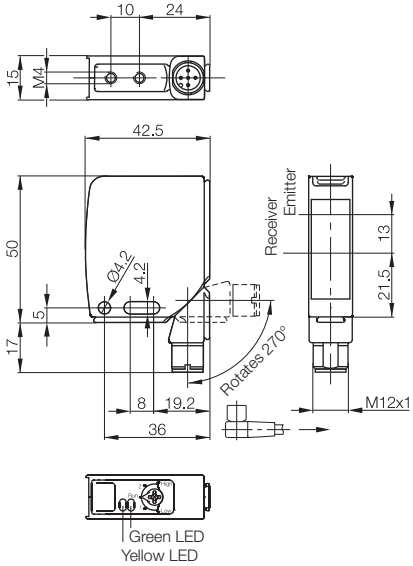
Suitable connector
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
Sheilded M12, 5-pin	Straight	PUR	Black	5 m	BCC08KP

Connectors without LED are suitable for PNP and NPN sensors.

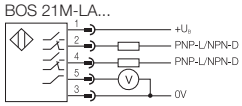
	BOD 21M	BOD 21M	BOD 21M	BOD 21M
	20...200 mm	**20...200 mm**	**20...500 mm**	**20...500 mm**
	180 mm	**180 mm**	**480 mm**	**480 mm**
	BOD000M	**BOD000R**	**BOD000N**	**BOD000T**
	BOD 21M-LA02-S92	BOD 21M-LB02-S92	BOD 21M-LA04-S92	BOD 21M-LB04-S92
	18...30 V DC	18...30 V DC	18...30 V DC	18...30 V DC
	1...10 V (max. 3 mA)	4...20 mA	1...10 V (max. 3 mA)	4...20 mA
	Teach-in (rotary switch)	Teach-in (rotary switch)	Teach-in (rotary switch)	Teach-in (rotary switch)
	Light/dark switching	Light/dark switching	Light/dark switching	Light/dark switching
	Laser, pulsed red light	Laser, pulsed red light	Laser, pulsed red light	Laser, pulsed red light
	630 nm	630 nm	630 nm	630 nm
	2	2	2	2
	Ø1 mm at 200 mm	Ø1 mm at 200 mm	1×6 mm at 500 mm	1×6 mm at 500 mm
	≤ 0.2 %/°K	≤ 0.2 %/°K	≤ 0.2 %/°K	≤ 0.2 %/°K
	100...200 µm	100...200 µm	100...500 µm	100...500 µm
	± 1 %	± 1 %	± 1% (to 200 mm) ± 3% (200...500 mm)	± 1% (to 200 mm) ± 3% (200 to 500 mm)
	≤ 300 ms	≤ 300 ms	≤ 300 ms	≤ 300 ms
	≤ 7 ms	≤ 7 ms	≤ 7 ms	≤ 7 ms
	≤ 70 Hz	≤ 70 Hz	≤ 70 Hz	≤ 70 Hz
	Green LED	Green LED	Green LED	Green LED
	Yellow LED	Yellow LED	Yellow LED	Yellow LED
	IP 67	IP 67	IP 67	IP 67
	Yes	Yes	Yes	Yes
	5 klx	5 klx	5 klx	5 klx
	–10...+50 °C	–10...+50 °C	–10...+50 °C	–10...+50 °C
	Gd-Zn	Gd-Zn	Gd-Zn	Gd-Zn
	Glass	Glass	Glass	Glass
	M12 connector, 5-pin	M12 connector, 5-pin	M12 connector, 5-pin	M12 connector, 5-pin



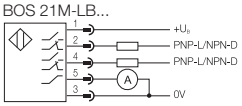


Wiring diagrams

BOS 21M-LA...



BOS 21M-LB...



BOD 26K-LA Laser

Features

- Fixed measuring range between 45...85 mm
- Analog output 0 to 10 V
- 20 µm or 80 µm resolution
- Connector or cable version

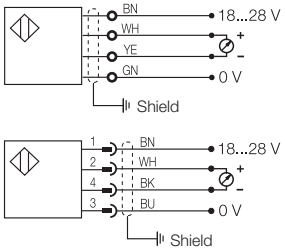
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series		
Working range		
Measuring range		
Ordering code		
Part number		
Supply voltage U_B		
Analog output		
No-load supply current I_0 max.		
Output current		
Cutoff frequency		
Polarity reversal/short-circuit protected		
Settings		
Emitter, light type		
Wavelength		
Laser class		
Light spot diameter		
Temperature drift		
Resolution		
Linearity		
Power-on indicator		
Contamination indicator		
Cutoff frequency		
Rise time (from 10% to 90%)		
Fall-off time (from 90% to 10%)		
Degree of protection as per IEC 60529		
Ambient temperature T_a		
Permissible ambient light		
Material	Housing	
	Optical surface	
Connection		

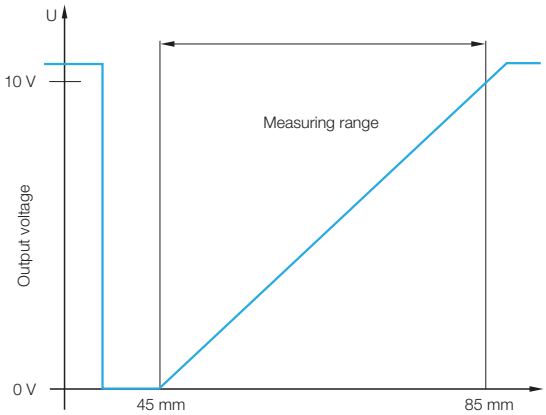
Measured values referenced to Kodak gray card 90 % reflective.

Connector orientation

Wiring diagrams



Analog output BOD 26K-LA0...



Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	BAM00TK

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connector
(please order separately)

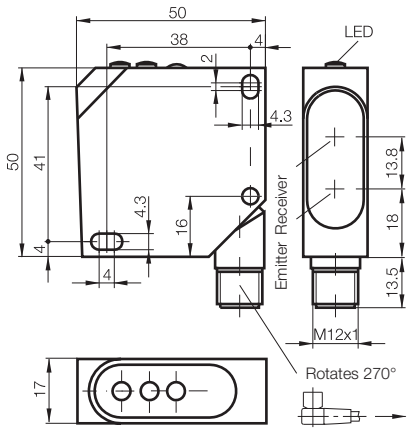
Size	Design	Cable material	Color	Length	Ordering code
Shielded M12, 4-pin	Straight	PUR	Black	5 m	BCC032L

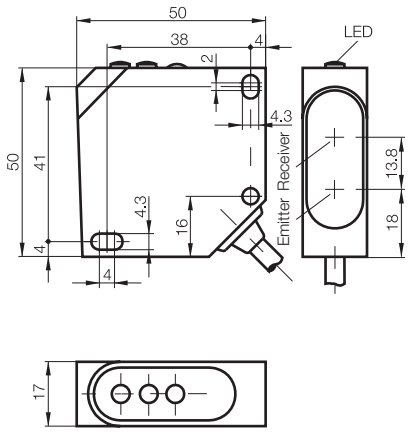
Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

BOD 26K-LA laser distance sensors

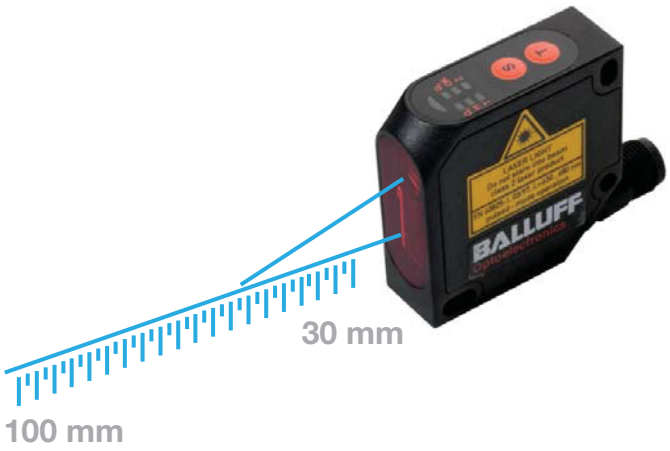
	BOD 26K	BOD 26K	BOD 26K	BOD 26K
	45...85 mm	**45...85 mm**	**45...85 mm**	**45...85 mm**
	40 mm	**40 mm**	**40 mm**	**40 mm**
	BOD0002	**BOD0004**	**BOD0001**	**BOD0003**
	BOD 26K-LA01-S4-C	BOD 26K-LA02-S4-C	BOD 26K-LA01-C-06	BOD 26K-LA02-C-06
	18...28 V DC	18...28 V DC	18...28 V DC	18...28 V DC
	0...10 V (max. 3 mA)	0...10 V (max. 3 mA)	0...10 V (max. 3 mA)	0...10 V (max. 3 mA)
	≤ 35 mA	≤ 35 mA	≤ 35 mA	≤ 35 mA
	100 mA	100 mA	100 mA	100 mA
	200 Hz	200 Hz	200 Hz	200 Hz
	Yes/Yes	Yes/Yes	Yes/Yes	Yes/Yes
	Fixed	Fixed	Fixed	Fixed
	Laser, red light	Laser, red light	Laser, red light	Laser, red light
	670 nm	670 nm	670 nm	670 nm
	2	2	2	2
	≤ 0.8 mm at 65 mm	≤ 0.8 mm at 65 mm	5×5 mm at 60 mm	5×5 mm at 60 mm
	18 µm/°C	18 µm/°C	18 µm/°C	18 µm/°C
	80 µm	20 µm	80 µm	20 µm
	≤ 1 %	≤ 1 %	≤ 1 %	≤ 1 %
	Green LED	Green LED	Green LED	Green LED
	Red LED	Red LED	Red LED	Red LED
	400 Hz	400 Hz	40 Hz	40 Hz
	3 ms	3 ms	30 ms	30 ms
	2 ms	2 ms	20 ms	20 ms
	IP 67	IP 67	IP 67	IP 67
	0...+45 °C	0...+45 °C	0...+45 °C	0...+45 °C
	EN 60947-5-2	EN 60947-5-2	EN 60947-5-2	EN 60947-5-2
	Impact-resistant ABS	Impact-resistant ABS	Impact-resistant ABS	Impact-resistant ABS
	PMMA	PMMA	PMMA	PMMA
	M12 connector, 4-pin	M12 connector, 4-pin	6 m PVC cable, 24 AWG	6 m PVC cable, 24 AWG



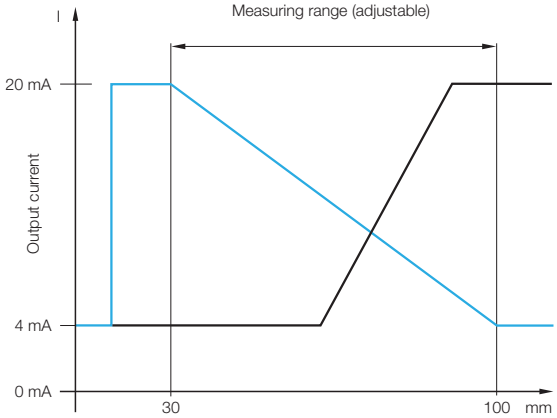


BOD 26K-LB Laser

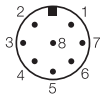
Features
- Adjustable measuring range between 30...100 mm
- Analog output 4...20 mA adjustable: Rising or falling
- Optional with RS485-interface (for master-slave-mode) and for visualization using a computer (additional software required)
- 2 switching outputs with adjustable switching points
- Teach-in
- Adjustable averaging
- Numerous additional functions



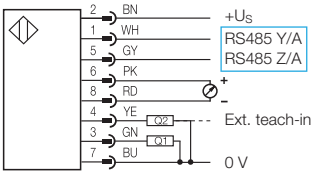
Analog output BOD 26K-LB(R)04...



Connector diagram



Wiring diagram



only type BOD 26K-LB**R**...

Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00TK**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

More mechanical accessories: You can find a large selection of mounting components of all types, such as clamping holders, mounting brackets and the Balluff mounting system BMS, in our Accessory Product Line catalog.

Suitable connector
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
Shielded M12, 8-pin	straight	PUR	Black	5 m	**BCC0995**
Shielded M12, 8-pin	angled	PUR	Black	5 m	**BCC0998**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

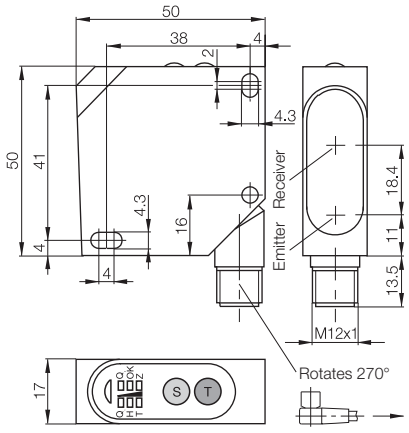
BOD 26K-LB laser distance sensors

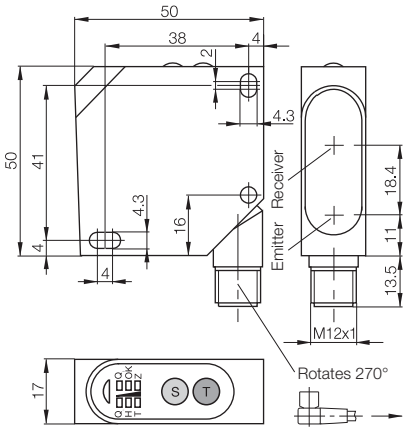
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series		**BOD 26K**	**BOD 26K**
Working range		**30...100 mm**	**30...100 mm**
Measuring range		**adjustable max. 70 mm**	**adjustable max. 70 mm**
2× PNP NO/NC	**Ordering code**	**BOD0005**	**BOD000C**
	Part number	BOD 26K-LB04-S115-C	BOD 26K-LBR04-S115-C
Supply voltage U_B		18...30 V DC	18...30 V DC
Analog output		4...20 mA	4...20 mA
No-load supply current I_0 max.		≤ 40 mA	≤ 40 mA
Output current		100 mA	100 mA
Switching type		Light/dark switching	Light/dark switching
Interface			**RS485**
Polarity reversal/short-circuit protected		Yes/Yes	Yes/Yes
Settings		Teach-in	Teach-in
Additional function			Master-slave mode
Emitter, light type		Laser, red light	Laser, red light
Wavelength		650 nm	650 nm
Laser class		2	2
Light spot diameter		3.25 mm at 100 mm	3.25 mm at 100 mm
Resolution		≤ 70 µm	≤ 70 µm
Linearity		≤ 175 µm	≤ 175 µm
Power-on indicator		Green LED	Green LED
Output function indicator		Yellow LED	Yellow LED
Switching frequency		1 kHz	1 kHz
Time function		50 ms pulse extension	50 ms pulse extension
Degree of protection as per IEC 60529		IP 67	IP 67
Ambient temperature T_a		–10...+60 °C	–10...+60 °C
Permissible ambient light		EN 60947-5-2	EN 60947-5-2
Material	Housing	Impact-resistant ABS	Impact-resistant ABS
	Optical surface	PMMA	PMMA
Connection		M12 connector,8-pin	M12 connector,8-pin

Measured values referenced to Kodak gray card 90% reflective.

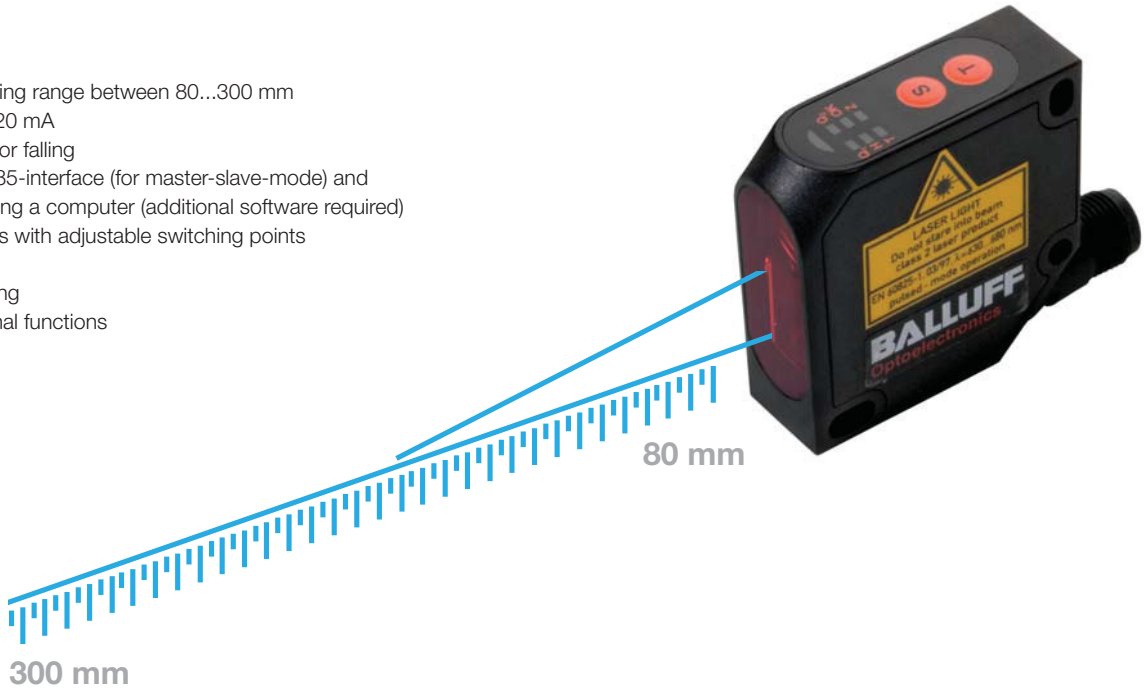
Connector orientation



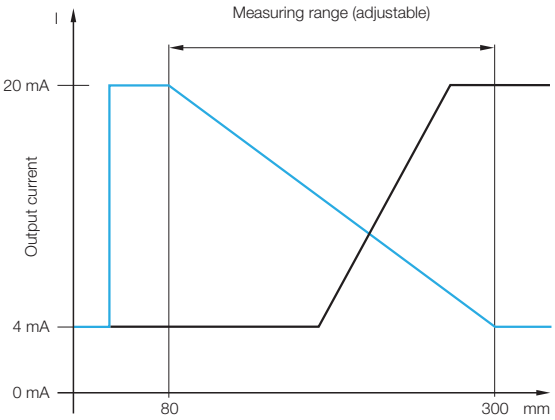


BOD 26K-LB
Laser

Features
- Adjustable measuring range between 80...300 mm
- Analog output 4...20 mA
  Adjustable: Rising or falling
- Optional with RS485-interface (for master-slave-mode) and for visualization using a computer (additional software required)
- 2 switching outputs with adjustable switching points
- Teach-in
- Adjustable averaging
- Numerous additional functions

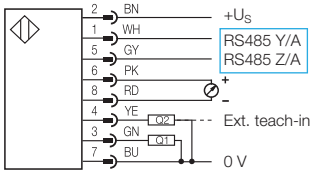


Analog output BOD 26K-LB(R)05...



Connector diagram

Wiring diagram



only type
BOD 26K-LB**R**...

Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00TK**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connector
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
M12, 8-pin	Straight	PUR	Black	5 m	**BCC0995**
M12, 8-pin	Angled	PUR	Black	5 m	**BCC0998**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

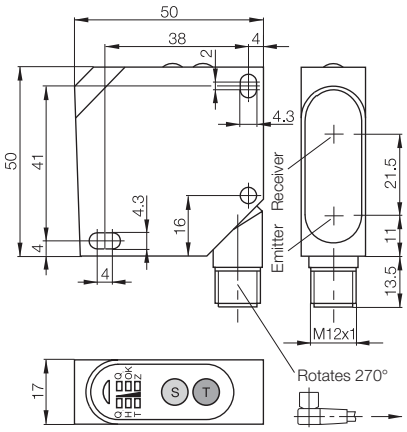
BOD 26K-LB laser distance sensors

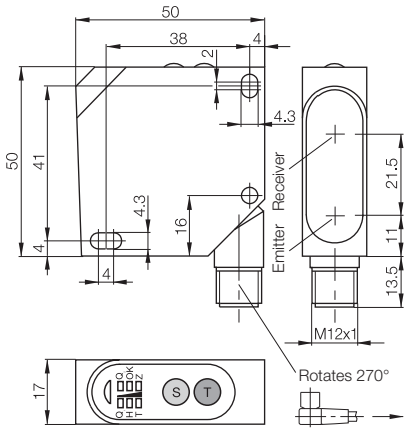
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series			**BOD 26K**	**BOD 26K**
Working range			**80...300 mm**	**80...300 mm**
Measuring range			**adjustable max. 220 mm**	**adjustable max. 220 mm**
2× PNP NO/NC		**Ordering code**	**BOD0006**	**BOD000E**
		Part number	BOD 26K-LB05-S115-C	BOD 26K-LBR05-S115-C
Supply voltage U_B			18...30 V DC	18...30 V DC
Analog output			4...20 mA	4...20 mA
No-load supply current I_0 max.			≤ 40 mA	≤ 40 mA
Output current			100 mA	100 mA
Switching type			Light/dark switching	Light/dark switching
Interface				**RS485**
Polarity reversal/short-circuit protected			Yes/Yes	Yes/Yes
Settings			Teach-in	Teach-in
Additional function				Master-slave mode
Emitter, light type			Laser, red light	Laser, red light
Wavelength			650 nm	650 nm
Laser class			2	2
Light spot diameter			4.5 mm at 300 mm	4.5 mm at 300 mm
Resolution			≤ 220 µm	≤ 220 µm
Linearity			≤ 550 µm	≤ 550 µm
Power-on indicator			Green LED	Green LED
Output function indicator			Yellow LED	Yellow LED
Switching frequency			1 kHz	1 kHz
Time function			50 ms pulse extension	50 ms pulse extension
Degree of protection as per IEC 60529			IP 67	IP 67
Ambient temperature T_a			–10...+60 °C	–10...+60 °C
Permissible ambient light			EN 60947-5-2	EN 60947-5-2
Material		Housing	Impact-resistant ABS	Impact-resistant ABS
		Optical surface	PMMA	PMMA
Connection			M12 connector,8-pin	M12 connector,5-pin

Measured values referenced to Kodak gray card 90% reflective.

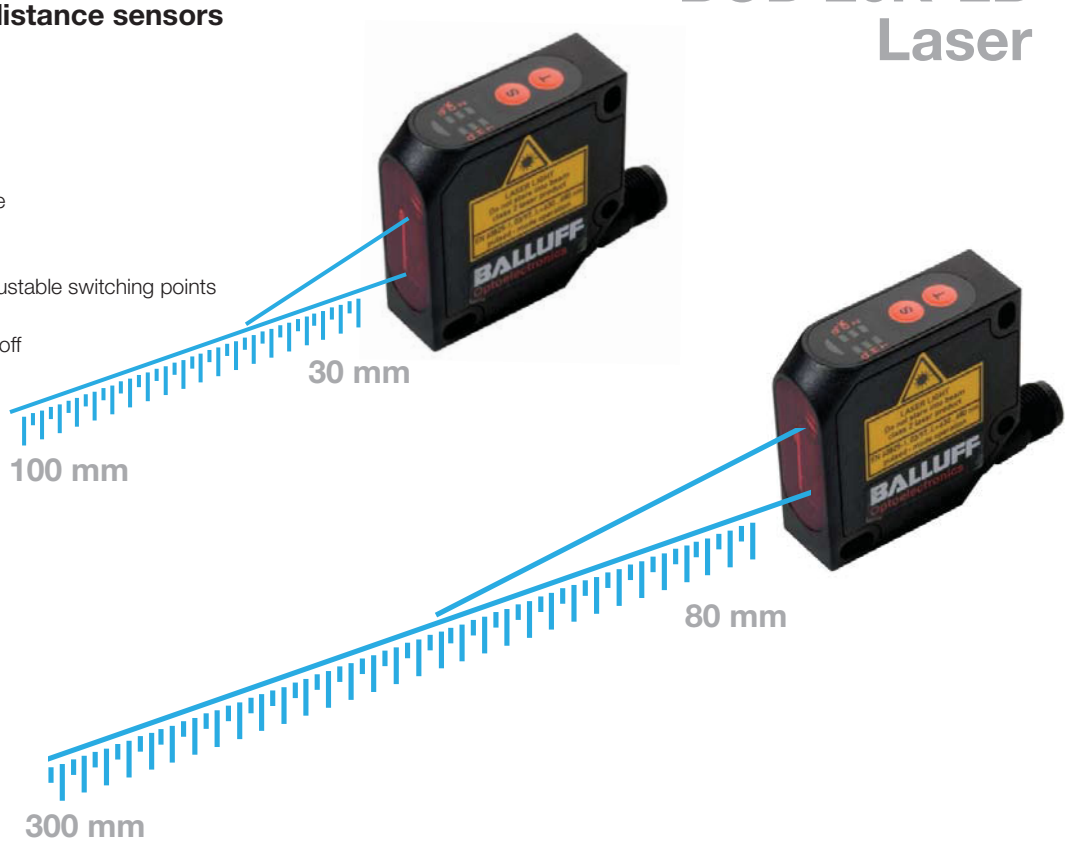
Connector orientation





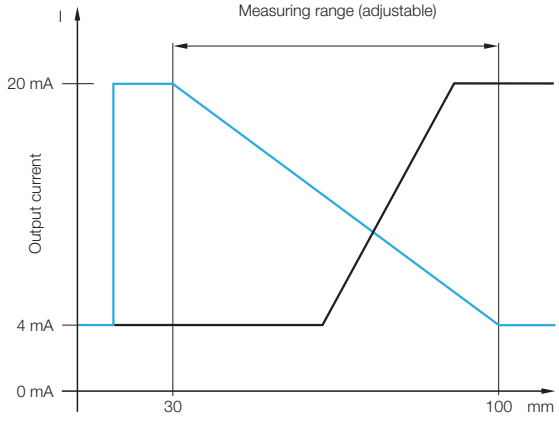
BOD 26K-LB Laser

Features
- Adjustable measuring range
- Analog output 4...20 mA
  Adjustable: Rising or falling
- 1 switching output with adjustable switching points
- Teach-in
- Laser beam can be turned off

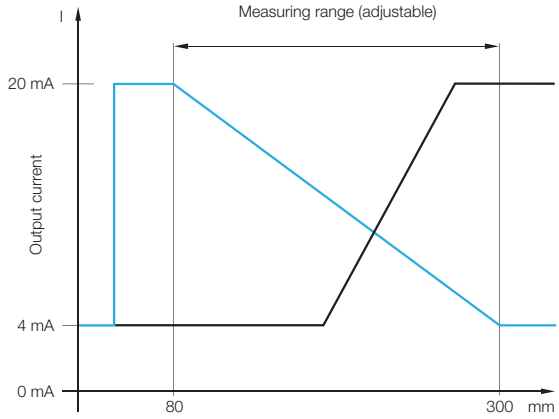


Connector diagram

Analog output BOD 26K-LB06...



Analog output BOD 26K-LB07...



Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00TK**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connector
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	Straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	Angled	PUR	Black	5 m	**BCC08FC**

Connectors without LED are suitable for PNP and NPN sensors.

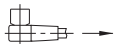
More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

BOD 26K-LB laser distance sensors

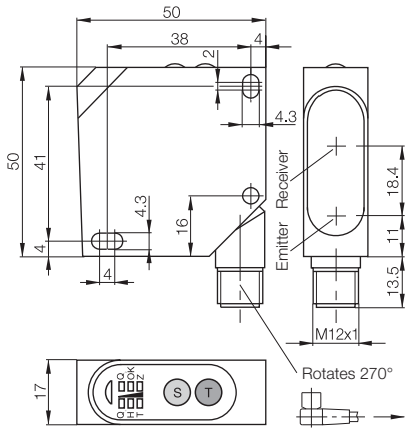
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

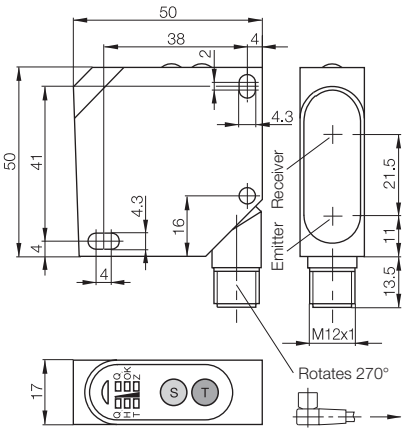
Series			**BOD 26K**	**BOD 26K**
Working range			**30...100 mm**	**80...300 mm**
Measuring range			**adjustable max. 70 mm**	**adjustable max. 220 mm**
PNP	NO/NC	**Ordering code**	**BOD0007**	**BOD0008**
		Part number	BOD 26K-LB06-S92-C	BOD 26K-LB07-S92-C
Supply voltage U_B			18...30 V DC	18...30 V DC
Analog output			4...20 mA	4...20 mA
No-load supply current I_0 max.			≤ 40 mA	≤ 40 mA
Output current			100 mA	100 mA
Switching type			Light/dark switching	Light/dark switching
Polarity reversal/short-circuit protected			Yes/Yes	Yes/Yes
Settings			Teach-in	Teach-in
Emitter, light type			Laser, red light	Laser, red light
Wavelength			650 nm	650 nm
Laser class			2	2
Light spot diameter			3.25 mm at 100 mm	4.5 mm at 300 mm
Resolution			≤ 70 µm	≤ 220 µm
Linearity			≤ 175 µm	≤ 550 µm
Power-on indicator			Green LED	Green LED
Output function indicator			Yellow LED	Yellow LED
Switching frequency			1 kHz	1 kHz
Time function			50 ms pulse extension	50 ms pulse extension
Degree of protection as per IEC 60529			IP 67	IP 67
Ambient temperature T_a			–10...+60 °C	–10...+60 °C
Permissible ambient light			EN 60947-5-2	EN 60947-5-2
Material		Housing	Impact-resistant ABS	Impact-resistant ABS
		Optical surface	PMMA	PMMA
Connection			M12 connector, 5-pin	M12 connector, 5-pin

Measured values referenced to Kodak gray card 90% reflective.

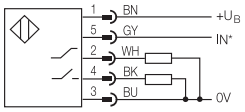


Connector orientation





Wiring diagram



*Laser shut-off (+U_S)
Key disable (0 V)

BOD 63M Laser

The **BOD 63M** in a robust metal housing has a working range of 200...2000/6000 mm. It has adjustable background suppression and an analog output with 0...10 V or 4...20 mA. Time of flight measurement enables longer ranges than using triangulation or energetic light scanners.
The switching outputs are set using a multi-turn-potentiometer.
This innovative sensor technology is used in applications where traditional methods meet either technological or economical limits. Such applications include detecting small objects at large distances and operating in difficult conditions, such as if sensing must be performed "outside" of processes with high temperatures or in robotic cells.

Features

- Small laser spot for detecting small objects over large distances
- Virtually independent of the reflective properties of the target object within a specific sensing distance
- Background suppression across the entire working range
- Analog, switching and alarm output
- Laser beam can be turned off

Applications

- Exact detection tasks over long distances (e.g. due to design limitations or heat at the target location)
- Detecting objects with changing colors, shiny surfaces or unfavorable angles to the light beam
- Flexible solutions for position detection, level measurement and monitoring, distance and height measurement, quality assurance applications

Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00P6**

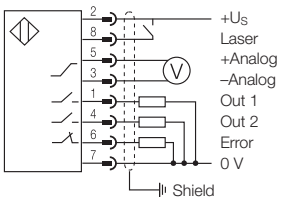
Suitable connector
(please order separately)

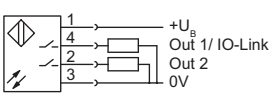
Size	Design	Cable material	Color	Length	Ordering code
M12, 8-pin	Straight	PUR	Black	5 m	**BCC0995**
M12, 8-pin	Angled	PUR	Black	5 m	**BCC0998**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

Wiring diagram





Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series		
Working range		
Measuring range		
2× PNP NO	**Ordering code**	
	Part number	
Supply voltage U_B		
Analog output		
No-load supply current I_0 max.		
Switching type		
Polarity reversal/short-circuit protected		
Settings		
Emitter, light type		
Wavelength		
Laser class		
Light spot diameter		
Resolution		
Gray value shift		
Repeat accuracy per BWN		
Temperature drift		
Linearity		
Switching hysteresis		
Power-on indicator		
Switching output		
Stability indicator		
Ready delay		
Response time		
Switching frequency		
Degree of protection as per IEC 60529		
Ambient temperature T_a		
Permissible ambient light		
Material	Housing	
	Optical surface	
Connection		

IO-Link

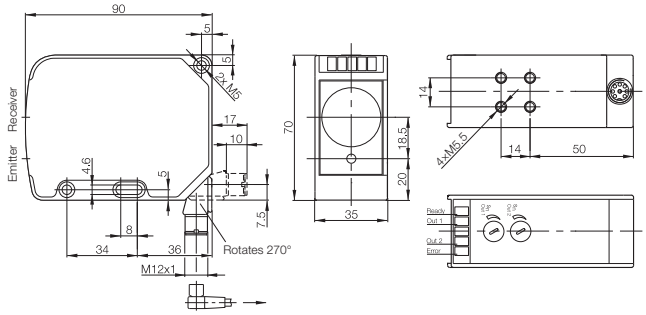
Mode	
Transfer rate	
Value range	
Diagnostics	
Parameters	

Measured values referenced to Kodak gray card 90% reflective.

Connector orientation

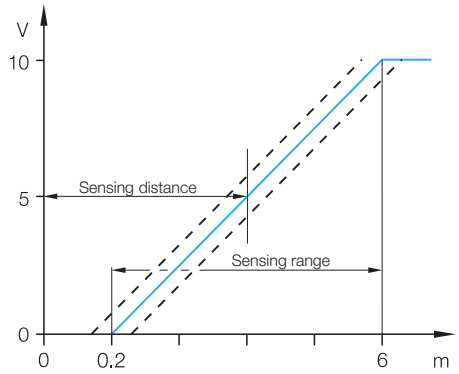
	BOD 63M 200...6000 mm 5800 mm BOD0012	BOD 63M 200...2000 mm 1800 mm BOD000U	BOD 63M 200...2000 mm 1800 mm BOD0010
	BOD 63M-LI06-S4	BOD 63M-LA02-S115	BOD 63M-LB02-S115
	18...30 V DC	15...30 V DC	15...30 V DC
		0...10 V	**4...20 mA**
	≤ 90 mA	≤ 75 mA	≤ 75 mA
	Light switching	Light switching	Light switching
	Yes/Yes	Yes/Yes	Yes/Yes
	Teach-in	Potentiometer, 4 revolutions	Potentiometer, 4 revolutions
	Laser, red light	Laser, red light	Laser, red light
	660 nm	660 nm	660 nm
	2	2 per EN 60825	2 per EN 60825
	5 mm at 3 m 10 mm at 6 m	10 mm	10 mm
	≤ 2 mm	≤ 1 mm	≤ 1 mm
	≤ 1.5%	≤ 2 %	≤ 2 %
	≤ ±4 mm	≤ ±3 mm	≤ ±3 mm
	≤ 2 mm/°C	≤ 0.6 mm/°C	≤ 0.6 mm/°C
	≤ ±1%	≤ ±2%	≤ ±2 %
	≤ 15 mm	≤ 10 mm	≤ 10 mm
	Green LED	Green LED	Green LED
	Yellow LED	2× yellow LED	2× yellow LED
	Red LED	Red LED	Red LED
	≤ 20 ms	≤ 20 ms	≤ 20 ms
		≤ 2 ms	≤ 2 ms
	≥ 150 Hz	≥ 250 Hz	≥ 250 Hz
	IP 65	IP 67	IP 67
	–10...+60 °C	–10...+60 °C	–10...+60 °C
	≤ 10 klx	≤ 10 klx	≤ 10 klx
	Anodized aluminum	Anodized aluminum	Anodized aluminum
	Glass	Glass	Glass
	M12 connector, 4-pin	M12 connector,8-pin	M12 connector,8-pin

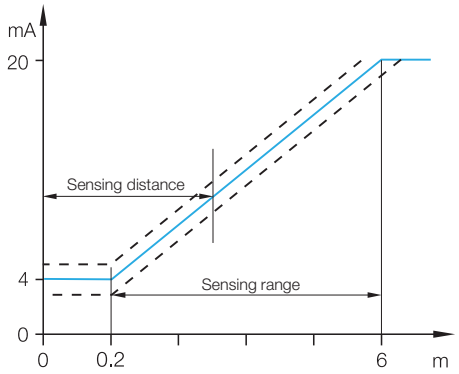
COM 2
38.4 kbaud
00C8 H...1770 H
Stability indicator
Switching points, laser on/off, button disable



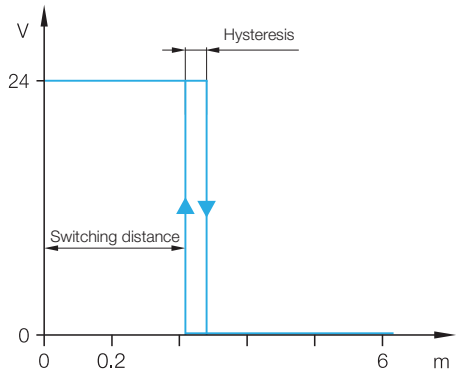
Laser class
The emitter corresponds to a class 2 laser according to EN 60825-1:2001-11.
Thus no additional protective measures are required for operation.
Install the device so that the laser warning label is easily visible.

Analog output

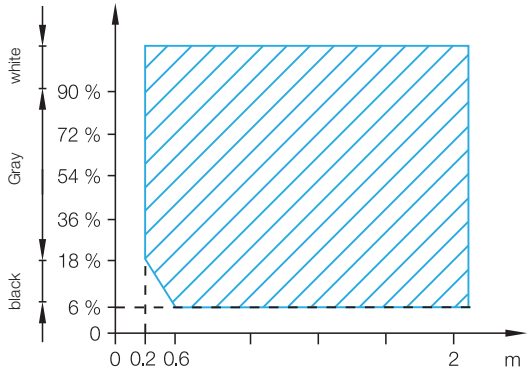




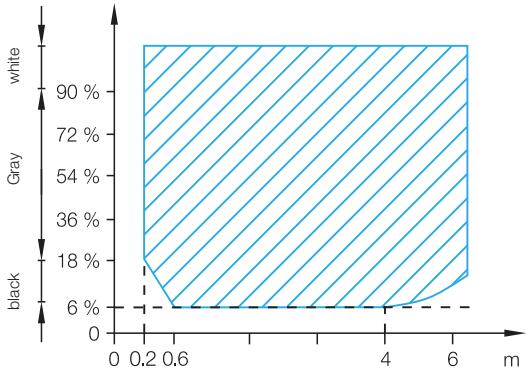
Switching output



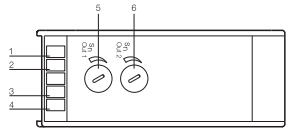
Measuring range BOD 63M-LA/LB02... depending on object reflection



Measuring range BOD 63M-LA/LB04... depending on object reflection



Indicators and operating elements



1 Supply voltage (green)
2 Switching output Out 1 (yellow)
3 Switching output Out 2 (yellow)
4 Stability indicator (red)
5 Potentiometer Out 1, 4 revolutions
6 Potentiometer Out 2, 4 revolutions

Connector diagram

Pin-assignment	Cable color	
1	white	Out 1
2	brown	$+U_S$
3	Green	–Analog output
4	Yellow	Out 2
5	Gray	+Analog output
6	pink	Stability indicator
7	Blue	0 V
8	Red	Laser shut-off
Knurled nut	Braided shield	Shield

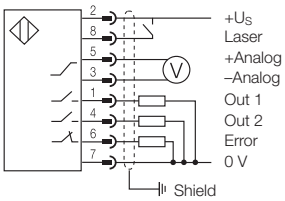
BOD 63M laser distance sensors

Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series		**BOD 63M**	**BOD 63M**
Working range		**200...6000 mm**	**200...6000 mm**
Measuring range		**5800 mm**	**5800 mm**
2× PNP NO	**Ordering code**	**BOD000W**	**BOD0011**
	Part number	BOD 63M-LA04-S115	BOD 63M-LB04-S115
Supply voltage U_B		15...30 V DC	15...30 V DC
Analog output		**0...10 V**	**4...20 mA**
No-load supply current I_0 max.		≤ 75 mA	≤ 75 mA
Output current	Switching output	200 mA	200 mA
	Error output	200 mA	200 mA
Switching type		Light switching	Light switching
Polarity reversal/short-circuit protected		Yes/Yes	Yes/Yes
Settings		Potentiometer, 4 revolutions	Potentiometer, 4 revolutions
Emitter, light type		Laser, red light	Laser, red light
Wavelength		660 nm	660 nm
Laser class		2 per EN 60825	2 per EN 60825
Light spot diameter		10 mm	10 mm
Resolution		≤ 1 mm	≤ 1 mm
Gray value shift		≤ 1.5%	≤ 1.5%
Repeat accuracy per BWN		≤ ±4 mm	≤ ±4 mm
Temperature drift		≤ 1.5 mm/°C	≤ 1.5 mm/°C
Linearity		≤ ±1%	≤ ±1%
Switching hysteresis		≤ 15 mm	≤ 15 mm
Power-on indicator		Green LED	Green LED
Switching output		2× yellow LED	2× yellow LED
Stability indicator		Red LED	Red LED
Ready delay		≤ 20 ms	≤ 20 ms
Response time		≤ 2 ms	≤ 2 ms
Switching frequency		≥ 250 Hz	≥ 250 Hz
Degree of protection as per IEC 60529		IP 67	IP 67
Ambient temperature T_a		–10...+60 °C	–10...+60 °C
Permissible ambient light		≤ 10 klx	≤ 10 klx
Material	Housing	Anodized aluminum	Anodized aluminum
	Optical surface	Glass	Glass
Connection		M12 connector,8-pin	M12 connector,8-pin

Measured values referenced to Kodak gray card 90% reflective.

Connector orientation



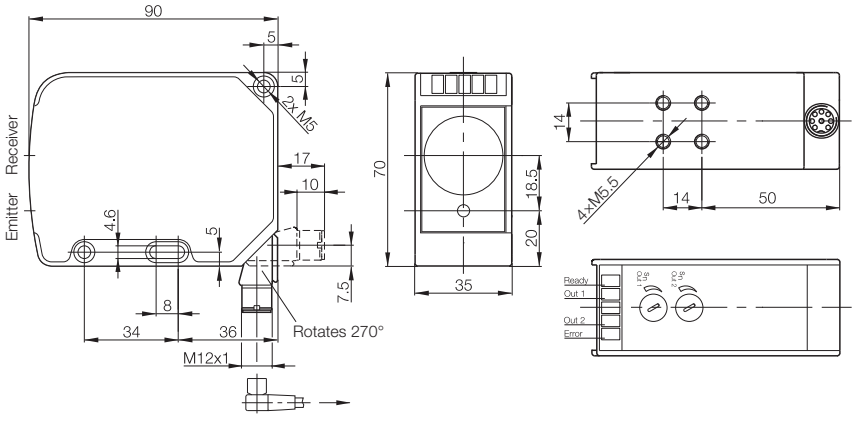


Photo electric distance sensors
Applications
Product overview
BOD 6K
BOD 21M Laser
BOD 26K-LA Laser
BOD 26K-LB Laser
BOD 63M Laser
BOD 66M-R
BOD 66M-L Laser

Distance measurements with high resolution are achieved using triangulation and modern CCD technology.
The **BOD 66M-R_01** with analog voltage or current output and an additional switching output can measure or monitor distance and, at the same time, operate as a light scanner with background suppression for object detection.
The BOD 66M-R_01 uses red light over a measuring range of 100...600 mm at a resolution of 0.5 mm.

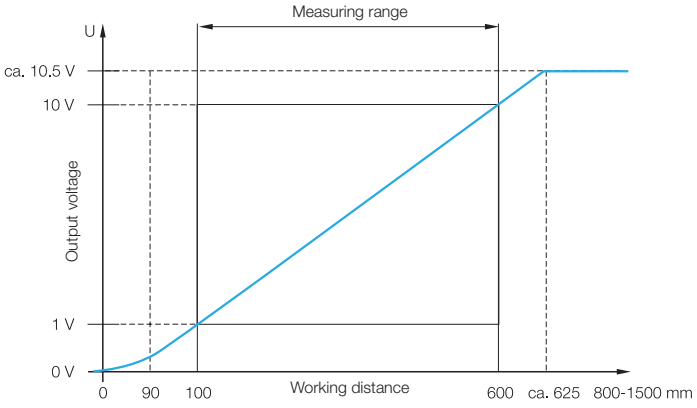
Features

- Extremely color and ambient light insensitive
- Working range 100...600 mm
- Resolution 0.5 mm
- Analog output with voltage (1...10 V) or current (4...20 mA)
- PNP switching output teachable
- Rugged metal housing
- Scratch-resistant glass optics

Applications

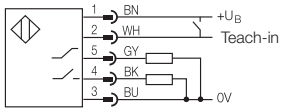
- Level monitoring
- Positioning tasks
- Winding diameter detection
- Profile measurement
- Sag control

Analog output BOD 66M-R...



Connector diagram

Wiring diagram



Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00P9**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connectors
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	Straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	Angled	PUR	Black	5 m	**BCC08FC**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

BOD 66M-R distance sensors

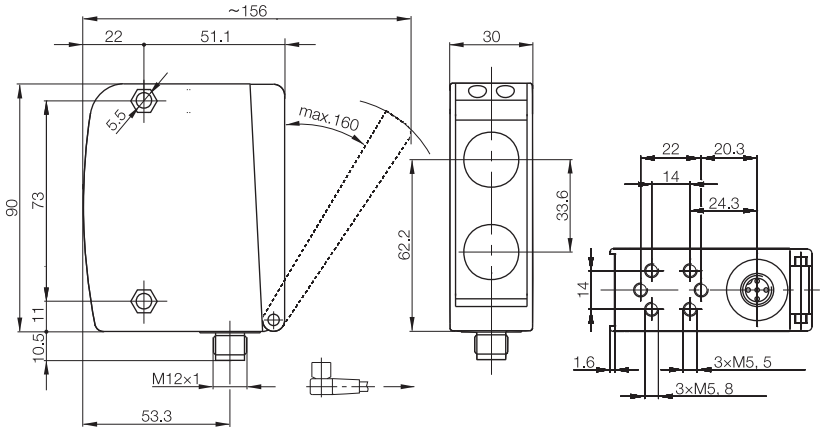
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

Series			**BOD 66M**	**BOD 66M**
Working range			**100...600 mm**	**100...600 mm**
Measuring range			**500 mm**	**500 mm**
PNP	NO	**Ordering code**	**BOD0015**	**BOD0016**
		Part number	BOD 66M-RA01-S92-C	BOD 66M-RB01-S92-C
Supply voltage U_B			18...30 V DC	18...30 V DC
Analog output			**0...10 V**	**4...20 mA**
No-load supply current I_0 max.			≤ 150 mA	≤ 150 mA
Output current			250 mA	250 mA
Switching type			Light switching	Light switching
Polarity reversal/short-circuit protected			Yes/Yes	Yes/Yes
Settings			Teach-in	Teach-in
Emitter, light type			LED, red light	LED, red light
Wavelength			660 nm	660 nm
Light spot diameter			approx. 10 mm	approx. 10 mm
Resolution			≤ 0.5 mm	≤ 0.5 mm
Gray value shift (90 %/6 %)			≤ 1 %	≤ 1 %
Repeat accuracy per BWN			±0.5%	±0.5%
Temperature drift			0.2 mm/°C	0.2 mm/°C
Absolute measuring accuracy**			±2% (at the measuring distance)	±2% (at the measuring distance)
Power-on indicator			Green LED	Green LED
Output function indicator			Yellow LED	Yellow LED
On/off delay			≤ 100 ms	≤ 100 ms
Ready delay			≤ 300 ms	≤ 300 ms
Switching frequency			20...100 Hz*	20...100 Hz*
Degree of protection as per IEC 60529			IP 65	IP 65
Ambient temperature T_a			–20...+50 °C	–20...+50 °C
Permissible ambient light			≤ 5 klx	≤ 5 klx
Material		Housing	Anodized aluminum	Anodized aluminum
		Optical surface	Glass	Glass
Connection			M12 connector,5-pin	M12 connector,5-pin

*depending on object reflectivity

**Target ≤ 50×50 mm²

Connector orientation



BOD 66M-L Laser

The **BOD 66M-L_04** features an analog as well as an additional switching output.
It measures the object position across a range from 200...2000 mm. In addition, it allows the switching output (background suppression) to be configured in the same area using teach-in. Forward-looking laser- and CCD-technology ensure accuracy and reliability.

Features

- Laser class 2
- Small light spot over the entire range
- Extremely color and ambient light insensitive due to CCD line receiver
- Analog current or voltage output over 200...2000 mm
- PNP switching output, teachable
- Rugged metal housing
- Scratch-resistant glass optics

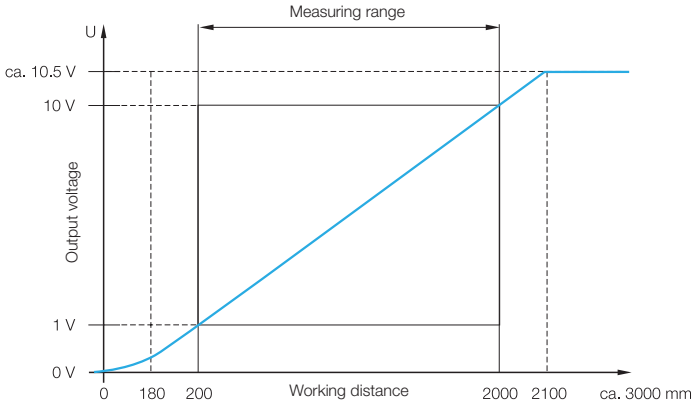
Applications

- Background suppression up to 2 m
- Analog measuring at up to 2 m target distance
- Positioning tasks

Laser class
(see page 895)

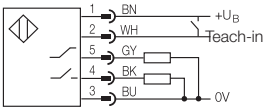
The emitter corresponds to a class 2 laser according to EN 60825-1:2001-11. Thus no additional protective measures are required for operation.
Install the device so that the laser warning label is easily visible.

Analog output BOD 66M-L...



Connector diagram

Wiring diagram



Recommended accessories
(please order separately)

Description	Ordering code
Mounting bracket	**BAM00P9**

You can find special accessories for photoelectric sensors, such as **reflectors, apertures, lenses, filters and deflection heads,** in the Object Detection Catalog.

Suitable connectors
(please order separately)

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	angled	PUR	Black	5 m	**BCC08FC**

Connectors without LED are suitable for PNP and NPN sensors.

More electrical accessories: You can find a large selection of plug connectors and connector cables in a wide variety of cable materials, colors, and lengths in our **Industrial Networking and Connectivity catalog.**

Distance sensors BOD 66M-L Laser

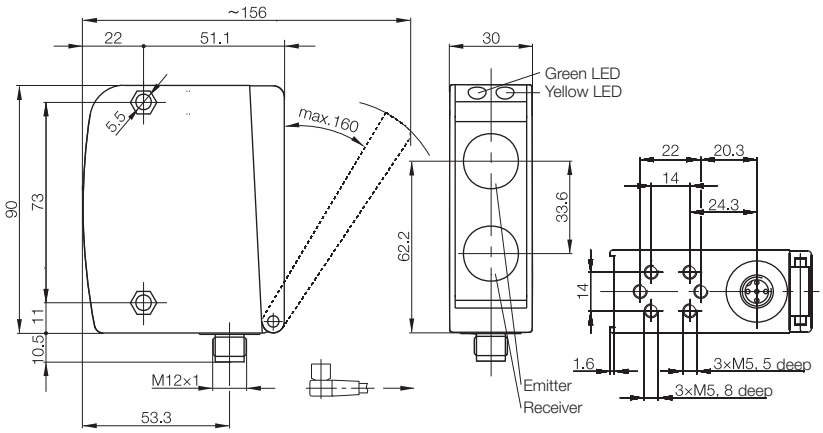
Distance sensors are assigned the linear position sensing and measurement that we have marked in blue.

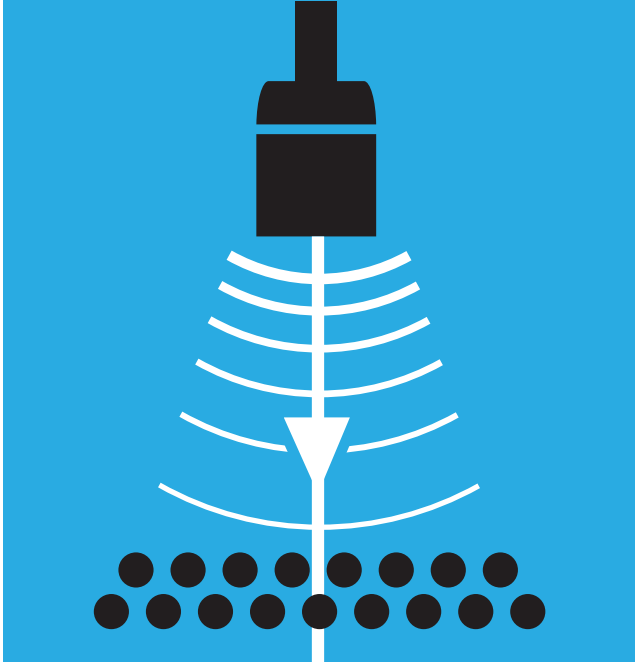
Series			**BOD 66M**	**BOD 66M**
Working range			**200...2000 mm**	**200...2000 mm**
Measuring range			**1800 mm**	**1800 mm**
PNP	NO	**Ordering code**	**BOD0013**	**BOD0014**
		Part number	BOD 66M-LA04-S92-C	BOD 66M-LB04-S92-C
Supply voltage U_B			18...30 V DC	18...30 V DC
Analog output			**1...10 V**	**4...20 mA**
No-load supply current I_0 max.			≤ 150 mA	≤ 150 mA
Output current			250 mA	250 mA
Switching type			Light switching	Light switching
Polarity reversal/short-circuit protected			Yes/Yes	Yes/Yes
Settings			Teach-in	Teach-in
Emitter, light type			Laser, red light	Laser, red light
Wavelength			660 nm	660 nm
Laser class			2	2
Light spot diameter			3× 12 mm² at 2 m	3× 12 mm² at 2 m
Resolution			≤ 5 mm	≤ 5 mm
Gray value shift (90 %/6 %)			≤ 1 %	≤ 1 %
Repeat accuracy			±0.5%	±0.5%
Temperature drift			0.6 mm/°C	0.6 mm/°C
Absolute measuring accuracy**			±2% (at the measuring distance)	±2% (at the measuring distance)
Power-on indicator			Green LED	Green LED
Output function indicator			Yellow LED	Yellow LED
On/off delay			≤ 100 ms	≤ 100 ms
Ready delay			≤ 300 ms	≤ 300 ms
Switching frequency			10...100 Hz*	10...100 Hz*
Degree of protection as per IEC 60529			IP 65	IP 65
Ambient temperature T_a			–20...+50 °C	–20...+50 °C
Permissible ambient light			≤ 5 klx	≤ 5 klx
Material		Housing	Anodized aluminum	Anodized aluminum
		Optical surface	Glass	Glass
Connection			M12 connector, 5-pin	M12 connector, 5-pin

*depending on object reflectivity

**Target ≤ 50×50 mm²

 Connector orientation





Ultrasonic Sensors

Regardless of color and material
BUS ultrasonic sensors are perfect for distance measurement or position detection of granules, fluids and powders. They measure fill levels, heights and sag without making contact as well as count and monitor the presence of objects.
They are extremely versatile, operate independently of color and surface finish, and are not affected by transparent objects that generate strong reflections.
Ultrasonic sensors are designed for critical situations. Dust, dirt and steam do not pose a problem.

Broad detection range – high precision
Balluff ultrasonic sensors detection ranges extend from 20 mm to 8 m. Their high resolution and small blind zones ensure extreme precision. Integral synchronization means that the sensors do not interfere with one another.

Switching and analog variants
BUS ultrasonic sensors differ from one another in their output signal. Each series is available as a switching or analog version. All analog versions are available with voltage or current output (0...10 V or 4...20 mA). The BUS M30 includes variants with two switching outputs (one switching and one analog output, or two switching outputs and one analog output) so that one sensor can adopt the function of a second sensor.

IO-Link
BUS 18M sensors with push/pull output are equipped with an IO-Link interface that enables a change from SIO mode to IO-Link mode.

IO-Link

Ultrasonic Sensors
Contents

Balluff ultrasonic sensors for difficult environments

Because the distance to the object is determined via a sound transit time, ultrasonic sensors have excellent background suppression. With their transit time measurement, ultrasonic sensors can record the measured value with highly-precise resolution. Some sensors to even 0.025 mm.
The sensors are able to measure in dusty air or through paint spray mist. Nearly all materials that reflect the sound are detected. Even thin foils, crystal clear materials and different colors are no problem for ultrasonic sensors. Thin deposits on the sensor membrane do not affect sensor function.

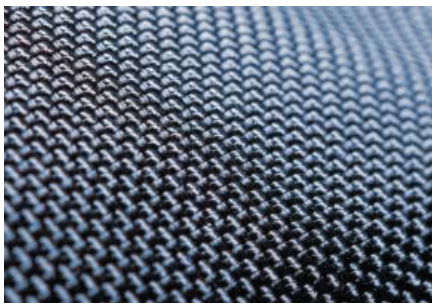
Colors
Red, green, yellow or blue — all make no difference to Balluff ultrasonic sensors: they reliably detect all colors.

Transparent layers
Glass plates, Plexiglas and razor thin foils — BUS ultrasonic sensors reliably detect transparent layers.

Surfaces of bulk materials
Fine sand, shavings or coarse-grained materials — in the areas of fill-level measurement, our ultrasonic sensors are unbeatable.

Contrasts
Black objects against a black background or white on white — BUS sensors perform flawlessly regardless of contrast.

Liquids
Clear water, cloudy liquids, oils or black coffee — ultrasonic sensors can be used with nearly any liquid.



Material surfaces
Whether velvet, wool or leather — nearly all clothing materials can be simply detected with our BUS ultrasonic sensors.

BUS ultrasonic sensors are ideal for the following industries

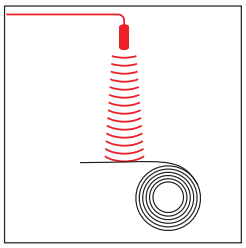
- Handling and automation
- Specialty machine construction
- Automotive industry
- Bottling and packaging
- Pharmaceutical industry
- Plastic and rubber industry
- Timber and furniture industry
- Paper and printing industry
- Conveying
- Commercial vehicles
- Scales
- Agricultural machinery
- Food processing machinery
- Office and information technology
- Construction and building material machinery
- Textile machinery

Handling and automation

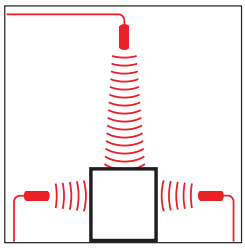
Bottling and packaging

Automotive industry

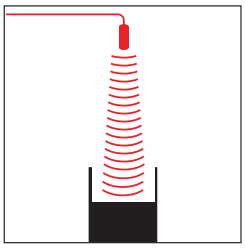
Ultrasonic sensors can be used in many application areas



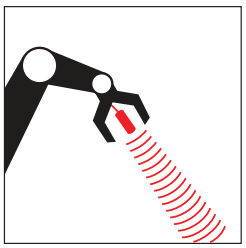
Foil tear monitoring
Ultrasonic sensors with switching output can be used for foil tear monitoring. If large waves are formed in the foil, the sensor should be operated as a diffuse reflective sensor. This operating mode functions reliably even if the sound is reflected by waves in the foil.



Height and width measurement
Through the use of multiple BUS M30 or BUS 18M ultrasonic sensors, three-dimensional measurements can be made for everything from small boxes to large cartons.

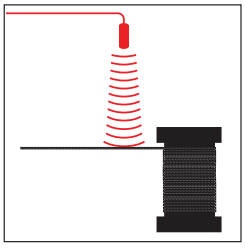


Presence verification
BUS detect filled or empty pallets and measure the content of transport containers. If a box or a container is to be inspected with multiple sensors, they can be synchronized with each other.

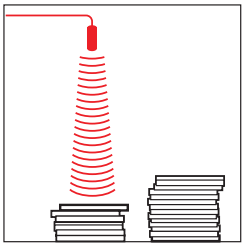


Robot positioning
Due to their small dimensions, BUS are ideally suited for exactly positioning robot arms: BUS 18M ultrasonic sensors in threaded sleeve and BUS R06K in block-style housing.

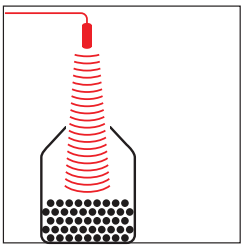
Positioning
When scanning glass plates or other smooth and flat surfaces, make certain that the ultrasound strikes the surface at a right angle.



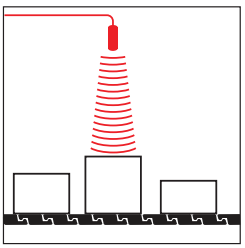
Wire-breakage monitoring
When winding and unwinding a wire rope, ultrasonic sensors with analog output detect its position on the layer.



Stack-height detection
Whether wooden boards, glass plates, paper or color plastic plates, BUS ultrasonic sensors measure stack heights with high precision.



Fill-level monitoring
In silos, bunkers, containers – for all bulk materials (e.g., sand, gravel, coal, grain), our ultrasonic sensors are ideal.



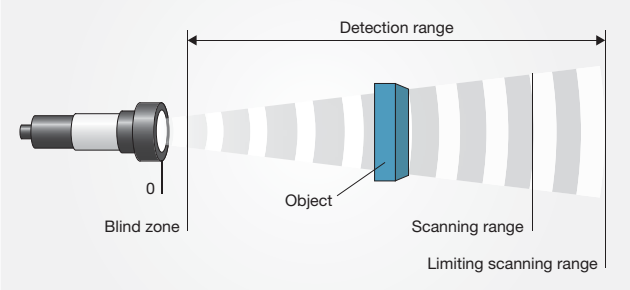
Object detection
BUS ultrasonic sensors sort containers and parts with different heights. BUS count objects. And with absolute reliability.

Sensor selection

Important selection criteria for an ultrasonic sensor are its scanning range and the associated, three-dimensional detection range.

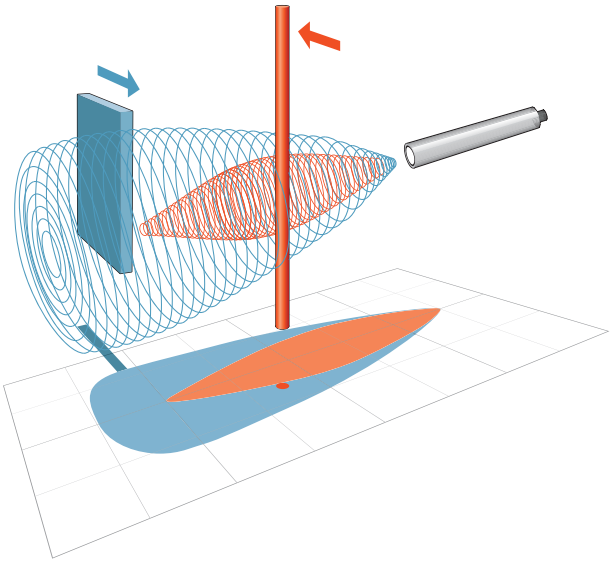
Definitions

- **Blind zone**
  The blind zone defines the smallest reliable scanning range of the sensor. There must be no objects or interfering reflections within the blind zone, as measurement errors may otherwise occur.
- **Operating scanning range**
  The operating scanning range is the typical working range of a sensor. For objects with good reflective properties, it can also be used up to its limiting scanning range.
- **Detection range**
  The detection range is measured using various standard targets.

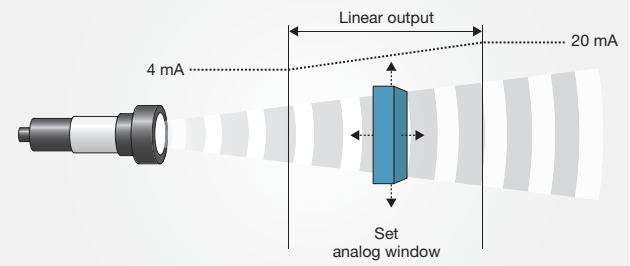


Detection ranges

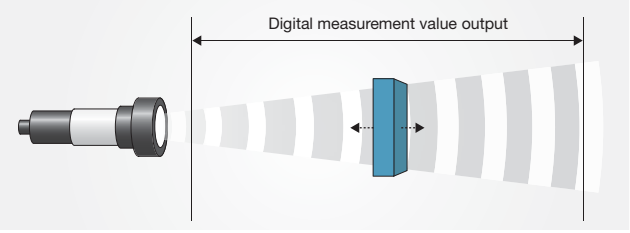
The red areas are measured with a thin round rod (Ø 10 mm or 27 mm, depending on sensor type) and show the typical working range of a sensor.
To obtain the blue areas, a plate is moved into the sound fields from the side. In doing so, the optimum angle of the plate to the sensor is set. This is thus the maximum detection range of the sensor.
It is not possible to evaluate ultrasound reflections outside of the blue sound cones.



Ultrasonic sensors with analog output output the measured distance value as a voltage that is proportional to distance (0...10 V) or as current that is proportional distance (4...20 mA). For the ultrasonic sensors with analog output, the sensor-near and sensor-distant window limits of the analog characteristic as well as a rising or falling characteristic can be set. Depending on the sensor model and window width, the resolution is between 0.025 mm and 0.36 mm.



Ultrasonic sensors with IO-Link enable gapless communication through all levels of the system architecture: from the sensor to the top fieldbus level. Transmission of the measured distance value to the controller is bit serial.



Scanning range
Blind zone
Limiting scanning range

BUS M30M analog output	
Resolution (depends on analog window used)	
0...10 V / 4...20 mA	**Ordering code**
	Part number

BUS M30M switching and analog output	
Resolution (depends on analog window used)	
0...10 V / 4...20 mA	**Ordering code**
PNP, NO/NC contact	Part number
0...10 V / 4...20 mA	**Ordering code**
2x NPN, NO/NC contact	Part number

Features and benefits

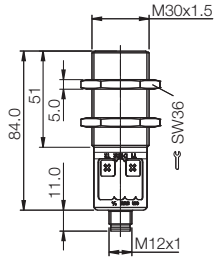
- **Display with direct, measured value output**
  for immediately visible results
- **Numeric setting of the sensor via the display**
  for completely presetting the sensor
- **Automatic synchronization and multiplex operation**
  for simultaneous operation of up to ten sensors
- **5 scanning ranges with a measuring range from 30 mm to 8 m**
- **Analog output 4...20 mA and 0...10 V**
  Automatic changeover between current and voltage output
- **Analog output plus switching output**
  for measurement that is proportional to distance with an additional limit value
- **Teach-in via 2 buttons**
  for simple, menu-driven commissioning

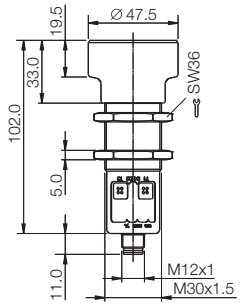
TouchControl
With TouchControl, all settings are made on the sensors. The three-digit LED indicator continuously displays the current distance value and automatically switches between mm and cm display. Two buttons are used to call up the configuration and navigate through the self-explanatory menu structure.

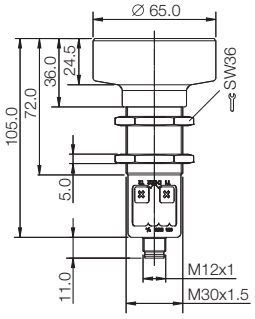
Inspecting transport boxes for “in order parts”
Target objects show up on conveyor belts. Multiple ultrasonic sensors simultaneously monitor transport containers for in order parts. Reflective, transparent or different-colored surfaces are reliably detected. In multiplex operation, mutual interference of the sensors is prevented.

General data		
Supply voltage		9...30 V DC, polarity reversal protected
Output current		200 mA
Accuracy		± 1% (temperature drift internally compensated)
Degree of protection as per EN 60529		IP 67
Operating temperature		–25...+70°C
Material	Housing	Nickel-plated brass, plastic parts: PBT, TPU
	Sensing surface	Polyurethane foam, epoxy resin containing glass
Connection		M12 connector, 5-pin

	30…250 mm	**65…350 mm**	**200…1300 mm**	**350…3400 mm**	**600…6000 mm**
	30 mm	65 mm	200 mm	350 mm	600 mm
	350 mm	600 mm	2000 mm	5000 mm	8000 mm
	0.025...0.10 mm	0.025...0.17 mm	0.18...0.57 mm	0.18...1.5 mm	0.18...2.4 mm
	BUS002N	**BUS005K**	**BUS003F**	**BUS003T**	**BUS0041**
	BUS M30M1-XC-03/025-S92K	BUS M30M1-XC-07/035-S92K	BUS M30M1-XC-20/130-S92K	BUS M30M1-XC-35/340-S92K	BUS M30M1-XC-60/600-S92K
	0.025...0.10 mm	0.025...0.17 mm	0.18...0.57 mm	0.18...1.5 mm	0.18...2.4 mm
	BUS002L	**BUS005M**	**BUS0038**	**BUS003L**	**BUS0043**
	BUS M30M1-PPC-03/025-S92K	BUS M30M1-PPC-07/035-S92K	BUS M30M1-PPC-20/130-S92K	BUS M30M1-PPC-35/340-S92K	BUS M30M1-PPC-60/600-S92K
			BUS003N	**BUS0044**	
			BUS M30M1-PWC-20/130-S92K	BUS M30M1-PWC-35/340-S92K	







Suitable connector

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	Straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	Angled	PUR	Black	5 m	**BCC08FC**
For optional shielded connector					
Shielded M12, 5-pin	Straight	PUR	Black	5 m	**BCC08KP**

For additional electrical accessories refer to our
Industrial Networking and Connectivity catalog

Recommended accessories

Description	Ordering code
Mounting cuff	**BAM00HN**
Mounting clamp	**BAM00TN**
Mounting bracket	**BAM00HH**
Sound deflection bracket	**BAM01ER**

For additional mechanical accessories refer to our website.

Features and benefits

- **90° angled M18 housing**
  for individual installation situations
- **IO-Link interface**
  for supporting the new industrial standard
- **Automatic synchronization and multiplex operation**
  for simultaneous operation of up to ten sensors
- **4 scanning ranges with a measuring range from 20 mm to 1.3 m**
- **Analog output 4...20 mA or 0...10 V**
  for analog distance measurements
- **Teach-in via control line (pin 5)**

Scanning range	
Blind zone	
Limiting scanning range	

BUS M18M analog output, straight

Resolution (depends on analog window used)	
0...10 V	**Ordering code**
Rising/falling	Part number
4...20 mA	**Ordering code**
Rising/falling	Part number

BUS W18M analog output, angled

Resolution (depends on analog window used)	
0...10 V	**Ordering code**
Rising/falling	Part number
4...20 mA	**Ordering code**
Rising/falling	Part number

Note: M18 housings have IO-Link

IO-Link

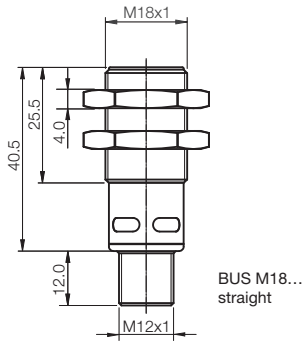
IO-Link — the new standard
With the IO-Link interface, the prerequisites are filled for gapless communication through all levels of the system architecture all the way to the sensor. Commissioning and maintenance of a machine are simplified and productivity is increased.

Control foil sag and monitor roll diameter
Using an ultrasonic sensor with analog output, the material on a roll or a coil is detected and the roll drive or a brake readjusted. Another sensor with analog output readjusts the material infeed at the dancer roller as a function of the cable loop.

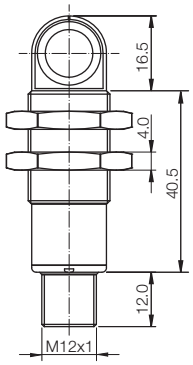
General data

Supply voltage		10...30 V DC, polarity reversal protected
Output current		200 mA
Accuracy		± 1 % (temperature drift internally compensated)
Degree of protection as per EN 60529		IP 67
Operating temperature		–25...+70°C
Material	Housing	Nickel-plated brass tube, plastic parts: PBT
	Sensing surface	Polyurethane foam, epoxy resin containing glass
Connection		M12 connector, 5-pin

	20…150 mm	**30…250 mm**	**65…350 mm**	**120…1000 mm**
	20 mm	30 mm	65 mm	120 mm
	250 mm	350 mm	600 mm	1300 mm
	0.069...0.10 mm	0.069...0.10 mm	0.069...0.10 mm	0.069...0.10 mm
	BUS0026	**BUS0024**	**BUS004T**	**BUS0052**
	BUS M18M1-XA-02/015-S92G	BUS M18M1-XA-03/025-S92G	BUS M18M1-XA-07/035-S92G	BUS M18M1-XA-12/100-S92G
	BUS0025	**BUS002C**	**BUS004W**	**BUS004M**
	BUS M18M1-XB-02/015-S92G	BUS M18M1-XB-03/025-S92G	BUS M18M1-XB-07/035-S92G	BUS M18M1-XB-12/100-S92G
	0.069...0.10 mm	0.069...0.10 mm	0.069...0.10 mm	0.069...0.10 mm
	BUS0028	**BUS0050**	**BUS004R**	**BUS0051**
	BUS W18M1-XA-02/015-S92G	BUS W18M1-XA-03/025-S92G	BUS W18M1-XA-07/035-S92G	BUS W18M1-XA-12/100-S92G
	BUS0027	**BUS002E**	**BUS004U**	**BUS0053**
	BUS W18M1-XB-02/015-S92G	BUS W18M1-XB-03/025-S92G	BUS W18M1-XB-07/035-S92G	BUS W18M1-XB-12/100-S92G



BUS M18...
straight



BUS W18...
angled

Suitable connector

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	Straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	Angled	PUR	Black	5 m	**BCC08FC**
For optional shielded connector					
Shielded M12, 5-pin	Straight	PUR	Black	5 m	**BCC08KP**

For additional electrical accessories refer to our
Industrial Networking and Connectivity catalog

Recommended accessories

Description	Ordering code
Mounting cuff	**BAM00F2**
Mounting clamp	**BAM00T3**
Mounting bracket	**BAM00EY**
Focusing attachment	**BAM01HJ**
Sound deflection bracket	**BAM01EP**

For additional mechanical accessories refer to our website.

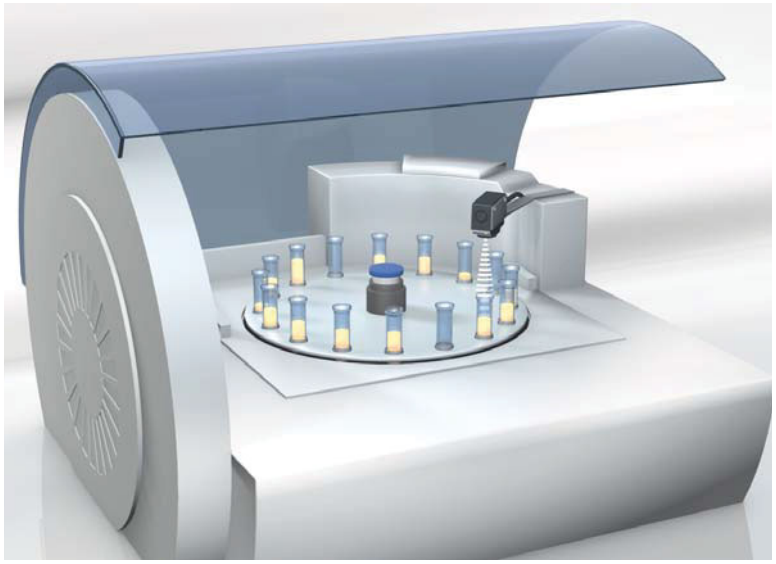
Scanning range	
Blind zone	
Limiting scanning range	

BUS R06K analog output

Resolution (depends on window used)		
0...10 V	**Ordering code**	
	Part number	
4...20 mA	**Ordering code**	
	Part number	

Features and benefits

- **Small ultrasonic sensor in block-style housing**
  ideal for compact applications
- **Same construction as many optical sensors**
  a true alternative in critical applications
- **Option for focusing attachment**
  for challenging measurement tasks
- **Analog output 4...20 mA or 0...10 V**
- **Teach-in via a button**



Focusing attachment

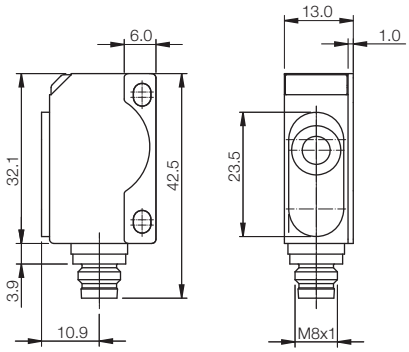
For fill-level measurement through small openings with diameters to 5 mm, the sensor with focusing attachment is positioned directly over the measurement location. The tightly bundled sound field is focused exactly on the location that is to be measured.
The blind zone of the sensor lies within the focusing attachment, making measurement possible starting directly from the sound outlet.
Comment: Can be used with BUS R06K1..-02/007-.. and BUS R06K1..-02/015-.. for measurements in boreholes and filling levels as well as for scanning circuit boards or highly transparent foils.

Fill-level measurement in narrow containers
On a rotary indexing table, narrow containers are filled with liquid or solid media. The ultrasonic sensor then verifies the exact filling level.

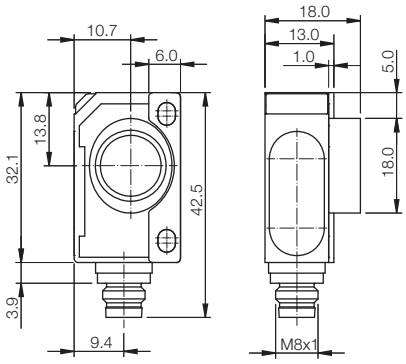
General data		
Size		20x32x12 mm
Supply voltage		20...30 V DC, polarity reversal protected
Output current		200 mA
Degree of protection as per EN 60529		IP 67
Operating temperature		–25...+70°C
Material	Housing	ABS
	Sensing surface	Polyurethane foam
Connection		M8 connector, 4-pin

	20…150 mm	**55…240 mm**	**120…700 mm**
	20 mm	55 mm	120 mm
	250 mm	350 mm	1000 mm

	0.056 mm	0.037...0.072 mm	0.037...0.215 mm
	BUS004K	**BUS0056**	**BUS005E**
	BUS R06K1-XA-02/015-S75G	BUS R06K1-XA-05/024-S75G	BUS R06K1-XA-12/070-S75G
	BUS004J	**BUS004F**	**BUS005C**
	BUS R06K1-XB-02/015-S75G	BUS R06K1-XB-05/024-S75G	BUS R06K1-XB-12/070-S75G



Operating scanning ranges 20–70 mm and 20–150 mm



Operating scanning range 120–700 mm

Ultrasonic sensors
Media
Industries
Application areas
Sensor selection, Modes
M30 tubular-style housing
M18 tubular-style housing
R06 block-style housing
Q80 block-style housing

Suitable connector

Size	Design	Cable material	Color	Length	Ordering code
M8, 4-pin	Straight	PUR	Yellow	5 m	**BCC0540**
M8, 4-pin	Angled	PUR	Yellow	5 m	**BCC059T**
For optional shielded connector					
Shielded M8, 4-pin	Straight	PUR	Black	5 m	**BCC02N6**
Shielded M8, 4-pin	Angled	PUR	Black	5 m	**BCC02NJ**

For additional electrical accessories refer to our **Industrial Networking and Connectivity** catalog

Recommended accessories

Description	Ordering code
Mounting tab	**Included**
Focusing attachment	**BAM01YU**
Mounting bracket	**BAM00UH**

For additional mechanical accessories refer to our website.

Features and benefits

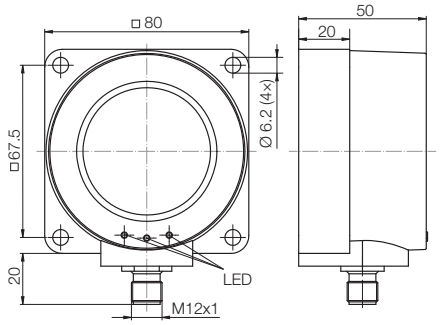
- **Measuring range from 600 mm to 6000 mm**
- **Analog output 4...20 mA or 0...10 V**
- **Teach-in via line (PIN 5)**

General data		
Supply voltage		18...30 V DC, polarity reversal protected
Output current		500 mA
Resolution		1 mm
Degree of protection as per EN 60529		IP 65
Operating temperature		–15...+70°C
Material	Housing	PBT
	Sensing surface	Epoxy resin - hollow-glass sphere /PUR
Connection		M12 connector, 5-pin

Scanning range	**600...6000 mm**
Blind zone	600 mm

BUS Q80K analog output

0...10 V	**Ordering code**	**BUS000E**
	Part number	BUS Q80K0-XAER-600-S92K
4...20 mA	**Ordering code**	**BUS000F**
	Part number	BUS Q80K0-XBER-600-S92K

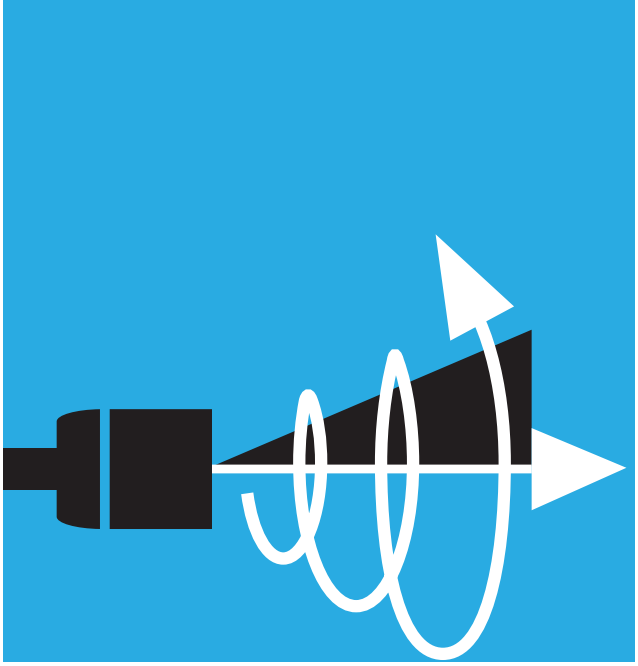


Fill-level monitoring in silos
The fill level of bulk materials in a container is detected by a continuous measurement with ultrasonic sensors. The fill level can be monitored with an antalog output signal or with two switching signals – as min./max value.

Suitable connector

Size	Design	Cable material	Color	Length	Ordering code
M12, 5-pin	Straight	PUR	Black	5 m	**BCC098C**
M12, 5-pin	Angled	PUR	Black	5 m	**BCC08FC**
For optional shielded connector					
Shielded M12, 5-pin	Straight	PUR	Black	5 m	**BCC08KP**

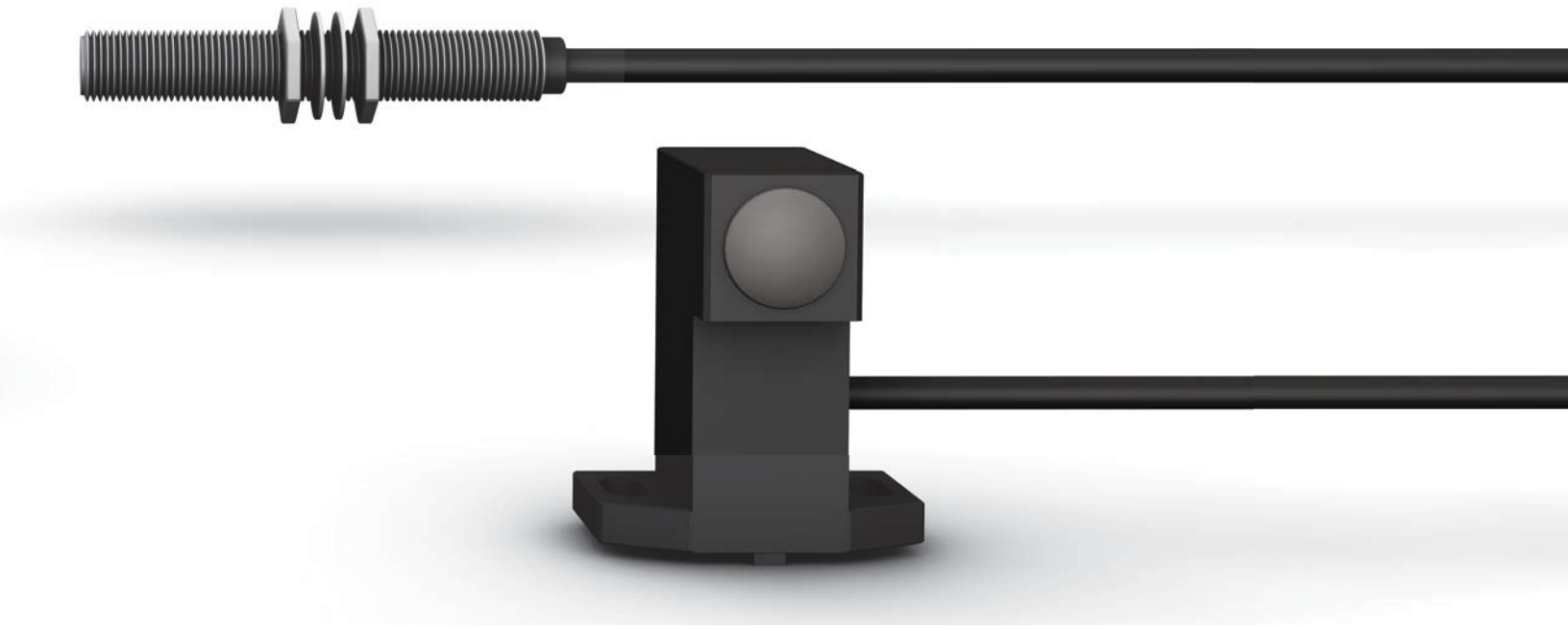
For additional electrical accessories refer to our **Industrial Networking and Connectivity** catalog



Inductive Distance Sensors

Balluff inductive distance sensors BAW provide an absolute voltage- or current signal that changes proportionally to the distance of a metallic target. Objects of varying shape and size made of ferrous or non-ferrous materials damp the sensor to different degrees. This provides a simple way of detecting positions, distances and material differences.

Inductive Distance Sensors
Contents



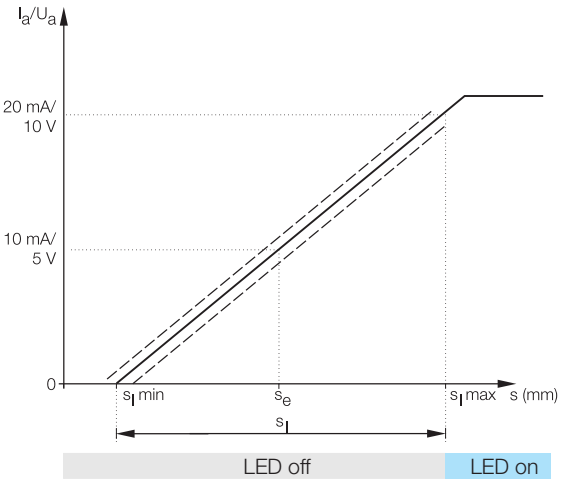
Inductive Sensors for Analog Distance Measurement

Features, approach curve, processing programmable switch points

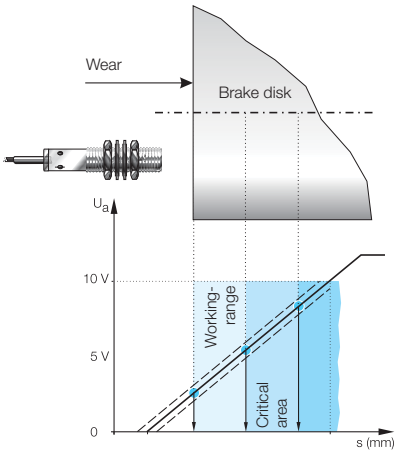
Features

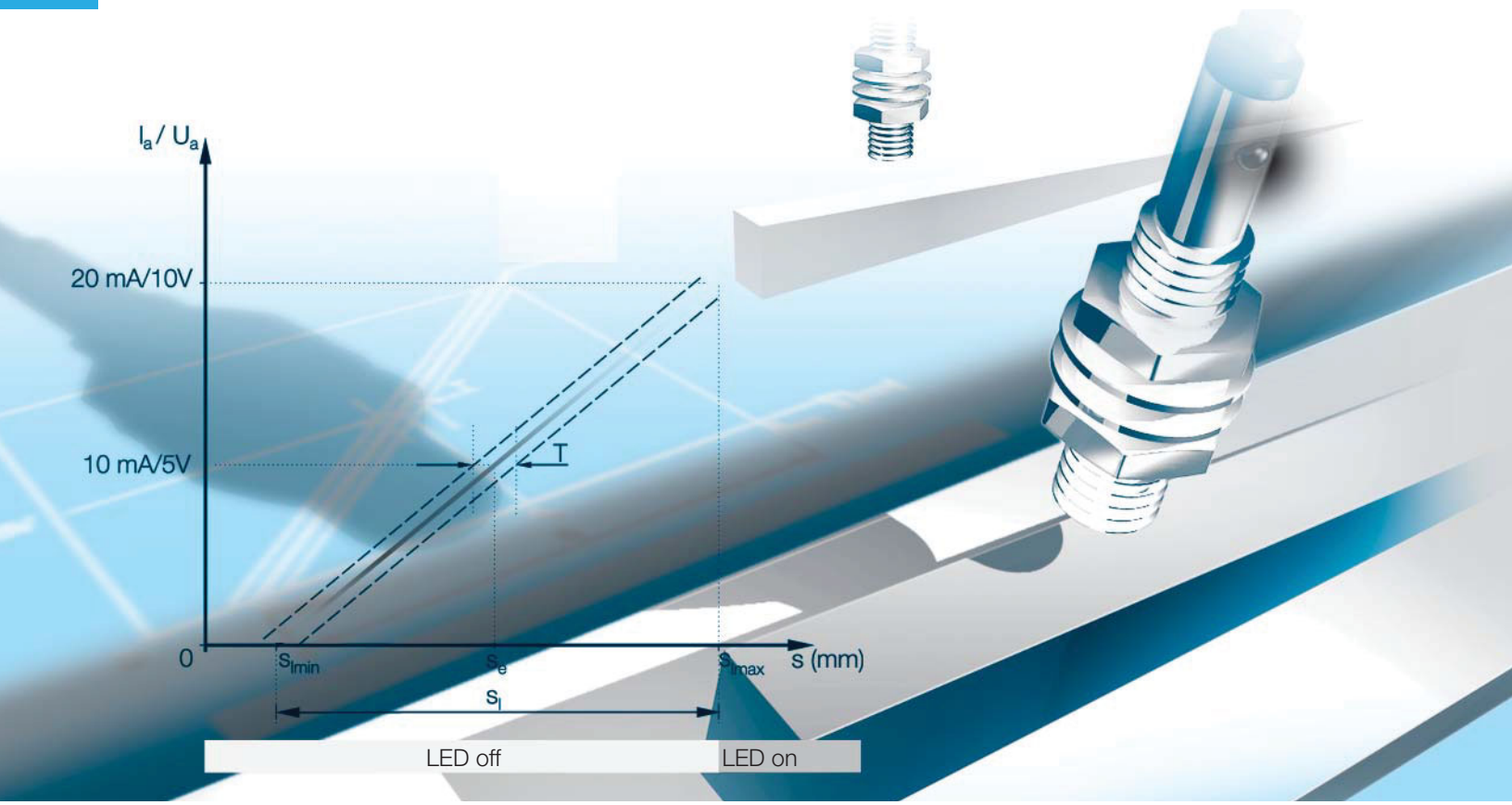
- Distance-proportional analog output signal
- Contactless, absolute measuring principle
- Wide variety of designs: cylindrical and cubical
- Measuring ranges from 0.5...50 mm
- High repeat accuracy
- Optimal linearity
- Low temperature drift
- LED for setup aid
- Compact, sealed, rugged and reliable

Output characteristics



Evaluating programmed switching points (brake disk example)





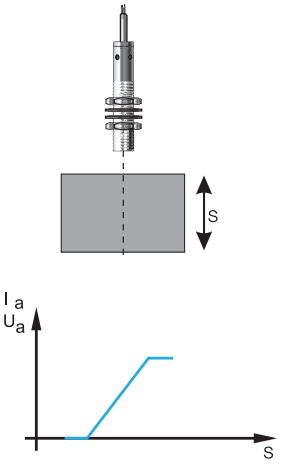
Inductive Sensors for Analog Distance Measurement
Sensors in Use

Applications

Some of the numerous applications in measuring and controlling include:

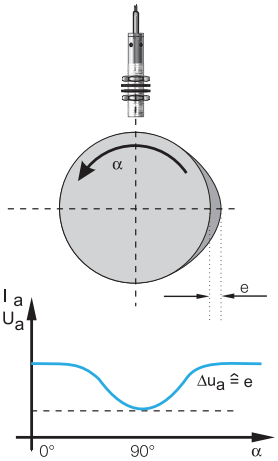
- Distance measurement
- Thickness measurement
- Run-off measurement
- Belt/band width measurement
- Detection of surface waves
- Counting
- Positioning
- Position monitoring
- Selection of parts of various sizes and materials

Axial approach



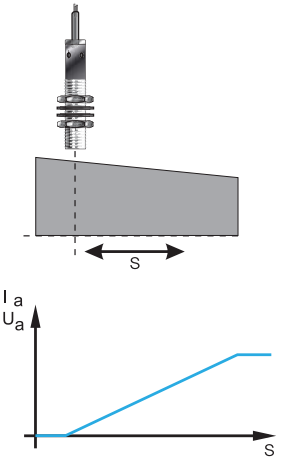
Distance changes in the sensor axis result in output signals proportional to distance.

Sensing a rotating object



Eccentrics, cams or unbalanced motion result in a periodic change in the output signal.

Lateral approach

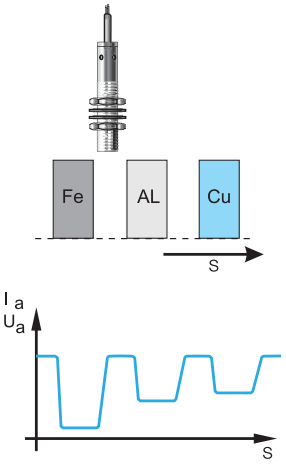


Detecting longer distances by sensing an inclined plane.

Reslution Application Notes:

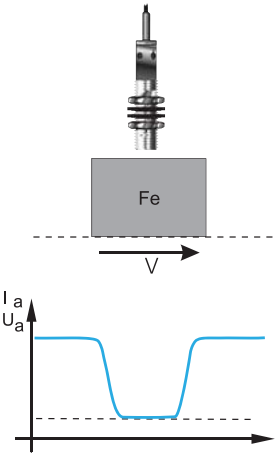
- BAW sensors are a pure analog device with theoretically infinite resolution.
- Application resolution depends on ambient electrical noise level.
- Typical industrial application noise level is 10-15mV.
- If application level noise proves troublesome, a connectorized model and shielded cordset are recommended.

Sensing various materials



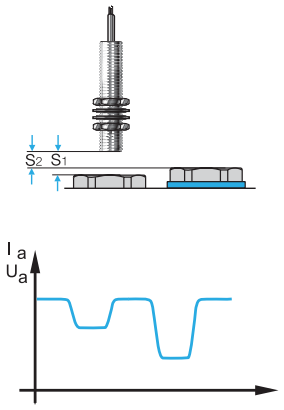
When the distance is kept constant, the output signal changes only when the object material is different.

Distance measurements at high object travel speeds



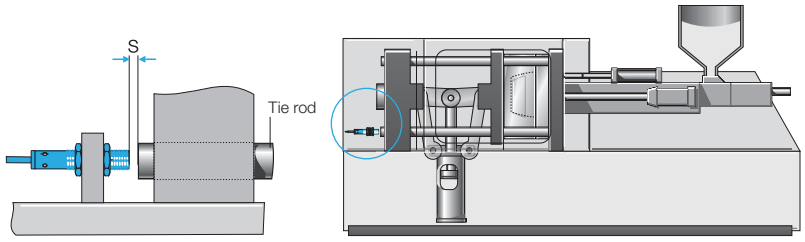
Even at high traverse speeds distances can be precisely measured.

Detecting installed seal rings



The seal ring effectively reduces the distance between the nut/screw and the sensor, thereby changing the output signal.

Tie rod length change on an injection molding machine



In injection molding machines, the clamping force of the tool is built up through a toggle joint and a hydraulic cylinder. The extension of the machine tie rods is thereby directly proportional to the clamping force, and can be easily determined using an inductive distance sensor.

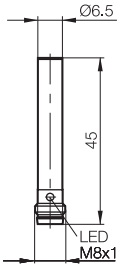
Inductive Sensors for Analog Distance Measurement

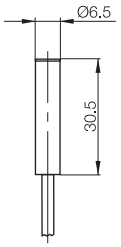
Tubular housings, Ø 6.5 mm, M8×1

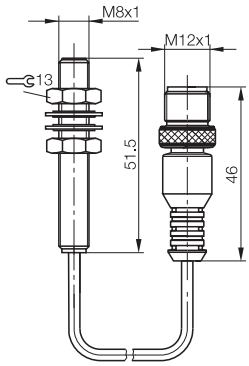
Temperature output

Series		**Ø 6.5 mm**	**Ø 6.5 mm**	**M8 × 1**	
Installation type (observe instructions in the Basic Information chapter)		Flush	Flush	Flush	
Output signal		**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**	
Linear range s_l		0.5...2 mm	0.5...2 mm	0.5...1.5 mm	
Ordering code		**BAW000L**	**BAW000J**	**BAW000N**	
Part name		BAW G06EF-UAC20B-S49G	BAW G06EE-UAF20B-EP03-K	BAW M08EI-UAD15B-BP00,2-GS04	
Supply voltage U_B		15...30 V DC	21.6...26.4 V DC	15...30 V DC	
Rated insulation voltage U_i (protection class)		75 V DC	75 V DC	250 V AC (⧈)	
Effective distance s_e		1.25 mm	1.25 mm	1 mm	
Load resistance $R_{L\ min.}$		2 kΩ	5 kΩ	2 kΩ	
Load resistance $R_{L\ max.}$					
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes	No/No/No	Yes/Yes/Yes	
Adjustment display (LED)		Yes	No	No	
Ambient temperature T_a		+10...+60°C*	+10...+60°C*	–10...+70 °C	
Repeat accuracy R_{BWN}		±40.0 µm	±10.0 µm	±8.0 µm	
Non-linearity max.		±45 µm	±45 µm	±30 µm	
Limit frequency (–3 dB)		1 kHz	1 kHz	1 kHz	
Response time		0.5 ms	1 ms	0.5 ms	
Temperature coefficient, typically in range from +10...+50 °C		-0.6 µm/K	–1 µm/K	–1 µm/K	
Degree of protection as per IEC 60529		IP 67	IP 67	IP 67	
Approvals		CE, cULus	CE	CE, cULus	
Material	Housing	Stainless steel	Stainless steel	Stainless steel	
	Sensing surface	PBT	PBT	PBT	
Connection		M8 connector, 3-pin	3 m PUR cable, 26 AWG	0.2 m PUR cable with M12 connector, 3-pin	
Suggested mating cable	Unshielded	BCC M313-0000-10-001-EX43T2-020		BCC M415-0000-1A-003-EX44T2-020	
	Shielded	BCC M313-0000-10-036-VS8334-020		BCC M415-0000-1A-014-VS8434-020	

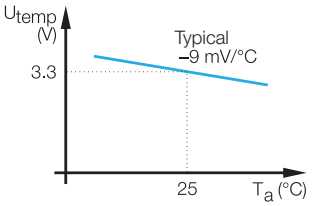
* The function is assured over a range of –10...+70 °C







Temperature output

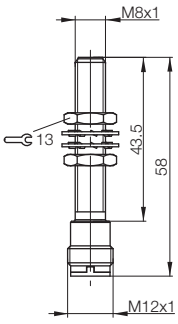


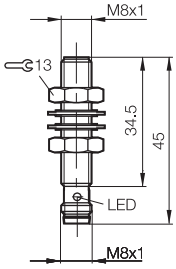
The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.

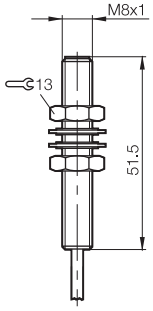
Inductive Sensors for Analog Distance Measurement

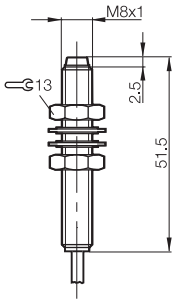
Tubular housings, M8×1, M12×1

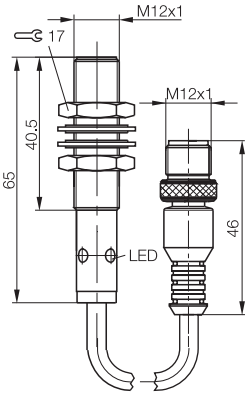
	M8 × 1	**M8 × 1**	**M8 × 1**	**M8 × 1**	**M12×1**
	Flush	Flush	Flush	Not flush	Flush
	Voltage, 0...10 V	**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Current, 4...20 mA**
	0.5...1.5 mm	0.5...1.5 mm	0.5...1.5 mm	0.5...2.5 mm	0.5...2 mm
	BAW003R	**BAW000M**	**BAW000T**	**BAW000W**	**BAW001F**
	BAW M08EH-UAD15B-S04G	BAW M08EF-UAC15B-S49G	BAW M08EI-UAD15B-BP03	BAW M08EI-UAD25F-BP03	BAW M12MG2-ICC20B-BP00,2-GS04
	15...30 V DC	15...30 V DC	15...30 V DC	15...30 V DC	10...30 V DC
	250 V AC	250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)
	1 mm	1 mm	1 mm	1.5 mm	1.25 mm
	2 kΩ	2 kΩ	2 kΩ	2 kΩ	
					500 Ω
	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
	No	Yes	No	No	Yes
	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+60 °C*	–10...+70 °C
	±40.0 µm	±40.0 µm	±8.0 µm	±10.0 µm	±5.0 µm
	±30 µm	±30 µm	±30 µm	±60 µm	±45 µm
	1 kHz	1 kHz	1 kHz	1 kHz	500 Hz
	0.5 ms	0.5 ms	0.5 ms	1 ms	0.5 ms
	0 µm/K	0 µm/K	–1 µm/K	–1.5 µm/K	–0.5 µm/K
	IP 67	IP 67	IP 67	IP 67	IP 67
	CE, cULus	CE, cULus	CE, cULus	CE, cULus	CE, cULus
	Stainless steel	Stainless steel	Stainless steel	Stainless steel	Brass, coated
	PBT	PBT	PBT	PBT	PBT
	M12 connector, 3-pin	M8 connector, 3-pin	3 m PUR cable, 26 AWG	3 m PUR cable, 26 AWG	0.2 m PUR cable with M12 connector, 3-pin
	BCC M415-0000-1A-003-EX44T2-020	BCC M313-0000-10-001-EX43T2-020			BCC M415-0000-1A-003-EX44T2-020
	BCC M415-0000-1A-014-VS8434-020	BCC M313-0000-10-036-VS8334-020			BCC M415-0000-1A-014-VS8434-020







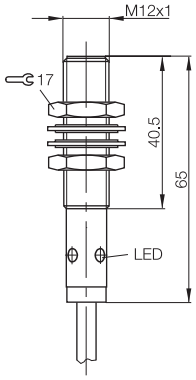


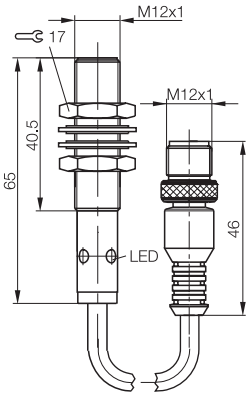


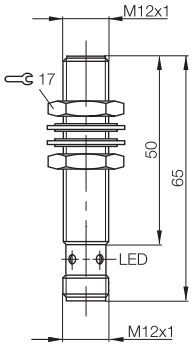
Inductive Sensors for Analog Distance Measurement

Tubular housings, M12×1

Series		**M12×1**	**M12×1**	**M12×1**	
Installation type (observe instructions in the Basic Information chapter)		Flush	Flush	Flush	
Output signal		**Current, 4...20 mA**	**Voltage, 0...10 V**	**Voltage, 0...10 V**	
Linear range s_l		0.5...2 mm	0.5...2 mm	0.5...2 mm	
Ordering code		**BAW001H**	**BAW001J**	**BAW001P**	
Part name		BAW M12MG2-ICC20B-BP03	BAW M12MG2-UAC20B-BP00,2-GS04	BAW M12MI-UAC20B-S04G	
Supply voltage U_B		10...30 V DC	15...30 V DC	15...30 V DC	
Rated insulation voltage U_i (protection class)		250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	
Effective distance s_e		1.25 mm	1.25 mm	1.3 mm	
Load resistance $R_{L\ min.}$			2 kΩ	2 kΩ	
Load resistance $R_{L\ max.}$		500 Ω			
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	
Adjustment display (LED)		Yes	Yes	Yes	
Ambient temperature T_a		–10...+70 °C	–10...+70 °C	–10...+70 °C	
Repeat accuracy R_{BWN}		±6.0 µm	±8.0 µm	±8.0 µm	
Non-linearity max.		±45 µm	±45 µm	±45 µm	
Limit frequency (–3 dB)		500 Hz	500 Hz	500 Hz	
Response time		0.5 ms	0.5 ms	0.5 ms	
Temperature coefficient, typically in range from +10...+50 °C		–0.5 µm/K	–1 µm/K	–0.5 µm/K	
Degree of protection as per IEC 60529		IP 67	IP 67	IP 67	
Approvals		CE, cULus	CE, cULus	CE, cULus	
Material	Housing	Brass, coated	Brass, coated	Brass, coated	
	Sensing surface	PBT	PBT	PBT	
Connection		3 m PUR cable, 22 AWG	0.2 m PUR cable with M12 connector, 3-pin	M12 connector, 3-pin	
Suggested mating cable	Unshielded		BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	
	Shielded		BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	





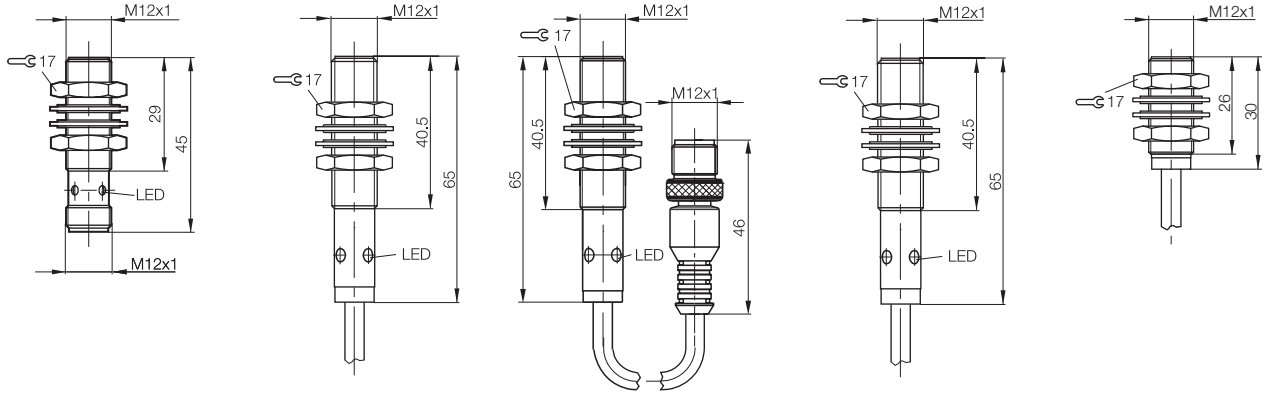


Inductive Sensors for Analog Distance Measurement

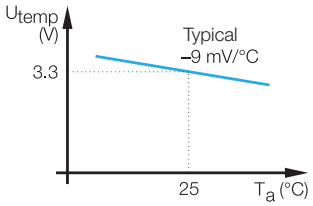
Tubular housings, M12×1

	M12×1	**M12×1**	**M12×1**	**M12×1**	**M12×1**
	Flush	Flush	Flush	Flush	Quasi-flush
	Voltage, 0...10 V	**Voltage, 0...10 V**	**Current, 0...20 mA**	**Current, 0...20 mA**	**Voltage, 0...10 V**
	0.5...2 mm	0.5...2 mm	0.5...2 mm	0.5...2 mm	1...5 mm
	BAW0010	**BAW001L**	**BAW0019**	**BAW001C**	**BAW0011**
	BAW M12ME-UAC20B-S04G	BAW M12MG2-UAC20B-BP03	BAW M12MG2-IAC20B-BP00,2-GS04	BAW M12MG2-IAC20B-BP03	BAW M12ME-UAD50B-BP01
	15...30 V DC	15...30 V DC	10...30 V DC	10...30 V DC	15...30 V DC
	250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	75 V DC
	1.25 mm	1.25 mm	1.25 mm	1.25 mm	3 mm
	2 kΩ	2 kΩ			2 kΩ
			500 Ω	500 Ω	
	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
	Yes	Yes	Yes	Yes	No
	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C	0...+60 °C
	±20.0 µm	±8.0 µm	±5.0 µm	±5.0 µm	±10.0 µm
	±45 µm	±45 µm	±45 µm	±45 µm	±160 µm
	500 Hz	500 Hz	500 Hz	500 Hz	1 kHz
	0.5 ms	0.5 ms	0.5 ms	0.5 ms	2 ms
	0 µm/K	–1 µm/K	–1 µm/K	–1 µm/K	–1.5 µm/K
	IP 67	IP 67	IP 67	IP 67	IP 67
	CE, cULus	CE, cULus	CE, cULus	CE, cULus	CE, cULus
	Brass, coated	Brass, coated	Brass, coated	Brass, coated	Brass, coated
	PBT	PBT	PBT	PBT	PA 12
	M12 connector, 3-pin	3 m PUR cable, 22 AWG	0.2 m PUR cable with M12 connector, 3-pin	3 m PUR cable, 22 AWG	1 m PUR cable, 24 AWG
	BCC M415-0000-1A-003-EX44T2-020		BCC M415-0000-1A-003-EX44T2-020		
	BCC M415-0000-1A-014-VS8434-020		BCC M415-0000-1A-014-VS8434-020		

Temperature output



Temperature output

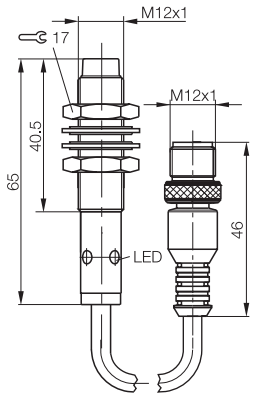


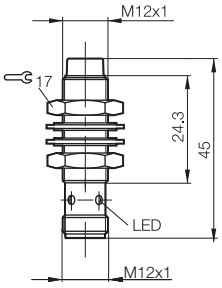
The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.

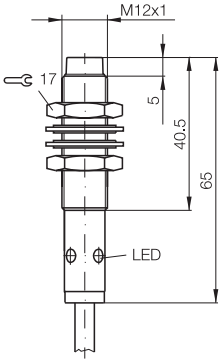
Inductive Sensors for Analog Distance Measurement

Tubular housings, M12×1

Series		**M12×1**	**M12×1**	**M12×1**	
Installation type (pay attention to the note in the Basic Information chapter)		Not flush	Not flush	Not flush	
Output signal		**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**	
Linear range s_l		1...4 mm	1...4 mm	1...4 mm	
Ordering code		**BAW0014**	**BAW000Z**	**BAW0017**	
Part name		BAW M12MF2-UAC40F-BP00,2-GS04	BAW M12MD-UAC40F-S04G	BAW M12MF2-UAC40F-BP03	
Supply voltage U_B		15...30 V DC	15...30 V DC	15...30 V DC	
Rated insulation voltage U_i (protection class)		250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	
Effective distance s_e		2.5 mm		2.5 mm	
Load resistance $R_{L\ min.}$		2 kΩ	2 kΩ	2 kΩ	
Load resistance $R_{L\ max.}$					
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	
Adjustment display (LED)		Yes	Yes	Yes	
Ambient temperature T_a		–10...+70 °C	–10...+70 °C	–10...+70 °C	
Repeat accuracy R_{BWN}		±10.0 µm	±10.0 µm	±10.0 µm	
Non-linearity max.		±90 µm	±90 µm	±90 µm	
Limit frequency (–3 dB)		500 Hz	500 Hz	500 Hz	
Response time		1 ms	1 ms	1 ms	
Temperature coefficient, typically in range from +10...+50 °C		0 µm/K	–2 µm/K	0 µm/K	
Degree of protection as per IEC 60529		IP 67	IP 67	IP 67	
Approvals		CE, cULus	CE, cULus	CE, cULus	
Material	Housing	Brass, coated	Brass, coated	Brass, coated	
	Sensing surface	PBT	PBT	PBT	
Connection		0.2 m PUR cable with M12 connector, 3-pin	M12 connector, 3-pin	3 m PUR cable, 22 AWG	
Suggested mating cable	Unshielded	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020		
	Shielded	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020		







Inductive Sensors for Analog Distance Measurement

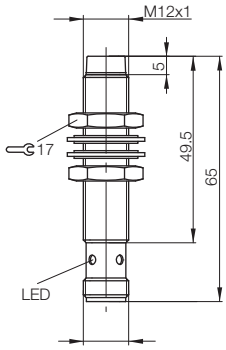
Tubular housings, M12×1, M18×1

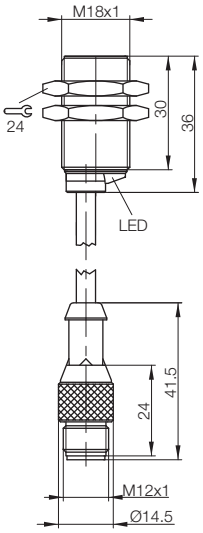


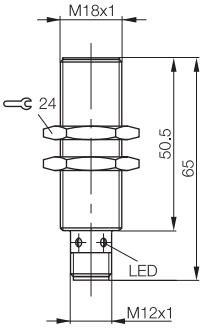


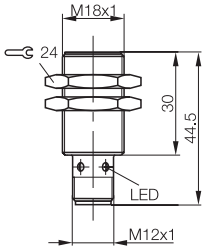
Temperature output

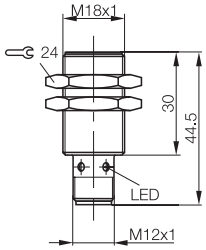
M12×1	**M18×1**	**M18×1**	**M18×1**	**M18×1**
Not flush	Flush	Flush	Flush	Flush
Current, 4...20 mA	**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**
1...4 mm	1...5 mm	1...5 mm	1...5 mm	1...5 mm
BAW003N	**BAW001Z**	**BAW002K**	**BAW0026**	**BAW0025**
BAW M12MH1-ICC40F-S04G	BAW M18ME-UAC50B-BP00,2-GS04	BAW M18MI-UAC50B-S04G	BAW M18ME-UAE50B-S04G-K	BAW M18ME-UAC50B-S04G
10...30 V DC	15...30 V DC	15...30 V DC	21.6...26.4 V DC	15...30 V DC
250 V AC (⧈)	75 V DC	250 V AC (⧈)	75 V DC	75 V DC
2.5 mm		3 mm	3 mm	3 mm
	2 kΩ	2 kΩ	2 kΩ	2 kΩ
500 ohms				
Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
Yes	Yes	Yes	Yes	Yes
–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C
	±8.0 µm	±8.0 µm	±8.0 µm	±8.0 µm
±120 µm	±120 µm	±120 µm	±120 µm	±120 µm
500 Hz	500 Hz	500 Hz	500 Hz	500 Hz
0.5 ms	1 ms	1 ms	1 ms	1 ms
	–1 µm/K	–2 µm/K	–1 µm/K	–2 µm/K
IP 67	IP 67	IP 67	IP 67	IP 67
CE, cULus	CE, cULus	CE, cULus	CE, cULus	CE, cULus
Brass, coated	Brass, coated	Brass, coated	Brass, coated	Brass, coated
PBT	PBT	PBT	PBT	PBT
M12 connector, 3-pin	0.2 m PUR cable with M12 connector, 3-pin	M12 connector, 3-pin	M12 connector, 4-pin	M12 connector, 3-pin
BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020
BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020



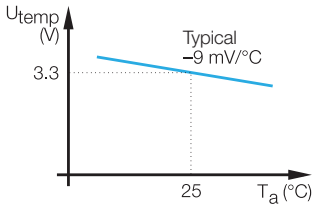








Temperature output



The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.

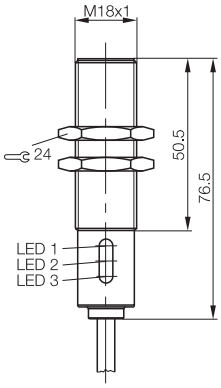
Inductive Sensors for Analog Distance Measurement

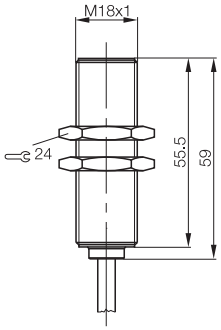
Tubular housings, M18×1

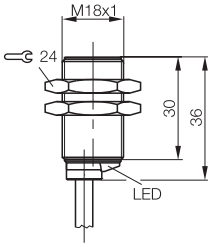
With teach-in, 3 switching points

With Teach-in

Series		**M18×1**	**M18×1**	**M18×1**
Installation type (observe instructions in the Basic Information chapter)		Flush	Flush	Flush
Output signal		**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**
Linear range s_l		1...5 mm	1...5 mm	1...5 mm
Ordering code		**BAW002M**	**BAW002U**	**BAW0022**
Part name		BAW M18MI2-UAC50B-BP05-002	BAW M18MM-UAZ50B-BP05-505	BAW M18ME-UAC50B-BP03
Supply voltage U_B		15...30 V DC	21.6...26.4 V DC	15...30 V DC
Rated insulation voltage U_i (protection class)		250 V AC (⧈)	250 V AC (⧈)	75 V DC
Effective distance s_e		3 mm	3 mm	3 mm
Load resistance $R_{L\ min.}$		2 kΩ	2 kΩ	2 kΩ
Load resistance $R_{L\ max.}$				
Polarity reversal protected/transposition protected/short-circuit protected		Yes/No/Yes	Yes/No/Yes	Yes/Yes/Yes
Adjustment display (LED)		Yes	No	Yes
Ambient temperature T_a		–10...+70 °C	–10...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}		±8.0 µm	±8.0 µm	±8.0 µm
Non-linearity max.		±120 µm	±120 µm	±120 µm
Limit frequency (–3 dB)		500 Hz	500 Hz	500 Hz
Response time		1 ms	1 ms	1 ms
Temperature coefficient, typically in range from +10...+50 °C		–1.5 µm/K	0 µm/K	–1 µm/K
Degree of protection as per IEC 60529		IP 67	IP 67	IP 67
Approvals		CE, cULus	CE, cULus	CE, cULus
Material	Housing	Brass, coated	Brass, coated	Brass, coated
	Sensing surface	PBT	PBT	PBT
Connection		5 m PUR cable, 24 AWG	5 m PUR cable, 24 AWG	5 m PUR cable, 22 AWG
Suggested mating cable	Unshielded			
	Shielded			







Inductive Sensors for Analog Distance Measurement

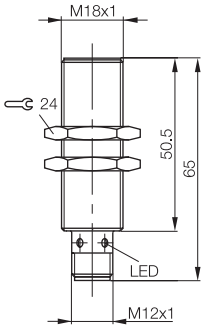
Tubular housings, M18×1

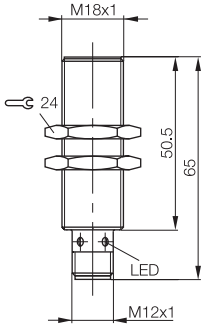


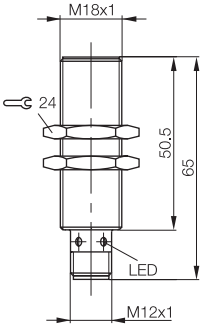


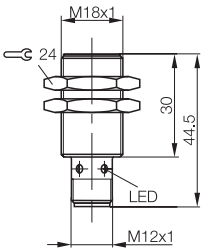
IO-Link

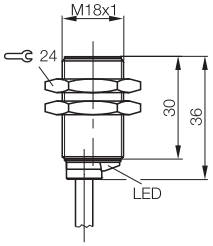
	M18×1	**M18×1**	**M18×1**	**M18×1**	**M18×1**
	Flush	Flush	Flush	Flush	Flush
	IO-Link, falling with rising proximity	**Current, 0...20 mA**	**Current, 4...20 mA**	**Current, 4...20 mA**	**Current, 4...20 mA**
	1...5 mm	1...5 mm	1...5 mm	1...5 mm	1...5 mm
	BAW002F	**BAW002H**	**BAW002J**	**BAW001U**	**BAW001T**
	BAW M18MI-BLC50B-S04G	BAW M18MI-IAC50B-S04G	BAW M18MI-ICC50B-S04G	BAW M18ME-ICC50B-S04G	BAW M18ME-ICC50B-BP03
	18...30 V DC	10...30 V DC	10...30 V DC	10...30 V DC	15...30 V DC
	250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)	75 V DC	75 V DC
	3 mm	3 mm	3 mm	3 mm	3 mm
		500 Ω	500 Ω	500 Ω	500 Ω
	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
	Yes	Yes	Yes	Yes	Yes
	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C	–10...+70 °C
	±10.0 µm	±8.0 µm	±8.0 µm	±8.0 µm	±8.0 µm
	±120 µm	±120 µm	±120 µm	±120 µm	±120 µm
	500 Hz	500 Hz	500 Hz	500 Hz	500 Hz
	2 ms	1 ms	1 ms	1 ms	1 ms
	–2 µm/K	–1 µm/K	-5 µm/K	–3 µm/K	–3 µm/K
	IP 67	IP 67	IP 67	IP 67	IP 67
	CE, cULus	CE, cULus	CE, cULus	CE, cULus	CE, cULus
	Brass, coated	Brass, coated	Brass, coated	Brass, coated	Brass, coated
	PBT	PBT	PBT	PBT	PBT
	M12 connector, 3-pin	M12 connector, 3-pin	M12 connector, 3-pin	M12 connector, 3-pin	3 m PVC cable, 22 AWG
	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	
	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	









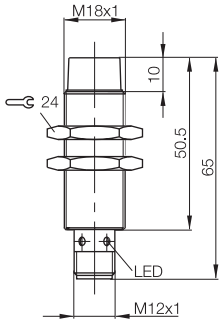


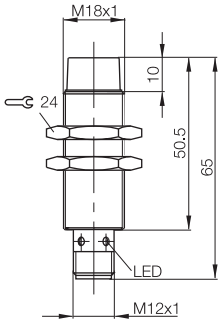
Inductive Sensors for Analog Distance Measurement

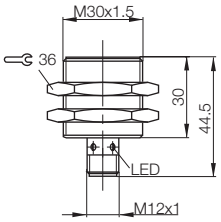
Tubular housings, M18×1, M30×1.5

Temperature output

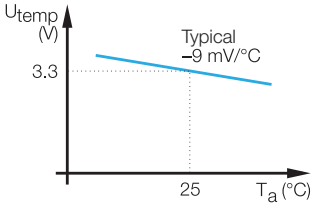
Series		**M18×1**	**M18×1**	**M30×1.5**
Installation type (observe instructions in the Basic Information chapter)		Not flush	Not flush	Flush
Output signal		**Voltage, 0...10 V**	**Voltage, 0...10 V**	**Voltage, 0...10 V**
Linear range s_l		2...8 mm	4...16 mm	2...10 mm
Ordering code		**BAW002C**	**BAW0029**	**BAW002W**
Part name		BAW M18MG-UAC80F-S04G	BAW M18MG-UAC16F-S04G-K	BAW M30ME-UAC10B-S04G
Supply voltage U_B		15...30 V DC	15...30 V DC	15...30 V DC
Rated insulation voltage U_i (protection class)		250 V AC (⧈)	250 V AC (⧈)	250 V AC (⧈)
Effective distance s_e		5 mm	10 mm	6 mm
Load resistance $R_{L\ min.}$		2 kΩ	2 kΩ	2 kΩ
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes	Yes/Yes/Yes	Yes/Yes/Yes
Adjustment display (LED)		Yes	Yes	Yes
Ambient temperature T_a		–10...+70 °C	+10...+60°C*	–10...+70 °C
Repeat accuracy R_{BWN}		±12.0 µm	±200.0 µm	±10.0 µm
Non-linearity max.		±180 µm	±360 µm	±240 µm
Limit frequency (–3 dB)		500 Hz	500 Hz	500 Hz
Response time		1.5 ms	3 ms	1.5 ms
Temperature coefficient, typically in range from +10...+50 °C		–3 µm/K	8 µm/K	1.5 µm/K
Degree of protection as per IEC 60529		IP 67	IP 67	IP 67 per BWN Pr. 14
Approvals		CE, cULus	CE, cULus	CE, cULus
Material	Housing	Brass, coated	Brass, coated	Brass, coated
	Sensing surface	PBT	PBT	PBT
Connection		M12 connector, 3-pin	M12 connector, 3-pin	M12 connector, 3-pin
Suggested mating cable	Unshielded	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020
	Shielded	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020







Temperature output

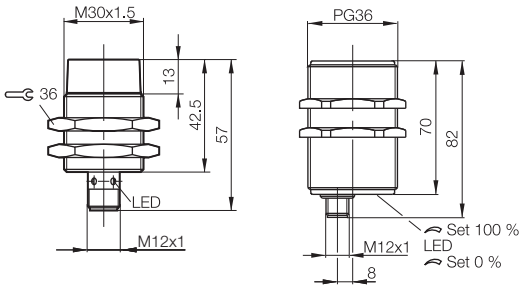


The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.

Inductive Sensors for Analog Distance Measurement

Tubular housings, M30×1.5, PG36

	M30×1.5	**PG36**			
	Not flush	Flush			
	Voltage, 0...10 V	**Voltage, 0...10 V**			
	3...15 mm	0...20 mm			
	BAW002Y	**BAW003M**			
	BAW M30ME-UAC15F-S04G	BAW MKZ-471.19-S4			
	15...30 V DC	20...30 V DC			
	250 V AC (⧈)	75 V DC			
	9 mm	10 mm			
	2 kΩ	10 kΩ			
	Yes/Yes/Yes	Yes/Yes/Yes			
	Yes	Yes			
	–10...+70 °C	–10...+70 °C			
	±12.0 µm	±5.0 µm			
	±360 µm	±600 µm			
	350 Hz	20 Hz			
	3 ms				
	1.5 µm/K	–1 µm/K			
	IP 67	IP 67			
	CE, cULus	CE			
	Brass, coated	Brass, coated			
	PBT	PBT			
	M12 connector, 3-pin	M12 connector, 3-pin			
	BCC M415-0000-1A-003-EX44T2-020	BCC M415-0000-1A-003-EX44T2-020			
	BCC M415-0000-1A-014-VS8434-020	BCC M415-0000-1A-014-VS8434-020			



Inductive Sensors for Analog Distance Measurement

Tubular housings, high-pressure resistant M12×1

- Analog for control of valves or soft stop
- Measurements of valves and cylinders possible
- Ceramic on medium side – robust
- Oil pressure up to 500 bar

Application areas

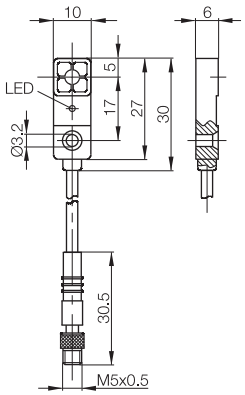
- Control of valves
- Parked position of cranes
- Final position of installation supports
- Service measurements of valves
- Position monitoring in mobile hydraulic systems
- Control of agricultural technology

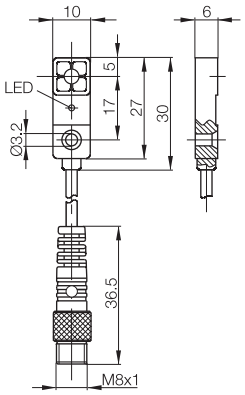
Series		**M12×1**
Installation (observe instructions in the Basic Information chapter)		Flush
Output signal		**Voltage, 0...10 V**
Linear range s_l		0.5...2 mm
Ordering code		**BAW0040**
Part name		BAW Z08EO-UAD20B-S04G-H11
Supply voltage U_B		15...30 V DC
Rated insulation voltage U_i (protection class)		75 V DC
Effective distance s_e		1.25 mm
Load resistance $R_{L\ min.}$		2 kΩ
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes
Adjustment display (LED)		No
Ambient temperature T_a		–25...+85 °C
Repeat accuracy R_{BWN}		±8.0 µm
Non-linearity max.		±45 µm
Limit frequency (–3 dB)		1 kHz
Response time		1 ms
Temperature coefficient, typically in range from +10...+50 °C		–1 µm/K
Degree of protection as per IEC 60529		IP 68
Approvals		CE, cULus
Material	Housing	Stainless steel
	Sensing surface	Ceramic
Connection		M12 connector, 3-pin
Suggested mating cable	Unshielded	BCC M415-0000-1A-003-EX44T2-020
	Shielded	BCC M415-0000-1A-014-VS8434-020

Inductive Sensors for Analog Distance Measurement

Block design, 10×30×6 mm

Series			**10×30×6 mm** R03	**10×30×6 mm** R03
Installation (observe instructions in the Basic Information chapter)			Flush	Flush
Output signal			**Voltage, 0...10 V**	**Voltage, 0...10 V**
Linear range s_l			1...4 mm	1...4 mm
Ordering code			**BAW0030**	**BAW0031**
Part name			BAW R03KC-UAE40B-BP00,3-GS26	BAW R03KC-UAE40B-BP00,3-GS49
Supply voltage U_B			21.6...26.4 V DC	21.6...26.4 V DC
Rated insulation voltage U_i (protection class)			75 V DC	75 V DC
Effective distance s_e			2.5 mm	
Load resistance $R_{L\ min.}$			5 kΩ	5 kΩ
Polarity reversal protected/transposition protected/short-circuit protected			No/No/No	No/No/No
Adjustment display (LED)			Yes	Yes
Ambient temperature T_a			0...+70 °C	0...+70 °C
Repeat accuracy R_{BWN}			±35.0 µm	±35.0 µm
Non-linearity max.			±150 µm	±150 µm
Limit frequency (–3 dB)			1 kHz	1 kHz
Response time			0.5 ms	0.5 ms
Temperature coefficient, typically in range from +10...+50 °C			4.7 µm/K	4.7 µm/K
Degree of protection as per IEC 60529			IP 67	IP 67
Approvals			CE, cULus	CE, cULus
Material	Housing		No/No/No	PA6-FG30
	Sensing surface		PA6-FG30	PA6-FG30
Connection			0.3 m PUR cable with M5 connector, 3-pin	0.3 m PUR cable with M8 connector, 3-pin
Suggested mating cable		Unshielded	BKS-B-25-3-PU-03	BCC M313-0000-10-001-EX43T2-020
		Shielded		BCC M313-0000-10-036-VS8334-020

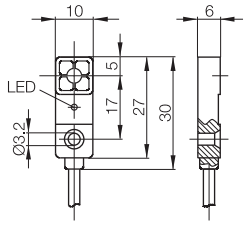


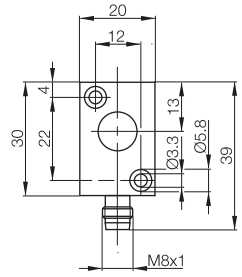


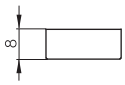
Inductive Sensors for Analog Distance Measurement

Block designs, 10×30×6 mm, 20×30×8 mm

Series			**10×30×6 mm** R03	**20×30×8 mm** R06
Installation type (observe instructions in the Basic Information chapter)			Flush	Flush
Output signal			**Voltage, 0...10 V**	**Voltage, 0...10 V**
Linear range s_l			1...4 mm	0.5...2 mm
Ordering code			**BAW0032**	**BAW0034**
Part name			BAW R03KC-UAE40B-BP03	BAW R06AC-UAF20B-S49G
Supply voltage U_B			21.6...26.4 V DC	21.6...26.4 V DC
Rated insulation voltage U_i (protection class)			75 V DC	75 V DC
Effective distance s_e			2.5 mm	1.3 mm
Load resistance $R_{L\ min.}$			5 kΩ	5 kΩ
Polarity reversal protected/transposition protected/short-circuit protected			No/No/No	No/No/No
Adjustment display (LED)			Yes	No
Ambient temperature T_a			0...+70 °C	–10...+70 °C
Repeat accuracy R_{BWN}			±35.0 µm	±12.0 µm
Non-linearity max.			±150 µm	±45 µm
Limit frequency (–3 dB)			1 kHz	1 kHz
Response time			0.5 ms	0.5 ms
Temperature coefficient, typically in range from +10...+50 °C			5 µm/K	0.5 µm/K
Degree of protection as per IEC 60529			IP 67	IP 67
Approvals			CE, cULus	CE
Material	Housing		PA6-FG30	Anodized aluminum
	Sensing surface		PA6-FG30	PBT
Connection			3 m PUR cable, 26 AWG	M8 connector, 3-pin
Suggested mating cable		Unshielded		BCC M313-0000-10-001-EX43T2-020
		Shielded		BCC M313-0000-10-036-VS8334-020







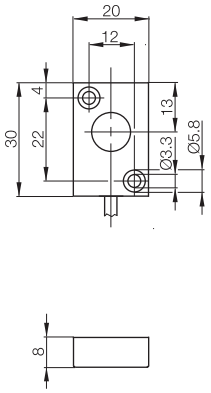
Inductive Sensors for Analog Distance Measurement

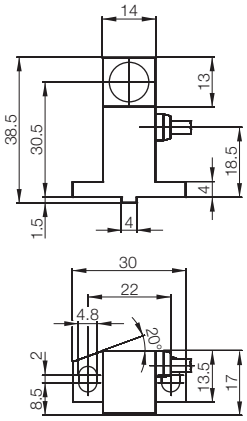
Block designs 20×30×8 mm, 14×38.5×17 mm

Temperature output

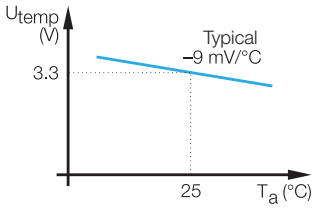
Temperature output

	20×30×8 mm R06	**14×38.5×17 mm** Z01	**14×38.5×17 mm** Z01	**14×38.5×17 mm** Z05
	Flush			
	Voltage, 0...10 V	**Voltage, 0...10 V**	**IO-Link, falling with rising proximity**	**IO-Link, falling with rising proximity**
	0.5...2 mm	1...5 mm	1...5 mm	1...5 mm
	BAW0033	**BAW003E**	**BAW003A**	**BAW003W**
	BAW R06AC-UAF20B-EP03	BAW Z01AC-UAD50B-DP03-K	BAW Z01AC-BLD50B-DP03	BAW Z05AC-BLD50B-BP00,75-GS04
	21.6...26.4 V DC	15...30 V DC	18...30 V DC	18...30 V DC
	75 V DC	75 V DC	75 V DC	75 V DC
	1.25 mm	3 mm	3 mm	3 mm
	5 kΩ	2 kΩ		
	No/No/No	Yes/No/Yes	Yes/Yes/Yes	Yes/Yes/Yes
	No	No		
	+10...+60°C*	–10...+60 °C	–10...+60 °C	–10...+60 °C
	±12.0 µm	±10.0 µm	±10.0 µm	±10.0 µm
	±45 µm	±120 µm	±150 µm	±150 µm
	1 kHz	1 kHz	200 Hz	200 Hz
	0.5 ms	1 ms	5 ms	5 ms
	0.5 µm/K	–3 µm/K	–3 µm/K	–3 µm/K
	IP 67	IP 67	IP 67	IP 67
	CE	CE, cULus	CE, cULus	CE, cULus
	Anodized aluminum	Anodized aluminum	Anodized aluminum	Anodized aluminum
	PBT	PA 12	LCP	LCP
	3 m PUR cable, 3×0.14 mm²	3 m PUR cable, 4×0.14 mm²	3 m PUR cable, 4×0.14 mm²	0.75 m PUR cable with M12 connector, 3-pin

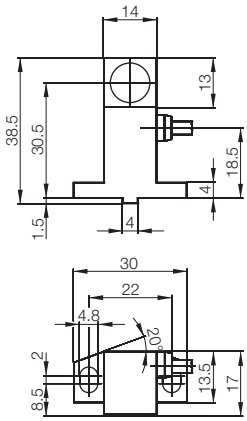




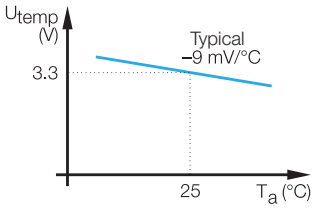
Temperature output



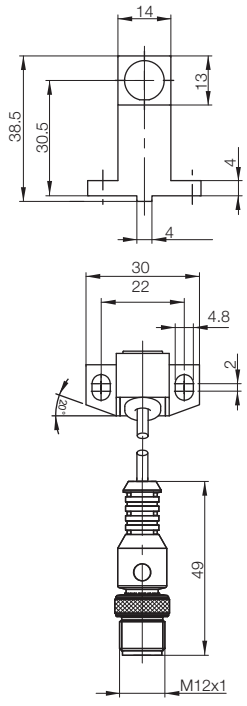
The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.



Temperature output



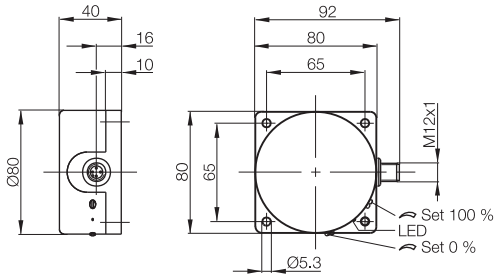
The temperature output (not short-circuit protected) provides a signal representing a precisely measured temperature change.



Inductive Sensors for Analog Distance Measurement

Block designs, 80×80×40 mm

Series		**80×80×40 mm** Maxisensor
Installation type (observe instructions in the Basic Information chapter)		Not flush
Output signal		**Voltage, 0...10 V**
Linear range s_l		0...50 mm
Ordering code		**BAW003K**
Part name		BAW MKK-050.19-S4
Supply voltage U_B		20...30 V DC
Rated insulation voltage U_i		75 V DC
Effective distance s_e		25 mm
Load resistance $R_{L\ min.}$		10 kΩ
Polarity reversal protected/transposition protected/short-circuit protected		Yes/Yes/Yes
Adjustment display (LED)		No
Ambient temperature T_a		–10...+70 °C
Repeat accuracy R_{BWN}		±12.0 µm
Non-linearity max.		±1500 µm
Limit frequency (–3 dB)		15 Hz
Temperature coefficient, typically in range from +10...+50 °C		15 µm/K
Degree of protection as per IEC 60529		IP 67
Approvals		CE
Material	Housing	PBT
	Sensing surface	PBT
Connection		M12 connector, 3-pin
Suggested mating cable	Unshielded	BCC M415-0000-1A-003-EX44T2-020
	Shielded	BCC M415-0000-1A-014-VS8434-020

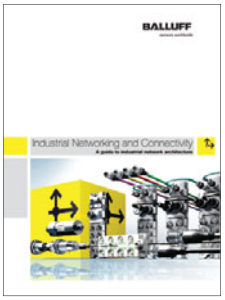


Power Supplies

Power Supplies
Contents

Industrial automation is becoming ever more demanding and the complexity of tasks is constantly increasing. Efficient operation of equipment demands reliable power sources. Balluff power supplies: the powerful solution for fault-free operation of your system.

Take advantage of the special benefits of Balluff power supplies
- Full product line – choose just what you need
- Short-circuit and overload protection in industrial environments
- High availability of all devices
- Unlimited, precise power for increased demands
- Long service life for reliable operation



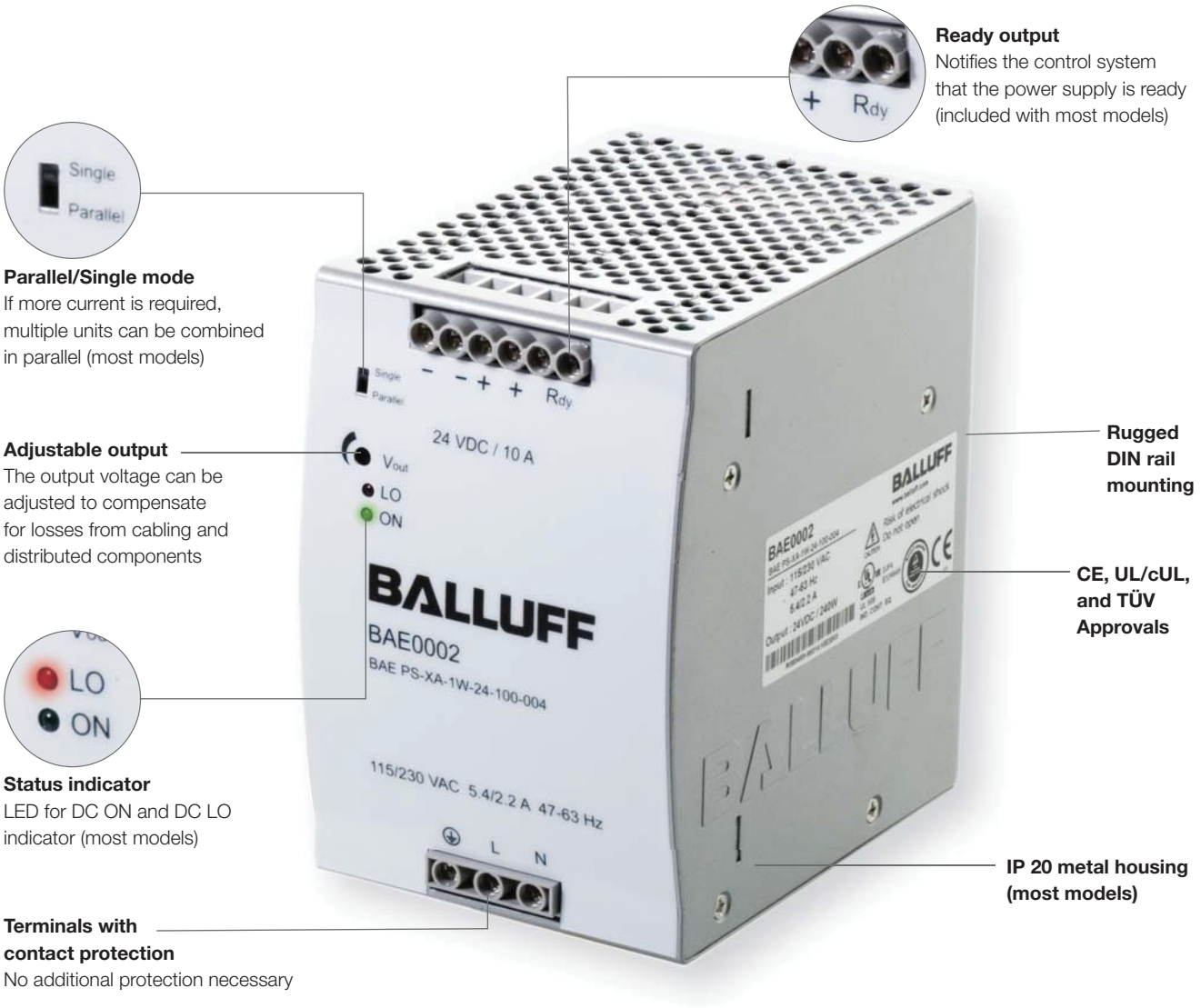
You will find many additional products from our total product line in “Industrial networking and connectivity – A guide to industrial network architecture” or online at: **www.balluff.us**.

Power Supplies

Reliable power for demanding industrial automation applications

Every industrial automation system needs a reliable, clean, and controlled source of power without spikes.
Only then can these systems deliver the expected performance.
With the new Balluff power supplies you get what you expect and more. They ensure reliable power even under demanding conditions. They fall in line with the long Balluff tradition of reliable and high-quality performance products for industrial automation. But that's not all. Balluff power supplies are one of many products from a comprehensive, professional system.

- **Ultra-reliable power supplies**
  for protecting sensitive control electronics
- **Protection against unforeseen events**
  Integrated overload and overvoltage protection
- **Wide selection of models**
  Whether stand-alone or an individual combination of various models, these solutions are perfect for your requirements
- **Clean, precision power supply for particularly**
  complex systems
  Load regulation ±1 % for all models, ripple & noise for most models less than 50 mV
- **Long service life for less system downtime**
  MTBF (Mean Time Between Failure) up to 800,000 hours/91 years



Ready output
Notifies the control system that the power supply is ready (included with most models)

Parallel/Single mode
If more current is required, multiple units can be combined in parallel (most models)

Adjustable output
The output voltage can be adjusted to compensate for losses from cabling and distributed components

Status indicator
LED for DC ON and DC LO indicator (most models)

Terminals with contact protection
No additional protection necessary

Rugged DIN rail mounting

CE, UL/cUL, and TÜV Approvals

IP 20 metal housing (most models)

Version	Output voltage	Output power															Features				Product information	
		0.75 A/18 W	1.25 A/30 W	1.5 A/18 W	2.5 A/30 W	2.5 A/60 W	2.5 A/120 W	3.8 A/91.20 W	5 A/60 W	5 A/120 W	5 A/240 W	10 A/120 W	10 A/240 W	10 A/480 W	20 A/480 W	40 A/960 W	Input voltage	Housing material	Parallel mode	Ready output	**Ordering code**	Part number
Standard IP 20	12 V			■													Single-phase[1]	Plastic			**BAE0036**	BAE-PS-XA-1W-12-015-001
					■												Single-phase[1]	Plastic		■	**BAE0039**	BAE-PS-XA-1W-12-025-002
									■								Single-phase[1]	Plastic		■	**BAE003E**	BAE-PS-XA-1W-12-050-002
												■					Single-phase[2]	Metal	■	■	**BAE003H**	BAE-PS-XA-1W-12-100-003
	24 V	■															Single-phase[1]	Plastic			**BAE0001**	BAE-PS-XA-1W-24-007-001
			■														Single-phase[1]	Plastic		■	**BAE0004**	BAE-PS-XA-1W-24-012-002
						■											Single-phase[1]	Plastic		■	**BAE0005**	BAE-PS-XA-1W-24-025-002
								■									Single-phase[2]	Metal	■	■	**BAE003J**	BAE-PS-XA-1W-24-038-003
										■							Single-phase[2]	Metal	■	■	**BAE0006**	BAE-PS-XA-1W-24-050-003
													■				Single-phase[2]	Metal	■	■	**BAE0002**	BAE-PS-XA-1W-24-100-004
															■		Single-phase[2]	Metal	■	■	**BAE0003**	BAE-PS-XA-1W-24-200-005
										■							3-phase[3]	Metal		■	**BAE0007**	BAE-PS-XA-3Y-24-050-009
													■				3-phase[3]	Metal	■	■	**BAE0008**	BAE-PS-XA-3Y-24-100-006
															■		3-phase[3]	Metal	■	■	**BAE0009**	BAE-PS-XA-3Y-24-200-007
																■	3-phase[3]	Metal	■	■	**BAE003R**	BAE-PS-XA-3Y-24-400-010
	48 V						■										Single-phase[2]	Metal	■	■	**BAE003K**	BAE-PS-XA-1W-48-025-003
											■						Single-phase[2]	Metal	■	■	**BAE003L**	BAE-PS-XA-1W-48-050-004
														■			Single-phase[2]	Metal	■	■	**BAE003M**	BAE-PS-XA-1W-48-100-005

[1] = 100...240 V AC
[2] = 115/230 V AC (Auto-Select)
[3] = 340...575 V AC

Control and Network Power
These power supplies were designed by Balluff with control products in mind, so you can be sure they will integrate perfectly with your control suite.

The PS Series of ultra reliable power supplies come in a wide range of 24 V DC models with single or 3-phase inputs. With current ranges from 0.75 A (18 W) to 40 A (960 W), there is a size for most applications. But if more power is needed, connect multiple power supplies together (parallel mode) for additive current capacity.

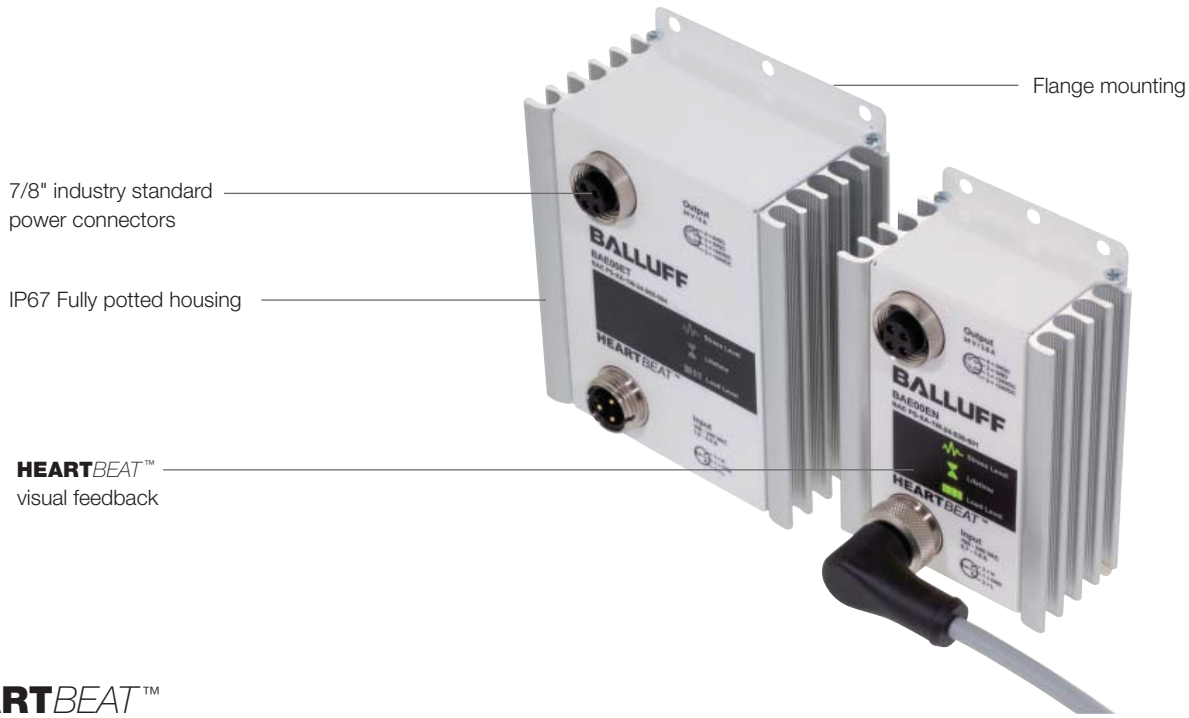
Seamless Installation
Reliable power has never been this easy to install. It starts with convenient DIN mounting with Balluff's heavy-duty, built-in mounting system. Screw terminals are oriented to allow AC power to enter from the bottom and DC power to exit from the top. Finger-safe terminals require no additional guarding.

Power Supplies
Intelligent devices for demanding industrial automation applications

A Power Supply You Can Trust

Intelligent power supplies with HeartBeat technology give reliable feedback on the real time and long term status of the supply. Built with the roughest applications in mind, these power supplies provide many great advantages:

- Highly energy efficient (>93% efficiency)
- Electrically durable (power boost 150% for 4 seconds)
- Long lasting (minimum service life of 15 years)
- Vibration and shock resistant
- IP67 - Outside the cabinet rated



HEARTBEAT™

Load level
Reversible
in short term

Load level indicates the current load on the device. The display indicates the load without delay.

Stress level
Reversible
in medium term

Stress level indicates the physical and thermal loads. A change in the load status delays the “pulse” of the device slightly.

Lifetime
Irreversible
in long term

Lifetime indicates the remaining useful life of the device and is based on the combination of all loads.

Network Auxiliary Power
This fully potted power supply can be installed virtually anywhere in an industrial manufacturing environment and provide efficient and reliable power. Easy to see indicators communicate the status of the power supply for simple preventative maintenance plan. With greater than 93% efficiency you can improve plant performance and decrease waste power consumption.

Degree of protection as per IEC 60529			IP 20	IP 67
Output current			5 A and 10 A	3.8 A and 8 A
Output power			120 W and 240 W	91.2 W and 192 W
Output voltage			24 V DC (SELV)	24 V DC (SELV/PELV)
Input voltage			100...240 V AC Single phase	100...240 V AC Single phase
5 A/120 W	Isolated output	**Ordering code**	**BAE00EK**	
Single phase	(4-pin), SELV	Part number	BAE PS-XA-1W-24-050-013	
10 A/120 W	Isolated output	**Ordering code**	**BAE00EU**	
Single phase	(4-pin), SELV	Part number	BAE PS-XA-1W-24-100-014	
3.8 A/91.2 W	Isolated output	**Ordering code**		**BAE00EN**
Single phase	(4-pin), SELV	Part number		BAE PS-XA-1W-24-038-601
3.8 A/91.2 W	Grounded output	**Ordering code**		**BAE00EP**
Single phase	(4-pin), PELV	Part number		BAE PS-XA-1W-24-038-602
3.8 A/91.2 W	Isolated output	**Ordering code**		**BAE00ER**
Single phase	(5-pin), SELV	Part number		BAE PS-XA-1W-24-038-603
3.8 A/91.2 W	Isolated output	**Ordering code**		**BAE00FW**
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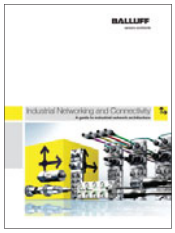
8 A/192 W	Isolated output	**Ordering code**		**BAE00ET**
Single phase	(4-pin), SELV	Part number		BAE PS-XA-1W-24-080-604
8 A/192 W	Isolated output	**Ordering code**		**BAE00FL**
Single phase	(5-pin), SELV	Part number		BAE PS-XA-1W-24-080-605
8 A/192 W	Grounded output	**Ordering code**		**BAE00FY**
Single phase	(4-pin), PELV	Part number		BAE PS-XA-1W-24-080-606
Efficiency			High efficiency, typically > 92 %	High efficiency, typically > 91 %
MTBF			> 800,000 h	> 800,000 h
Input			Screwed contact	7/8", 3-pin
Output			Screwed contact Potential-free alarm contacts for DC alarm and lifetime	7/8", 4-pin (socket) fitting for Ethernet/IP, DeviceNet 7/8", 5-pin (socket) fitting for CC-Link,Profinet, Profibus
Operating temperature			–25...+70 °C	–25...+70 °C
Storage temperature			–40...+80 °C	–40...+80 °C
Fasteners			DIN rail mounting	Panel, wall, and field mounting
Housing material			Metal, semi-potted	Metal, fully potted
Service life (at 80 % load and 40 °C)			15 years	15 years
Warranty			2 years	2 years



Please find more detailed information in our Industrial Networking and Connectivity catalog or online.

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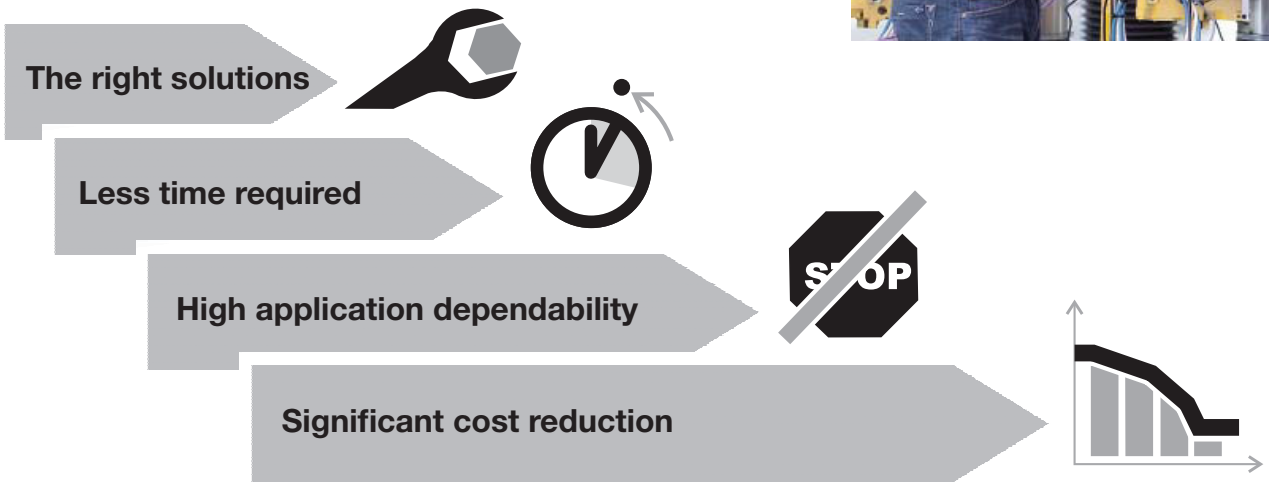

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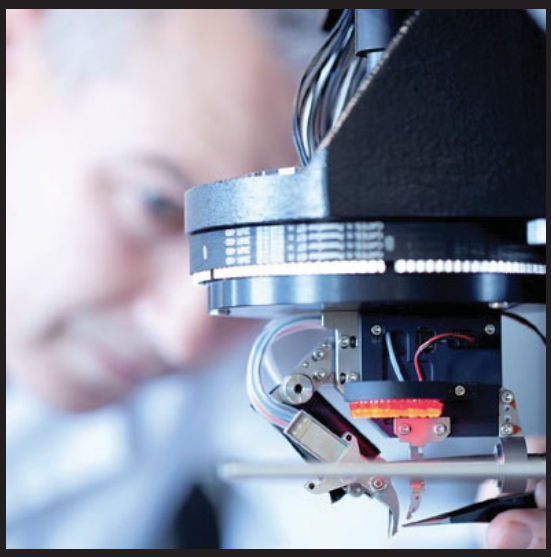

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Colonia La Vista Residencial.
Querétaro, Qro. CP76232
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